Thought Suppression and Cognitive Ability
Investigating the role of cognitive load, inhibitory control and working memory capacity in the frequency of intrusive thoughts

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Ritgerð þessi er lokaverkefni til Cand. Psych gráðu í sálfræði og er óheimilt að afrita ritgerðina á nokkurn hátt nema með leyfi réthafa.

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This study sought to investigate the role of cognitive load, working memory capacity (WMC) and proactive inhibition (PI) in suppression of a personally relevant intrusive thought. It also investigated the relationship between thought intrusions and mood, OCD-related appraisals and symptoms. In total, 105 female students at the University of Iceland took part in an experiment where their working memory capacity and proactive inhibition were measured before they took part in a thought suppression task involving a personal intrusive thought. Participants were randomly assigned instructions in the first interval to either suppress the thought during cognitive load, to suppress it without load or not to suppress it at all. In the second interval all participants received the same instructions to monitor their thoughts. The study found support for an immediate enhancement effect of thought suppression with cognitive load. Contrary to the hypotheses this relationship was not mitigated by WMC or PI. No effects of thought rebound were found. Measures of anxiety and appraisals of thought suppression failure had significant correlations with thought intrusion frequencies in both intervals of the thought suppression task. Measures of OCD related appraisals and symptoms were associated with greater thought intrusion frequencies only in the second interval of the task.
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Most people recognise having had an inappropriate thought at some point in their lives which they have found to be intrusive (Rachman & de Silva, 1978). These could be thoughts of harming someone or otherwise behaving inappropriately. For most people these thoughts come and go without having much impact on their lives but for other people these thoughts are very distressing. This distress can call upon effort to control thoughts in order to reduce the distress. However, as many people have experienced firsthand, controlling one’s thoughts is not always a simple enterprise. Distressing thoughts and attempts to control them has been researched in relation to Obsessive-Compulsive Disorder (OCD) as these factors may be important in the development of obsessions, which are characteristic of OCD.

In this thesis, results from a study of control over intrusive thoughts are described. Research on control over intrusive thoughts has become an increasingly important research topic ever since the publication of Paul Salkovskis (1985) account of how regular intrusive thoughts might turn into clinical obsessions. The main focus in this area of research has been on interpretation of intrusive thoughts (Rachman 1997, Salkovskis, 1985) but other factors such as mood (Purdon, 2001) and cognitive ability (Bomyea & Amir, 2011; Verwoerd Wessel & de Jong, 2009) have also been investigated. All of these factors were investigated in the current study.

**Obsessive-Compulsive Disorder**

*Diagnostic criteria*

Obsessive-compulsive disorder (OCD) is an anxiety disorder that is characterised by obsessions and compulsions (APA, 2000). In order to fulfill the present diagnostic criteria for OCD of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR) that is published by the *American Psychiatric Association*, one must have either obsessions or compulsions, which the individual recognises at some point to be excessive or unreasonable (APA, 2000).
The obsessions or compulsions cause marked distress, are time-consuming (take more than 1h a day) or interfere with the individuals daily life functioning, ability to work or engage in social activities (APA, 2000). The obsessions or compulsions are not better accounted for by another mental disorder, or due to a substance or general medical condition (APA, 2000).

**Obsessions**

According to the DSM-IV-TR (APA, 2000) obsessions are recurrent intrusive thoughts or images that the individual finds inappropriate and causes significant distress. Obsessions are experienced as “ego-dystonic”, meaning that the thought’s content is experienced as alien, going against ones sense of self and is perceived to be uncontrollable (APA, 2000). Even though the content is alien the thought is not believed to have originated from anywhere else than the persons own mind (APA, 2000). The most common obsessions revolve around contamination, doubt (e.g. whether one locked the door), need to have things in a certain order, aggressive impulses and sexual imagery (Foa & Kozak, 1995). According to cognitive-behavioural models of OCD the content of obsessions is highly personalised and is presumed to be dependent on the individuals experience and belief-systems (see Clark, 2004).

**Compulsions**

Compulsions are repetitive behaviours (e.g. hand washing) which are meant to alleviate anxiety or guilt felt by the individual in response to an obsession or are aimed at preventing some feared consequence of the obsession (APA, 2000). The individual is compelled to perform these acts, even though the compulsions are experienced to be excessive or sometimes not logically connected to the obsession (APA, 2000). Common compulsions in OCD include excessive hand washing elicited by obsessions about contamination or excessively checking whether or not the door is locked, as well as counting, requesting assurances (e.g. from doctors), repeating certain actions and placing things in a certain order (APA, 2000). Compulsions can be either overt behaviours or covert mental acts such as
counting (APA, 2000). In their study of 431 OCD patients, Foa and Kozak (1995) found that 79.5% of patients in their study reported having both behavioural and mental compulsions. About 20% of patients reported having only compulsive behaviours and 0.2% reported having only mental compulsions (Foa & Kozak, 1995). Foa and Kozak (1995) also found in their study that less than 10% of reported compulsions were perceived to have either no purpose or to have an unclear relationship with an obsession. The other 90% of compulsive behaviours were reported to be intended to prevent harm or reduce discomfort following an obsessional thought (Foa & Kozak, 1995).

In Salkovskis inflated responsibility model of OCD (Salkovskis, 1985, 1989) a compulsion is considered a control process which is aimed at limiting a person’s exposure to an obsession which suggests a specific reaction. For instance, if someone has obsessions about vomiting he/she could engage in compulsions regarding sickness prevention, in order to minimise the chances of vomiting (see Clark, 2004). A phenomenon highly related to compulsions and a key component in cognitive-behavioural theories of OCD is neutralisation (Salkovskis, 1989). Much like compulsions, neutralisation behaviour is thoughts or behaviours which are undertaken in response to obsessions. However, in Salkovskis theory of obsessions, neutralisation is considered an action which is taken to neutralise the responsibility felt over the perceived consequences of an obsession (see Clark, 2004). Neutralisation is a key concept in cognitive appraisal theories of obsessive-compulsive disorder and its role will be described later in the text.

**Prevalence**

Results from epidemiological studies have not been very consistent, showing varied prevalence rates amongst surveys (see Ruscio, Stein, Chiu & Kessler, 2010). This is presumably because of methodological factors and the fact that intrusive, obsession-like and compulsion-like mental rituals and behaviours are quite common in non-clinical populations (Ruscio et al., 2010). Epidemiological research has shown that at any given year about 0.5% - 2.1% of adults will develop OCD and about 2.5% of adults will develop OCD in their lifetime (APA, 2000). However, a large survey of 9282 respondents indicated that the lifetime prevalence rate of OCD was 1.6% in that sample (Kessler et al., 2005). Equal
gender ratios are generally observed in the adult population, but OCD beginning in childhood tends to be more common amongst boys than girls (APA, 2000). For children the lifetime prevalence rates range from 1% - 2.3% and one year prevalence is around 0.7% for children (APA, 2000). The modal age of onset (both childhood and adult onset together) for males is between 6 and 15 years of age and between 20 and 29 years of age for females (APA, 2000).

Comorbidity with other disorders

Comorbid disorders are frequently found in individuals with OCD. Especially frequent are other anxiety disorders, major depressive disorder, eating disorders and some personality disorders (APA, 2000).

Ruscio et al. (2009) found in their survey of a large community sample of 2073 individuals that 90% of respondents who had at some point in their lives fulfilled diagnostic criteria for OCD, had also fulfilled diagnostic criteria for another disorder in their lifetime. In this study the two most common types of comorbid disorders found with OCD were anxiety disorders (75.8%), followed by mood disorders (63.3%). Another study Torres et al. (2006) found that 62% of the 114 OCD patients in their sample had at least one comorbid disorder. The most common comorbid disorders in this sample were depressive episode (37%), generalised anxiety disorder (31%), agoraphobia or panic disorder (22%), social phobia (17%) and specific phobia (15%). Torres et al. (2006) also found that 20% of the OCD patients in their study fulfilled criteria for alcohol dependence and 13% fulfilled criteria for drug dependence.

Differentiating OCD from other disorders

Obsessive-like symptoms can be found in other disorders, which do cause significant distress and impairment but are qualitatively different from that of OCD. In major depressive disorder patients may ruminate about choices made or actions taken (or not taken) which can take up a sizeable portion of the day and cause distress. But the ruminative thoughts are generally not experienced as ego-dystonic (APA, 2000). Delusions of schizophrenic patients may resemble obsessions, but schizophrenic delusions are usually ego-syntonic and the
schizophrenic patient often does not realise that the delusions are not realistic (Maxmen, Ward & Kilgus, 2009). OCD is differentiated from obsessive-compulsive personality disorder (OCPD) by the fact that OCD is characterised by ego-dystonic obsessions and compulsions which is experienced as uncontrollable. In OCPD however the obsessive-compulsive-like thoughts and behaviours are ego-syntonic. The symptoms may look the same, but the thoughts and behaviours of OCPD are not experienced as distressing or ego-dystonic by the person having them (Maxmen et al., 2009).

### Cognitive appraisal theories of OCD

There are many theories of the aetiology of obsessive-compulsive disorder. The focus in this thesis will be on cognitive appraisal approaches to obsessions, because they form the framework for the research hypotheses that are tested in the present study. Cognitive appraisal theories of OCD are all based on the notion that clinical obsessions stem from ordinary intrusive thoughts, impulses and images that are also frequently observed in the general population (see for instance; Rachman & de Silva, 1978). According to appraisal theories, these ordinary intrusive thoughts usually have some clear environmental triggers (Parkinson & Rachman, 1981), such as having a thought of throwing someone into traffic when seeing them walking on the side-walk next to a busy road. However, only for a small minority of people do thoughts such as these develop into clinical obsessions. According to cognitive appraisal theories, ordinary intrusive thoughts turn into obsessions because of the meaning people put into them (Rachman, 1997; Rachman, 1998; Salkovskis, 1985; Salkovskis, 1989; Salkovskis, Forrester & Richards, 1998; Salkovskis et al., 2000). The theories differ on what kind of appraisal is considered the most pathogenic, but what they all have in common is that an obsession stems from an intrusive thought which is interpreted as signifying some form of threat or harm (see Clark, 2004). The interpretation of threat or harm leads to anxiety and distress which in turn forces the person to take action against this distress or anxiety. These actions are called neutralisations. A neutralisation is an action (behaviour or thinking) which is intended to neutralise
the threat or distress invoked by the intrusive thought (see Clark, 2004). It can be some form of ritual (e.g. hand washing) or mental exercise (e.g. thought suppression). The most influential contemporary theories of obsessive-compulsive disorder are Salkovskis’s model of inflated responsibility and Rachman’s model of misinterpretation of significance (Rachman, 1997; Salkovskis, 1985). They will be described next.

Salkovskis’s Inflated Responsibility Model

According to Salkovskis’ cognitive model of obsessions, ordinary intrusive thoughts can develop into clinical obsessions if they are interpreted as signifying some form of threat which the person feels responsible for (Salkovskis, 1985; Salkovskis, 1989; Salkovskis et al., 2000; Salkovskis et al., 1998). These interpretations stem from responsibility beliefs which bias their thinking. These responsibility beliefs are presumably due to previous negative experience involving personal responsibility, such as incidents where actions or inactions have led to real or perceived harm or misfortune (Salkovskis, 1998). Four of the most common biases in OCD are (see Clark, 2004): Firstly, that if one can influence negative consequences, then one is responsible for preventing those consequences. Secondly, whereas most people would feel less responsible for consequences of them failing to act, this is commonly not the case for OCD patients. This bias states that one is equally responsible for negative consequences of events one did not prevent, as one is for negative consequences of one’s own actions. Thirdly, that having a thought about an inappropriate or harmful action is as bad as performing the act which the thought revolved around. Fourthly and finally, that they (the OCD patients) can foresee potential negative consequences that others cannot, and thus feel responsible to prevent these consequences.

In a study of responsibility attitudes Salkovskis et al. (2000) found that responsibility attitudes were significantly greater in OCD patients than in patients with other (non-OCD) anxiety disorders and non-clinical controls. OCD patients also had significantly higher scores on measures of frequencies of intrusive thoughts and beliefs in responsibility following these thoughts than the other two groups. Additionally, there have been studies (though on non-clinical individuals)
showing positive correlations between scores on self-report measures of obsessive-compulsive symptoms and measures of inflated sense of responsibility (e.g. Smári, Gylfadóttir & Halldórsdóttir, 2003; Smári & Hólmsteinsson, 2001). This indicates that an inflated sense of responsibility for one’s thoughts is characteristic of OCD, perhaps more so than in other anxiety disorders.

According to Salkovskis’s model people may feel responsible for their intrusive thoughts because they believe that they have a pivotal role in preventing some actual or moral consequences of these intrusive thoughts (Salkovskis et. al. 2000). These interpretations of responsibility (according to Salkovskis, 1989) can cause anxiety and distress and force people neutralise these feelings. The importance of perceived responsibility in neutralisation was partially demonstrated by Lopatka and Rachman (1995) who experimentally increased and decreased perceived responsibility in 30 patients with OCD. Decreased responsibility resulted in significantly less discomfort and urge for compulsive checking. There was an indication that increased responsibility might increase discomfort and urge for compulsive checking, thought the effect was not statistically significant. Ladouceur, Rhéaume and Aublet (1997) aimed to investigate the role of perceived influence over events and their potential negative consequences on perceived responsibility and checking behaviour in a non-clinical sample. The authors found that an increase in the perceived negative consequences was not enough to cause changes in checking behaviour on its own. Perceived negative consequences and perceived personal influence together were needed to produce changes in checking behaviour. This indicates that a belief in potential negative consequences and a belief in influence over these negative consequences are necessary components in compulsive checking behaviour. This supports Salkovskis’s (1985) argument that perceived responsibility for negative consequences is likely to be followed by neutralisation.

In the short term neutralisation provides some relief and is thus seen as an adaptive response (Salkovskis, 1985), but in the long term it leads to more discomfort and greater urge to neutralise (Salkovskis et. al., 1997; Salkovskis, Forrester, Wahl, Wroe & Forrester, 2003). Presumably this is because neutralisation precludes disconfirmation of the misinterpretation of responsibility and potential negative consequences (Salkovskis, 1985). Neutralisation in the
form of thought suppression may make obsessions and related thought content more salient and accessible, resulting in increased thought frequency (Salkovskis, 1985; Salkovskis, 1997). If the responsibility belief persists, then increased thought frequency is likely to increase neutralisation attempts, potentially forming a vicious cycle of intrusive thoughts and neutralisations (Salkovskis, 1985).

Taken together, Salkovskis (1985) model predicts that OCD patients are characterised by inflated responsibility beliefs for preventing harm and misfortunes. These harms and misfortunes are highly unlikely and in the rare cases that a feared event actually does take place, the consequences are rarely as serious as patients imagine them to be. The responsibility beliefs persist (and strengthen) because the patient attributes the non-occurrence of the event to neutralisations instead of the unrealistic probability of the event (see Clark, 2004). This may increase the frequency of intrusive thoughts, which is likely to cause more neutralisation attempts.

**Ranchman’s Theory of Misinterpretation of Significance**

Rachman (1997) proposed a cognitive theory of obsessions which builds on Salkovskis (1985) cognitive-behavioural account of obsessions and Clark’s cognitive theory of panic (Clark, 1986). Like Salkovskis’s theory of obsessions, so does Rachman’s account assume that obsessions stem from misinterpretations of intrusive thoughts which are common in the general population (Rachman & de Silva, 1978). Rachman (1997, 1998) expands on the idea that appraisals of an intrusive thought leads to obsessions by adding a catastrophic misinterpretation of the thought as personally significant and threatening. Specifically, that having the thought is viewed as an indication of a negative personality trait, such as being dangerous, evil or even mentally ill (Rachman, 1997)

Rachman (1997) defined misinterpretations of significance of intrusive thoughts in terms of five dimensions. Firstly, that the thoughts are considered important because they are believed to reveal something about the person. Secondly, the thoughts are believed to signify something personal since they originate from their own mind. Thirdly the content is ego-alien, that is; uncharacteristic of the person, which is seen as significant. Fourthly, the thought
is believed to have consequences, no matter how unlikely they may actually be. Finally, the consequences are believed to be serious, often involving harm or danger.

Which thoughts develop into obsessions depends on the person’s belief- and value systems. Thoughts that run contrary to a person’s beliefs and values are more likely to lead to obsessions (Rachman, 1998). For example: person who is completely opposed to all forms of violence may develop an obsession when walking down the side-walk and suddenly has a thought of hurling someone into traffic – a thought he finds utterly repugnant. If he also interprets this as a sign that he may have latent desires to kill someone or is about to lose control he is viable to develop an obsession about this.

Rachman (1998) theorised that there could be two cognitive processes making an intrusive thought more frequent. The first process is that a misinterpretation of significance turns previously neutral stimuli in the environment into cues that can elicit the intrusive thought. For the man in the example mentioned above, a side-walk could come to remind him of the thought of hurling someone into traffic. The second process is that the anxiety one might feel in response to obsessions could be misinterpreted as signs of losing control. In the previously mentioned example the man may become very anxious when walking down the side-walk since it could trigger the intrusive thought. This anxiety could be taken as an indication that he is losing control of himself. It is well known that anxiety is often accompanied by physical symptoms, such as twitches, jitters, sweating, heart racing and dizziness as well as psychological symptoms, such as hypervigilance, worry, tension and apprehension (Maxmen et al., 2009). Experiencing these symptoms may be taken as an indication that one is losing control, which in turn could increase anxiety and distress, since it could be seen as confirmation that one is losing control (Rachman, 1998). Additionally, distress in general has been shown to increase unwanted intrusive thoughts (Horowitz, 1975). When someone experiences an intrusive thought as distressing, then the intrusive thought is likely to become more intrusive and frequent – which causes even more distress and makes the intrusive thought more frequent (Rachman, 1997, Rachman, 1998). So the misinterpretation of the physical symptoms of
anxiety may invoke more anxiety, developing a vicious cycle of increased anxiety and ever more frequent intrusive thoughts.

Misinterpretations of an intrusive thought as personally significant, physical reactions of anxiety and environmental cues which can come to elicit an intrusive thought play major roles in Rachman’s theory of obsessions (Rachman, 1998). Another important construct in Rachman’s cognitive theory of obsessions is a cognitive bias that has been termed thought-action fusion (Shafran, Thordarson & Rachman, 1996).

**Thought-action fusion**

Thought-action fusion (TAF) is a cognitive bias characterised by a belief that one’s thoughts can affect the outside world in non-realistic ways (Rachman, 1997). TAF can be divided into two components called TAF-probability and TAF-moral (Shafran et al., 1996). TAF probability is the logical fallacy of believing that having a thought about something will make it more likely to happen (Rachman, 1997). For instance, that having a thought about a friend being in an accident will make it more probable that this friend will be in an accident. TAF-moral is the belief that having a thought about an act is morally equivalent to actually performing the act (Rachman, 1997). For instance, that imagining causing a friend harm is as bad as actually causing the harm. If people believe that their thoughts can influence the probability of an event or are morally equivalent to actions, then those people are more likely to feel responsible for the thought and try to prevent its occurrence (Rachman, 1998; Shafran et al., 1996).

To investigate the role of TAF in the development of obsessions, Rassin, Merckelbach, Muris and Spaan (1999) experimentally induced TAF in subjects by connecting them to fake electrodes and telling them that they were connected to an apparatus that could read electrical impulses from their brain. This apparatus (participants were told) could discern discrete thoughts such as the word “apple”. They were also told that every time they had a thought with the word apple in it, the machine would send a harmless, though unpleasant, electric shock to another person, which the participants had briefly met earlier. The participants were told that they could cancel the electric shock by pressing a button within two seconds
of having the thought. There was of course no brain-reading apparatus or electric shock but this setup gave participants a sense that their thoughts could be dangerous to others and thus give them a sense of responsibility to control their thoughts and minimising the aversive consequences – in effect inducing TAF. The results from this study showed that participants in the experimental condition had more instances of apple related thoughts, experienced more discomfort, anger and resistance than participants in the control condition (no fake electric shock). Participants in the experimental group also reported feeling fairly responsible and guilty and tried to neutralise the thoughts (by pushing the button) in about 50% of intrusions. This study clearly shows that feelings of guilt and responsibility can follow intrusions when people believe that their thoughts can hurt other people and when they have some perceived means of neutralising the harm.

A neutralisation technique commonly used in real life (and of primary importance in this study) is thought suppression. Rassin, Diepstraten, Merckelbach and Muris (2001) investigated the significance of TAF and thought suppression in a sample of OCD patients and patients diagnosed with a non-OCD anxiety disorder. They found that there was no difference in TAF between OCD patients and non-OCD. Nor was any significant difference found between the groups in tendency to spontaneously suppress unwanted thoughts. However, tendency to spontaneously suppress thoughts was found to be related to symptom severity in the OCD group. These results indicate that even though TAF and thought suppression can occur to similar degrees in other anxiety disorders than OCD, thought suppression seems to have special significance for OCD symptom severity.

In conclusion, it seems that TAF (especially TAF probability) and thought suppression are related to symptom severity in OCD. Those who believe that their thoughts can have real world implications may feel responsible for preventing their occurrence and thus either try to suppress the thought or otherwise neutralise it. It would seem though that thought suppression, though not unique to OCD, could have especially aversive ramifications in this particular anxiety disorder. Thought suppression is of primary interest in this study and will be discussed next.
Thought suppression

Thought suppression is a common phenomenon and people tend to try and push unwelcome thoughts out of consciousness when they come up. The problem with this strategy, however, is that it seems to have the paradoxical effect of making the thought more frequent and salient (Wegner, Schneider, Carter & White, 1987). This is why Wegner (1994) came to call the processes he proposed to be behind this phenomenon the “ironic processes of mental control”. In the first study of these paradoxical effects of thought suppression, Wegner et al. (1987) instructed participants to suppress the thought of a white bear in an initial 5 minute interval (suppression) and then later in another 5 minute interval to try to generate thoughts of a white bear (expression). A control group went through the same conditions in reversed order. The results showed that participants who first suppressed thoughts of a white bear showed significantly more tokens of thoughts of white bears in the subsequent expression interval than the other group. Wegner et al., 1987 called this the rebound effect. Wegner et al. (1987) proposed that participants may have made associations between stimuli in the laboratory and the target thought in the suppression interval, and which may have acted as reminders of the target thought in the expression interval. If for instance a participant focused on a clock in the room and it’s ticking in order to distract themselves from the thought of a white bear then the clock and its ticking could serve as reminders of the very material they were trying to suppress in the subsequent expression interval. (Wegner et al., 1987) In support of this, Wegner et al. (1987) found that when they provided participants with a distracter thought not related to anything in the laboratory (e.g. a Volkswagen) no thought rebound occurred.

Another paradoxical effect of thought suppression worth mentioning is the immediate enhancement effect of thought suppression. The immediate enhancement effect is a paradoxical surge of target thoughts during suppression (Wegner & Erber, 1992).

Wegner (1994) later speculated that the act of thought suppression activates two mental processes. The first being the operating process, which is a wilful search for distracters, that is, a search for other thoughts that can occupy the mind instead of the unwanted thought. The second process is a non-conscious monitoring
process, which tests if the operating process is still needed by searching for signs of the unwanted thought in consciousness. Wegner (1994) compared his dual-processing theory with the operations of a thermostat, in which one sets the desired criterion (e.g. 20°C - or in the case of thought suppression; no unwanted thought) which initiates a change (increasing heat or searching for distracters). Coupled with this is the thermometer which monitors the change and shuts off the change process once the criterion has been met. These processes work together to make the change and monitor whether the desired change has taken place. The problem, however, is that the operating process is a resource dependent process, which means that its efficiency is dependent on there being sufficient cognitive resources available. This in turn means that it can be disrupted when cognitive resources are insufficient, resulting in immediate enhancement (Wenzlaff & Wegner, 2000). The monitoring process, on the other hand, is non-conscious and automatic and is therefore relatively independent of mental resources. Wegner (1994) proposed that in successful suppression, the two processes work together in harmony, but when suppression fails, it’s because the operating process has been disrupted, leaving the monitoring process to continue unopposed. That means that it is likely to find signs of the unwanted thought and signal suppression failure, which brings the thought back into consciousness.

Ironic processes of thought suppression are not only seen in laboratory studies. For instance; McFall (1970) manipulated conscious processing of quitting smoking in smokers. Some participants were asked to count the number of cigarettes they smoked and others were asked to count the number of times they thought of smoking but didn’t smoke. Counting smoked cigarettes increased actual smoking whereas counting instances of non-smoking decreased smoking. This is in line with Wegner’s ironic processes theory, since trying to quit when counting number of cigarettes smoked should initiate a monitoring process aimed at finding failures of non-smoking. Counting instances of non-smoking on the other hand should initiate a monitoring process aimed at finding occurrences of starting smoking (since these are inconsistent with the desired state) and thus make non-smoking related thoughts more accessible.
Methodological Issues

Research on thought suppression has not always found support for ironic effects of thought suppression. Studies have differed in methodology which may influence results. Abramowitz, Tolin, and Street (2001) conducted a meta-analysis of 28 studies researching ironic effects of thought suppression. In this meta-analytical study Abramowitz et al. (2001) found that control groups in studies using an expression condition (generate thoughts) found fewer intrusions than mention (push a button, make a check-mark) studies. Stream of consciousness studies were also found to systematically record fewer intrusions during the initial suppression interval than other procedures. Regarding thought characteristics, the only variable found to be related to thought frequency was the discreteness of target thoughts, with non-discrete targets (e.g., thoughts related to a story) yielding greater thought rebound than discrete thoughts (e.g., thoughts of a white bear). Regarding recording methods, the only variable found to be consistently related to thought frequency was whether or not the recording methods were overt or covert, with overt recording procedures being related to lesser ironic effects of thought suppression than covert recording procedures (Abramowitz et al., 2001).

In the original study by Wegner et al. (1987) a suppression/expression setup was used, which has been criticised for not accounting for practice effects (see Purdon & Clark, 2000). Instead, newer studies have opted for a suppression/monitoring setup which is considered to have greater ecological validity (see Purdon & Clark, 2000). In a monitoring interval participants are allowed to think of anything they want to and simply record any incidence of the target thought instead of trying to generate target thoughts (Abramowitz et al., 2001). Studies on thought suppression differ also on other important aspects. For one, there has been no real consensus on what procedure should be used to record thought intrusions. Wegner et al. (1987) used a “stream of consciousness” procedure in which participants verbalised all of their thoughts out loud. Others have opted for so called “event marking” procedures in which participants mark each intrusion with some kind of representation, such as ringing a bell, making a check-mark on a piece of paper or pressing a button. Some of these procedures are more overt than others and may influence results. As Purdon and Clark (2000) point out, verbalisation of intrusive thoughts may be affected by self-report biases, such as defensiveness and
reluctance to self-disclose. This would be especially likely if the material was personally relevant or emotionally charged. The previously mentioned meta-analysis supports this argument as thought frequencies tended to be lesser when overt recording procedures were used than covert ones (Abramowitz et al., 2001).

Another important consideration in this field of research is the nature of the target thoughts used. Researchers are interested in studying ironic effects of thought suppression because of the implications it may have for obsessive thoughts in clinical disorders. Even so, some studies have used neutral thoughts such as white bears (e.g., Tolin, Abramowitz, Przeworski & Foa, 2002; Wegner et al., 1987), which do not accurately reflect the obsessional thoughts experienced by individuals with obsessive-compulsive disorder. Obsessions in OCD rarely revolve around such innocuous things as white bears, but rather ego-dystonic and upsetting material. This qualitative difference in the nature of thoughts may be of great significance to the ecological validity of this research.

Kelly and Kahn (1994) sought to investigate whether type of thought (personal or neutral) would have an effect on thought intrusion frequency in a thought suppression task. They found that participants suppressing the novel thought of a white bear had significantly more intrusions in the suppression interval than participants suppressing their own personal intrusive thoughts. This pattern repeated itself in the post-suppression interval, with participants who suppressed thoughts of white bears reporting significantly more instances of the thought than those suppressing personally relevant, intrusive thoughts. Kelly and Kahn (1994) also found that participants suppressing their own intrusive thoughts reported using many more outside distracters (i.e. distracter material not related to anything in the laboratory setting) than did participants suppressing the thought of a white bear. This could explain the difference in thought frequencies since participants suppressing a novel thought would have had more reminders of the target thought in the second interval than participants suppressing a personally relevant thought. More interestingly though, even though participants suppressing their own thoughts had fewer intrusions than participants suppressing thoughts of white bears, the participants who suppressed their own thoughts felt significantly more distressed and out-of-control than participants in the white bear condition (Kelly & Kahn, 1994). Related to this are the results of Purdon and Clark (2001) who
examined the effect of suppression of obsessional, neutral and positive thoughts in non-clinical individuals. They did not find any ironic effects for any type of thought. However, they did find that suppression of obsessional thoughts was associated with greater discomfort and negative mood compared to negative and positive thoughts (Purdon & Clark, 2001).

Sample characteristics is another important variable to consider. Researchers study ironic effects of thought suppression because of its implications for obsessional thoughts in psychological disorders, such as obsessive-compulsive disorder. However, most studies on thought suppression have been conducted using non-clinical participants (Abramowitz et al., 2001). Even though studies using non-clinical samples are more common, there are those that use clinical samples in thought suppression studies.

Thought Suppression and Obsessive Compulsive Disorder

So far the text has dealt with research on suppression which has largely focused on thought suppression in non-clinical samples as opposed to clinical samples. Although this is very interesting, the main interest of this line of research lies in thought suppression in anxiety disorders, especially obsessive-compulsive disorder, which is characterised by frequent obsessive thoughts.

In their study of 20 OCD patients and 20 non-clinical controls, Najmi, Rieman and Wegner (2009) did not find any ironic effects of thought suppression, but rather that suppression increased distress in their OCD patients. Additionally, even though there was no support for ironic effects of thought suppression, their OCD participants had significantly higher target thought frequencies than the controls in both intervals. Related to this are the results of the study by Janeck and Calamari (1999) who investigated thought suppression in a sample of 32 OCD patients and 33 non-clinical controls. The participants engaged in a thought suppression task of a negative, personally relevant thought. Janeck and Calamari (1999) found a small rebound effect in their OCD sample, yet no immediate enhancement effect. However, they too found that their OCD patients had significantly greater target thought frequencies in both intervals than the controls. Janeck and Calamari (1999) also found that their OCD participants were
significantly more distressed and felt that their thoughts were much less acceptable and less controllable than the non-clinical participants after the suppression task.

The studies of Najmi et al. (2009) and Janeck and Calamari (1999) indicate that the potential negative consequences of thought suppression for OCD patients are not ironic effects of thought suppression per se, but rather a negative impact on mood. The studies also showed that the OCD patients had significantly greater target thought frequencies than the non-OCD controls in both intervals. This could mean that OCD patients could have some form of deficit in thought suppression ability.

Tolin et al. (2002) set out to investigate whether OCD patients could have a deficit in cognitive inhibition, compared to non-OCD controls. They had OCD patients, patients diagnosed with a non-OCD anxiety disorder and non-anxious controls take part in a thought suppression task. In this task all participants received the same instructions for both intervals and they were instructed to suppress the thought of a white bear in the thought suppression task. Tolin et al. (2002) found that their OCD patients showed increased immediate enhancement effects compared to non-OCD anxiety patients and non-anxious controls. There was also a significant positive correlation between obsessive-compulsive symptom severity (as measured by the Yale-Brown Obsessive Compulsive Scale) and number of intrusions in the OCD group. Suppression was not manipulated by instruction, nor were there any significant differences between groups on reported suppression effort. This indicates that OCD patients may have some form of deficit in thought suppression ability, causing the thought to become more frequent with attempted thought suppression. In the same study Tolin et al. (2002) conducted a second experiment with the same participants, which consisted of a lexical decision-task in which participants were to determine if a given sequence of letters presented to them were a word or not. Some of the sequences were not words, others were words that pertained to the target thought of the first experiment and others were words unrelated to that thought. OCD-patients responded significantly quicker to words related to the target thought than non-OCD anxiety patients and non-anxious controls, indicating that suppression had led to a priming effect in the OCD patients. Tolin et al. (2002) concluded that
their OCD participants might have a deficit in cognitive inhibition, which caused more frequent intrusions in the first experiment and a priming effect in the second experiment.

Research on thought suppression with OCD patients has not consistently found evidence in support of ironic effects of thought suppression. However, studies have shown that thought suppression has not only an effect on thought frequency, but also on mood and appraisals. Additionally, OCD patients seem to have higher target thought frequencies in suppression tasks than non-OCD controls and as the study by Tolin et al. (2002) indicates, OCD patients may have a deficit in cognitive inhibition. Cognitive inhibition along with working memory capacity will be discussed next.

Cognitive Load, Working Memory Capacity and Proactive Inhibition

It has been theorised that thought suppression depends on two processes - the consciously initiated, resource dependent operating process and the less resource dependent monitoring process (Wegner, 1994). It has further been speculated that failed thought suppression is a failure of the active, resource dependent operating process rather than the monitoring process (Wegner, 1994). If cognitive resources are taxed during a suppression task by competing cognitive demands it should increase thought intrusion frequencies during suppression since the operating process is more likely to be interrupted by competing cognitive demands than the monitoring process (Wenzlaff and Wegner, 2000). As Wegner and Erber (1992) found in their study, participants who were subjected to cognitive load (competing cognitive demands) during the initial suppression interval showed significantly more immediate enhancement effects than participants not subjected to cognitive load. One thing that may mediate this effect is working memory capacity (WMC). Working memory is the ability to temporarily store and manipulate information in one’s mind and thus it determines what information is available in consciousness (Conway et al., 2005). Working memory capacity is the control one has over the content in this limited storage and ability to allocate resources to keep irrelevant information out of consciousness and relevant information in it (Bomyea & Amir,
2011). It stands to reason that WMC and other cognitive capabilities could mediate immediate enhancement effects of thought suppression.

The role of cognitive capabilities, such as WMC have been implicated in target thought frequencies in thought suppression tasks. For instance, Brewin and Beaton (2002) investigated the role of WMC, fluid intelligence and crystallised intelligence on thought suppression. They found that higher WMC and greater fluid intelligence was related to more effective thought suppression, whereas crystallised intelligence was not. Brewin and Smart (2005) examined individual differences in WMC and the ability to suppress personally relevant intrusive thoughts and found that greater WMC was related to reduced immediate enhancement but unrelated to rebound of thoughts. WMC was also unrelated to thought intrusion frequency in everyday life as reported by the participants themselves (Brewin & Smart, 2005).

Another cognitive capability which has been intimately linked with WMC and thought suppression efficiency is proactive inhibition. Proactive interference is when information which was once task relevant (but now irrelevant) interferes with a current task (Friedman & Miyake, 2004). Inhibitory control is the control one has over cognitive interference, such as proactive interference (Friedman & Miyake). So proactive inhibition is the control one has over proactive interference. Bomyea and Amir (2011) investigated the effects of WMC and inhibitory control on intrusive thoughts. They gave WMC training to all of their 50 participants. Half of them received WMC training in which there was high proactive-interference and the other half received WMC training with low proactive-interference. Bomyea and Amir (2011) found that those who had received high proactive-interference WMC training had increased their WMC and had significantly fewer intrusions than participants that received low proactive interference WMC training. These results clearly indicate that WMC could be related to the ability to keep intrusions to a minimum, but also that proactive inhibition could be significant in this relationship. In fact, in their study of inhibition processes and their relation to cognitive functions Friedman and Miyake (2004) found that there was a significant correlation between lesser proactive inhibition and greater frequency of intrusive thoughts. Related to this is the study by Ólafsson et al. (2013) who found that poorer inhibition was related to
greater thought frequencies during thought suppression. Additionally Verwoerd Wessel and de Jong (2009) found in their study of resistance to interference and intrusive memories that lesser proactive inhibition was related to more frequent intrusions of an unwanted, personal memory. Another example comes from Verwoerd, Wessel, de Jong, Nieuwenhuis and Hutjens (2011) who sought to investigate whether poor proactive inhibition as measured before a stressful event would be related to increased frequency of intrusive memories. They had 85 non-clinical individuals first take a test to measure ability to resist proactive interference in working memory (California Verbal Learning Test) and then watch an emotionally charged film clip. Participants recorded intrusive memories in a journal every day for one week. Results showed that individuals with lesser proactive inhibition experienced more intrusive memories of the film clip than those with greater proactive inhibition (Verwoerd et al., 2011). The results of Verwoerd et al. (2011) indicate that poor proactive inhibition could be a risk factor in developing obsessions. In relation to this; a study conducted by Bannon, Gonsalvez, Croft and Boyce (2002) showed that OCD patients in their sample had lesser cognitive inhibition than panic disorder patients. This indicates that lesser proactive inhibition could be of special significance to OCD.

Individuals with lower WMC should be more susceptible to having the operating process disrupted by cognitive load than those with greater WMC, since WMC is the ability to disregard irrelevant material and shift attention from one task to another in order to achieve one’s goals (Barrett, Tugade & Engle, 2004). Proactive inhibition also seems to play a part here with lesser inhibition being related to more frequent intrusions (Friedman & Miyake, 2004). Pre-existing deficits in proactive interference could be related to intrusions (Verwoerd et al., 2011) which could be especially relevant for OCD patients as there are indications that OCD patients could have lesser proactive inhibition than patients of other anxiety disorder (Bannon et al., 2002). However, as Brewin and Smart (2005) found in their study, WMC was not related to self-reported intrusions in everyday life, so it might not be relevant to in-vivo spontaneous suppression. What was related to real-world intrusions, however, was mood, with negative mood predicting self-reported intrusions better than WMC (Brewin & Smart, 2005).
Thought Suppression and Mood

According to cognitive-behavioural theories of OCD, obsessional thoughts will call on suppression attempts because they are experienced as intrusive and aversive (e.g. Rachman, 1998; Salkovskis, 1985, 1989). However, as some studies have indicated, thought suppression might be more likely to increase the frequency of intrusive thoughts than decrease it (e.g. Tolin et al., 2002; Wegner & Erber, 1992; Wegner et al., 1987). However, as has been mentioned previously, research on thought suppression of personally relevant thoughts has found that thought suppression has a negative effect on mood rather than increasing thought frequencies. Purdon (2001) argued that failure to suppress an aversive thought which one believes to carry great personal significance would have a negative impact on mood, which in turn could make the aversive thought more accessible. Purdon (2001) sought to investigate the relationship between appraisals of an intrusive thought and thought suppression. The sample consisted of 84 nonclinical participants who were asked to identify their most distressing thought and complete measures of appraisals of this thought. The measures used were the Interpretation of Intrusions Inventory and the Concerns about Failures in Thought Control Questionnaire. These measures are described in the Method section of this text since they were used in the present study. Participants then took part in a thought suppression task. The study did not find support for ironic effects of thought suppression in this sample. However, the results indicated that interpretations of thought occurrences as signifying a negative personality trait or that the thought was indicative of the participant doing something terrible predicted greater post task negative mood. In a related study, Purdon, Rowa and Anthony (2005) examined ironic effects of thought suppression with 50 OCD patients. No ironic effects of thought suppression were found in this study, but what was found was that the more negatively participants viewed their thought recurrences, the greater the effect intrusions had on mood state and discomfort.

There is some evidence then that suppression, appraisals of target thoughts and appraisals of thought control failure can have a negative impact on mood. But there is also evidence for that pre-existing mood can influence thought frequencies and thought suppression efficiency. For instance; Wenzlaff, Wegner and Roper (1988) investigated the mental control abilities and strategies of
individuals with depression and non-depressed controls in a thought suppression task. They found a rebound effect in their depressed participants, but not in their non-depressed participants. Further analysis indicated that that the depressed participants often used negative thoughts as distracters in the suppression task, whereas non-depressed participants often chose positive ones. This indicates that mood can serve to supply the kind of distracters participants have available to them. Related to this, Wenzlaff, Wegner and Klein (1991) investigated the effect positive and negative mood may have on thought suppression efficiency. Positive and negative mood was induced in participants that suppressed thoughts of white bears. Mood was induced by letting the participants listen to different kinds of music. Results showed that participants in the suppress-first group experienced a reinstatement of the mood state in the second interval that they were in during the first interval. Meaning that the act of suppressing a thought could bring back the mood associated with the thought. Wenzlaff et al. (1991) noted that when participants try to suppress material they search for distracters with which to occupy themselves with. Distracters that do not work are rejected and replaced by new ones. Wenzlaff et al. (1991) argue that this gives ample opportunity for associations to form between the unwanted thought and the participants many concerns. Thus, suppression can mediate a contextual association between mood and thought by providing reminders of the association.

Taken together, the studies of Purdon (2001) and Purdon et al. (2005) indicate that appraisals and thought suppression failure can have a negative impact on mood. The studies of Wenzlaff et al (1991, 1988) indicate that mood and thought suppression are intimately linked. Mood has been shown to (at least to some extent) determine the kinds of thoughts that are available in consciousness with which to distract oneself with. Also, the mood one was in during thought suppression can potentially be reinstated at a later time, indicating that suppression could serve to make a particular mood state more persistent. Thus, these studies indicate that thought suppression (and failed thought suppression) can lead to negative mood which can to some extent dictate what thoughts are available with which to distract oneself with. Distracters available when in a negative mood may be less effective than distracters available when in a positive mood. If thought suppression is less likely to succeed when in a negative mood.
then people are likely to need to engage in more thought suppression when in such a mood, which is likely to reinstate the negative mood later on.

**Summary and Aims of the Present Study**

Intrusive thoughts tend to be similar in content to clinical obsessions experienced by people with OCD and are quite common in non-clinical populations (Rachman & de Silva, 1978). Yet only a minority of people develop clinical obsessions. According to cognitive appraisal theories of OCD, interpretations of intrusive thoughts is one of the things that differentiates clinical obsessions from ordinary intrusive thoughts (Rachman, 1997; Rachman, 1998; Salkovskis, 1985; Salkovskis et al., 2000). If the thought is interpreted as signifying threat then the thought is likely to cause distress which is likely to be followed by attempts to suppress the thought. However, some research indicates that thought suppression is more likely to increase the frequency of the thought than to decrease it (Wegner and Erber, 1992; Wegner et al., 1987). Wegner’s (1994) theory of ironic processes of mental control argues that failures of immediate thought suppression can be caused by the operating process getting disrupted by competing cognitive demands. It stands to reason then that by inducing competing cognitive demands (i.e. cognitive load) it should disrupt the operating process, which should lead to greater thought frequencies in the suppression interval (Wenzlaff & Wegner, 2000). There is some evidence that some cognitive capabilities, such as WMC and PI might mediate this effect. For instance, Bomyea and Amir (2011) found in their study that both greater WMC and PI were related to lesser thought frequencies in a thought suppression task. Also Ólafsson et al. (2013) found support for greater PI to be related to less intrusions during suppression. This has implications for OCD since there are indications that OCD patients may have deficits in thought suppression ability (Tolin et al., 2002).

Research into ironic effects of thought suppression have, however not consistently shown that thought suppression increases thought frequency (see
Abramowitz et al., 2001, Purdon & Clark, 2000). Studies indicate that immediate enhancement and rebound effects of thought suppression may be more common amongst non-clinical participants suppressing novel thoughts rather than clinical participants suppressing personally relevant thoughts (Kelly & Kahn, 1994; Najmi et al., 2009). Rather, the effect of thought suppression of personally relevant thoughts seems to be a negative impact on mood rather than ironic effects of thought suppression (Janeck & Calamari 1999; Purdon, 2001; Purdon et al., 2005).

To date, the effects of cognitive load on thought suppression have not been well researched, nor has the potential relationship between cognitive load and cognitive capabilities (such as WMC and PI) been well researched. The present study aims to partially rectify this by investigating the effect of thought suppression of a personally relevant thought in a non-clinical sample and potential mediating effects of WMC and PI on thought frequency. Additionally the relationship between mood, appraisals, obsessive symptoms and thought frequencies was investigated.

The hypotheses to be tested in this study are the following:

It is predicted that suppression will result in significantly greater immediate enhancement and rebound effects than no suppression. It is further predicted that suppression during cognitive load will lead to greater immediate enhancement effects than suppression without load. Thought intrusions in the first interval are predicted to be mediated by PI and WMC so it is hypothesised that there will be a significant interaction effect between proactive inhibition and working memory capacity on immediate enhancement. It is further predicted that there will be significant correlations between thought frequencies in both intervals and measures of anxiety, depression, negative interpretations of thought intrusions, obsessive symptoms and interpretations of the intrusive thought.
Method

Participants

Participants were 105 female undergraduate students at the University of Iceland.

Gender differences have been observed in thought control studies (e.g., Robichaud, Dugas, & Conway, 2003; Rutledge, 1998) although this has not been well studied. Only females were required in this experiment because analyses by gender would require larger samples. For the present thesis, 24 participants were tested and added to an existing data pool of 81 participants. Participants were randomly assigned to one of three conditions with 35 participants in each condition. The mean age in this sample was 26.63 (SD= 8.20) ranging from 19 – 64 years of age. An e-mail presenting the study and advertising participation was sent out to all female undergraduate students at the University of Iceland. Participants were enrolled in a lottery with one of them winning a 15,000 ISK prize for participating in the study.

Measures

Both self report questionnaires and computerised neuropsychological tests were used to measure the variables under study. Three of the questionnaires that were administered were not used in the statistical analysis of this study. These were: the Responsibility Attitude Scale–10, the Attentional Control Scale and the Baratt Impulsiveness Scale-11. These questionnaires will not be reviewed here.

OCD related questionnaires

Obsessive Compulsive Inventory – Revised (OCI-R) is an 18 item self-report questionnaire designed to evaluate obsessive and compulsive symptoms. The items are scored on a five point (0-4) Likert scale. The original version was developed by Foa, Kozak, Salkovskis, Coles and Amir (1998) but has since been edited and revised. The revised version used in the present study evaluates obsessive and compulsive symptoms on six subscales: washing,
checking, ordering, obsessing, hoarding, and neutralising, each consisting of three items (Foa et al., 2002). The OCI-R has been found to be a valid and reliable measure of obsessive-compulsive symptoms (Abramowitz & Decon, 2006). The Icelandic version of the OCI-R that was used in the present study, was translated by Ásdís Eyþórsdóttir and Jakob Smári and has good psychometric properties in non-clinical samples (Smári, Ólason, Eyþórsdóttir, Frölunde, 2007).

**Obsessional Beliefs Questionnaire (OBQ-44)** is a 44 item self-report questionnaire designed by the Obsessive Compulsive Cognitions Working Group (OCCWG, 2005). The OBQ-44 assesses the following beliefs related to the development and maintenance of OCD: 1) responsibility/threat estimation (16 items) 2) perfectionism/certainty (16 items) and 3) importance of thoughts and thought control (12 items) (OCCWG, 2005). The items are scored on a 7 point Likert scale (1-7). The OBQ-44 has good internal consistency as well as good convergent and discriminant validity (OCCWG, 2005) The OBQ-44 was translated into Icelandic by Eggert Birgisson and Jakob Smári in 2007 and has demonstrated good psychometric properties in a sample of university students (Pétursdóttir, 2008).

**Interpretation of Intrusions Inventory – 31 (III-31)** is a 31 item self-report questionnaire developed by the OCCWG to measure interpretations of recent intrusive thoughts, images and impulses (OCCWG, 2001, 2005). Participants write down a personal intrusive thought and then answer the 31 questions as they pertain to the intrusive thought and ones similar to it. The III-31 It measures interpretations of recent intrusions on three subscales; 1) inflated responsibility (10 items), 2) overimportance of thoughts (10 items) and 3) need to control thoughts (11 items), and also produces a total score (OCCWG, 2001). Investigations into the subscales have indicated that they may not tap different domains but rather a single domain, which the OCCWG suggest could be called negative interpretations of intrusive thoughts (OCCWG, 2005). Only the total score was used in this study. The questionnaire is scored on a 0-100 scale with 10 point intervals (0, 10, 20 etc.). It has good internal consistency, discriminant validity and convergent validity (OCCWG, 2005). Jakob Smári translated the III into Icelandic and it too has good psychometric properties (Magnúsdóttir & Einarsson, 2003).
Anxiety and depression

Hospital Anxiety and Depression Scale (HADS) is a 14 item self-report questionnaire assessing depression and anxiety symptoms in the past week. Each item is scored on a 4 point scale. The questionnaire was developed by Zigmond and Snaith (1983) and was translated into Icelandic by Högni Óskarsson. The original English scale has good validity (Bambauer, Locke, Aupont, Mullan & McLaughlin (2005), as has the Icelandic version (Schaaber, Smári & Óskarsson, 1990).

Neuropsychological tests

The AB-AC Paired Associates test is a computerised test designed by Rosen and Engle (1998) to measure proactive inhibition, that is, the ability to suppress information which is no longer task relevant (see for example Verwoerd, Wessel & De Jong, 2009). There is some evidence that greater proactive inhibition is related to reduced frequency of intrusive thoughts (Verwoerd et al., 2009). The test was administered using the E-prime program. The test consists of two lists of word pairs and each list consists of 12 word pairs. The words were all Icelandic and all target words were single-syllable words. In each word pair the first word serves as a cue for the second (target) word. Both lists had the same cue words but different target words. The first list (called AB) consisted of strong association word pairs such as Píanó – Stóll, which in Icelandic makes up the compound word Píanóstóll, meaning piano chair. The second list (AC) had the same cue words as the A-B list but was paired with a different non-associated target word, such as Píanó – Kál (Piano – Lettuce).

Participants first went through a practice phase to ensure that they understood the task correctly. Then the participants went through a learning phase where both the cue and target words were presented together in a fixed random order. This was followed by a testing phase in which only the cue words (e.g. Píanó) were presented one at a time. Participants were required to name the correct target word within 1.3 seconds of cue presentation. This was then followed by a 2 second display of the complete word-pair to allow for feedback and further learning. Three consecutive correct responses of a particular word-pair were required for the cue word to stop appearing. The test phase ended when this criterion had been reached for all word pairs in a list. Finally, all word pairs were displayed once again to balance presentation.
order in the test phase. The number of times participants responded with a B target word when a C target word was appropriate (intrusions) during test phase of the second word list, was used as a measure of proactive inhibition.

*The Automated operation span task (Aospan)* is a computerised version of the Ospan test originally developed by Turner and Engle (1989) to assess working memory capacity (see Unsworth, Heitz Schrock and Engle, 2005). The E-prime program was used to administer the Aospan test. The test measures ability to retain information in memory whilst attending to other information (Turner & Engle, 1989). In this version of the test participants were presented with math problems whilst they needed to remember letters of the alphabet.

The participants had an equation displayed to them on the screen (e.g., “(2*2)+1=?”). Once they had solved the equation they clicked with the mouse and the equation was replaced by a solution to the problem. Participants then judged whether the proposed solution was correct or incorrect by checking the corresponding box on the screen with the mouse. After each equation a letter was displayed for 800ms for later recall. After 3-7 equation-letter trials 12 letters were presented and participants were asked to select the letters they remembered in the correct order. The test consisted of 15 rounds of equation-letter trials and feedback on correct recall and correctly solved equations was provided after each round. The Aospan absolute score reflects the number of rounds participants correctly recalled all the letters presented. It was used to measure WMC in this study. The Aospan has adequate reliability and validity (Unsworth et. al., 2005) and was translated by Vilhjálmur Jónsson (2008).

*Thought suppression task questionnaires*

Before the suppression task started each participants filled out a questionnaire assessing their emotional state. It measured anxiety, stress, sadness, guilt, shame and distress on a nine point Likert scale ranging from “Not at all” to “Very“. An identical questionnaire was administered at the end of the suppression task. After the first interval of the suppression task participants answered a questionnaire measuring anxiety, stress and sadness on a 0-100 VAS scale. On the same questionnaire they also rated how hard they tried to suppress the thought, how often they felt the thought came to mind and how difficult they found it to suppress the thought on a 0-100mm VAS scale. After the second interval of the suppression task participants answered
a questionnaire asking them to rate how hard they tried to suppress the thought and how often they felt the thought came to mind on a 0-100 VAS scale.

Lastly all participants answered an 8-item modified version of the Concerns about Failures in Thought control Questionnaire (CFTQ). The questionnaire was originally designed by Purdon (2001) to assess the extent to which the recurrence of an obsessional thought can escalate concerns about responsibility for and possible consequences of an obsessive thought. The original scale consisted of two subscales called Need to control and Fusion/dystonicity, consisting of six and eight items respectively. The modified version used in this study consisted of eight items taken from both subscales measured on a seven point Likert scale ranging from Disagree very much to Agree very much. The items were all in Icelandic. The scores were compiled into a total score ranging from 8-56. The total score was used in this study.

**Procedure**

Participants were tested individually. Upon arrival participants were given a document containing information about the study. Then they filled in the self-report questionnaires in the following order: OCI-R, HADS, RAS-10, OBQ-44, ACS and the BIS-11. Next they participated in the OSPAN and the AB-AC computerised tasks in this order. During the Aospan test participants were seated in front of a computer with the experimenter present in the room. For the AB-AC test the experimenter needed to encode the participants’ responses with an encoding box. Participants’ responses were coded as follows; 1) Correct, 2) No response, 3) Intrusion (responding with a B target word when a C target word was correct), 4) Incorrect response – but the word was on the list, 5) Wrong answer – word not on the list. After this, participants answered the III-31 questionnaire where they were first instructed to write down a short description of a personally relevant negative intrusive thought as per the instructions of the III-31 and put it in the envelope that was only marked with participant number. Participants then answered the questions of the III-31 as they pertained to the recorded thought.

Before starting the thought suppression task, participants were first asked to imagine for 30 seconds that the content of their intrusive thought were to happen/take place in some situation. This was done to prime the thought before participating in the thought suppression task. Participants then completed a questionnaire measuring anxiety, stress, sadness, guilt,
shame and distress on a 1-9 Likert scale before starting the thought suppression task. Finally the participants completed the suppression task. The suppression task consisted of two suppression conditions (suppression with cognitive load, suppression only) and one control condition. Each condition was made up of two intervals. Before the first interval participants in the suppression group were instructed to monitor their thoughts and think of anything they liked for the next five minutes and if the thought they had written down before taking the III came up they were to press the button on a standard hand tally counter and suppress the thought as hard as they could. Cognitive load was induced in one group by asking the participants to count down from 1000 in threes, that is; to count 1000, 997, 994, 991 and so on. For the second interval they were instructed to monitor their thoughts and if the target thought came up they were to not suppress it, but rather let it flow freely and press the button if it came up. Participants in control group received similar instructions for both intervals. After the first interval all participants completed a questionnaire measuring anxiety, stress and sadness on a 0-100mm VAS scale. The total tally was recorded by the experimenter between each interval of the suppression task and the hand tally counter was reset after each time.

Once the suppression task was completed the participants answered three questionnaires. The first measured how much they tried to suppress the target thought in the monitoring interval and how often they thought it came up on a 0-100 mm VAS scale. The second measured anxiety, stress, sadness, guilt, shame and distress on a 1-9 Likert scale and was identical to the one administered before the suppression task began. Lastly they completed the modified eight item CTFQ questionnaire. Participants were then thanked for participating and asked for comment, feedback and any emotional distress due to the experiment. At the end of the experiment the envelope was sealed and not opened until data collection was completed in order to ensure anonymity.
Results

Preliminary Analyses

Means and standard deviations of thought intrusion frequency in the thought suppression task are displayed in Table 1.

Table 1. Means (and standard deviation) of thought intrusion frequency by group and interval in the thought suppression task

<table>
<thead>
<tr>
<th></th>
<th>Interval 1</th>
<th>Interval 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppression with</td>
<td>4.57 (5.17)</td>
<td>3.51 (3.11)</td>
</tr>
<tr>
<td>cognitive load (n=35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppression only (n=35)</td>
<td>3.37 (3.30)</td>
<td>2.26 (2.17)</td>
</tr>
<tr>
<td>Control (n=35)</td>
<td>2.57 (2.66)</td>
<td>2.40 (3.07)</td>
</tr>
</tbody>
</table>

Analysis of the frequency of thought intrusions in both intervals revealed that the distributions were positively skewed. A logarithmic transformation was therefore attempted and it showed that although the normality tests (Kolmogorov-Smirnov, Shapiro-Wilk) were still significant the residuals were normally distributed (see appendix A).
Means and standard deviations for the self-report questionnaire measures and neuropsychological tests are presented in Table 2.

**Table 2.** Means and standard deviations on neuropsychological tests and questionnaires by group.

<table>
<thead>
<tr>
<th></th>
<th>Suppression Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Cognitive Load</td>
</tr>
<tr>
<td><strong>Self report measures</strong></td>
<td></td>
</tr>
<tr>
<td>III total score</td>
<td>965.14 (575.68)</td>
</tr>
<tr>
<td>HADS anxiety*</td>
<td>7.29 (2.82)</td>
</tr>
<tr>
<td>HADS depression*</td>
<td>3.97 (3.52)</td>
</tr>
<tr>
<td>OCI-R total score</td>
<td>15.54 (10.13)</td>
</tr>
<tr>
<td>OBQ 44 total score</td>
<td>132.71 (41.89)</td>
</tr>
<tr>
<td><strong>Neuropsychological measures</strong></td>
<td></td>
</tr>
<tr>
<td>Proactive interference</td>
<td>11.29 (19.24)</td>
</tr>
<tr>
<td>Aospan absolute score</td>
<td>37.49 (20.14)</td>
</tr>
</tbody>
</table>

*Differed at the $p<0.05$ level.

Group differences were investigated by means of ANOVA and a post hoc analysis using a Bonferroni correction. There were significant main effects of group on HADS anxiety $F(2, 102) = 3.963, p<0.05$ and HADS depression $F(2, 102) = 4.515, p<0.05$. The post hoc comparisons revealed that for both HADS scales the difference detected was between the control group and the suppression only group ($p<0.05$).

**Manipulation Check**

Suppression effort served as a manipulation check for thought control instructions in the task. It was expected that a significant difference would emerge between the control group and the two suppression groups in the first interval, since only the suppression groups were instructed to suppress the target thought. It was also expected that no differences would emerge in the second interval since all groups were instructed not to suppress during that interval. ANOVA showed that there was a significant main effect of group on suppression effort during the first interval of the thought control task ($F(2, 101) = 3.417, p<0.05$). Post-hoc tests using a Bonferroni correction revealed a significant difference between the suppression with load and
control group ($p<0.05$) but not between the suppression-only group and the control group ($p<0.10$). This means that manipulation of suppression effort with different thought control instructions was not successful in producing the expected differences between the suppression-only and control group. To counter this, it was decided to remove 10% ($n=4$) of participants in each group that deviated the most in suppression effort scores from the expected results given the nature of the instructions that the group received. Thus, 12 cases in total were removed, leaving 93 individuals for subsequent analyses (31 in each group). After this, an ANOVA showed a significant main effect of group on suppression effort, $F(2, 90) = 9.80$, $p<0.05$, in the first interval of the suppression task. Post-hoc comparisons with a Bonferroni correction showed that there was a significant difference between the control group and the two experimental groups ($p<0.05$) in the expected direction. The two suppression groups did not differ significantly from each other ($p>0.10$). An ANOVA with suppression effort in the second interval of the thought suppression task showed that the main effect of group was not significant as expected, $F(2, 90) = 0.76$, $p>0.10$. This means that there was no difference in thought suppression effort between groups in the second interval. Means and standard deviations of suppression efforts in each interval before and after adjustment are presented in Table 3. Subsequent analyses of results will be based on 93 subjects.

**Table 3.** Means and standard deviations of suppression effort during the thoughts suppression task.

<table>
<thead>
<tr>
<th></th>
<th>Suppression effort before adjustment (n=105)</th>
<th>Suppression effort after adjustment (n=93)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interval 1</td>
<td>Interval 2</td>
</tr>
<tr>
<td>Suppression with cognitive load</td>
<td>54.05 (38.05)</td>
<td>17.93 (24.60)</td>
</tr>
<tr>
<td>Suppression only</td>
<td>41.75 (36.94)</td>
<td>12.10 (16.61)</td>
</tr>
<tr>
<td>Control</td>
<td>32.12 (30.10)</td>
<td>21.34 (29.34)</td>
</tr>
</tbody>
</table>
Immediate Enhancement Effects of Thought Suppression

It was hypothesised that thought intrusion frequency in interval 1 would be higher in both of the suppression groups compared to the control group. It was further hypothesised that suppression with cognitive load would result in a significantly greater amount of thought intrusions than suppression only. As can be seen in Table 1 there were more instances of thought intrusions in the first interval when participants were actively attempting to suppress the thought than when they were not. The table also indicates that there were more instances of thought intrusions in the group suppressing the thought with cognitive load than the suppression-only group. An ANOVA was computed to test this with group type as a factor and logarithmically transformed thought intrusion frequency in the first interval as the dependent variable. There was a significant main effect of group $F(2, 90) = 5.360, p<0.01$. Post-hoc comparisons using a Bonferroni correction revealed a significant difference between the suppression with cognitive load group and the control group ($p<0.01$), but not between any other groups ($p>0.10$). Thus, the hypotheses were partially supported. There was support for suppression during cognitive load to lead to more thought intrusions than no suppression, but there was no evidence found for that suppression only would lead to more thought intrusions than no suppression.

Working Memory Capacity and Immediate Enhancement

It was hypothesized that greater working memory capacity (WMC) would be associated with significantly fewer intrusions in the first interval of the suppression task. Aospan absolute scores were divided into two groups with a median-split. Aospan absolute score median was found to be 36 and scores ranging from 0 to 36 were taken to indicate poor working memory capacity (n=47) and scores from 37 to 75 to indicate good working memory capacity (n=46). An ANOVA with working memory capacity and group type as factors and number of thought intrusions in the first interval of the suppression task as the dependent variable showed that the main effect of group was significant, $F(2, 87) = 4.897, p<0.05$, whereas the main effect of working memory capacity, $F(1, 87) = 0.006, p>0.10$ was not. The interaction between the two was not significant, $F(2, 87) = 0.455, p>0.10$. Thus, no evidence was found for WMC being related to thought intrusion frequency in the first interval of the thought suppression task.
Proactive Inhibition and Immediate Enhancement

An ANOVA was computed with number of intrusions in the AB-AC paired associates test and type of group as factors and number of thought intrusions in the first interval of the thought suppression task as the dependent variable. A median split was performed on the AB-AC intrusion score. The median was found to be 1 and all participants who had between 0-1 intrusions were considered good inhibitors (n=47) whereas those with 2-72 intrusions were considered poor inhibitors (n=46). A significant main effect of group was found, $F(2, 87) = 5.399, p<0.01$, but not of proactive inhibition, $F(1, 87) = 0.276, p>0.10$, nor was the interaction between the two significant, $F(2, 87) = 0.955, p>0.10$. Thus, no evidence was found for the role of proactive inhibition in immediate enhancement of thoughts. Even though no significant effect of proactive inhibition was found, a pattern can be observed visually in figure 2. There it can be seen that there was a tendency for poor inhibitors to have more thought intrusions than good inhibitors in the suppression only group. This pattern seems to be present in both intervals of the thought suppression task.
Figures 1 & 2 Mean number of thought intrusions in interval 1 (top panel) and interval 2 (bottom panel), divided by type of group and proactive inhibition.
Rebound Effects of Thought Suppression

A mixed-ANOVA was conducted with type of interval in the thought suppression task (interval 1 and interval 2) as a within-subject factor and group type as the between-subjects factor to test the hypothesised rebound effects of thought suppression. It revealed a significant main effect of interval, $F(1, 90) = 14.628, p<0.01$, meaning that there was a statistically significant difference in number of intrusions participants had between the first and the second interval. The interaction between group type and interval was not significant, $F(2, 90) = 0.528, p>0.10$. This means that the change in number of thought intrusions between intervals 1 and 2 was not dependent on group type. Thus there was no support for the hypothesis that thought suppression would lead to thought rebound in the second interval of the suppression task.

OCD Symptoms, Mood, Appraisals and Thought Control Failures

As was discussed in the introduction, thought control failures can affect mood and reinforce interpretations of the thought as being dangerous (Purdon, 2001). There have also been indications that obsessive symptoms and appraisals of the thought as personally relevant and important can make a thought more intrusive. In order to examine the relationship between mood, obsessionality, appraisals and thought control failures, correlations between number of intrusions in both intervals and these measures were computed.

Table 4. Correlations between measures of mood, obsessionality, appraisals of target thought and thought intrusion frequency.

<table>
<thead>
<tr>
<th></th>
<th>Interval 1 thought intrusions</th>
<th>Interval 2 thought intrusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HADS anxiety</td>
<td>0.304**</td>
<td>0.392**</td>
</tr>
<tr>
<td>HADS depression</td>
<td>0.071</td>
<td>0.160</td>
</tr>
<tr>
<td>OCI-R total score</td>
<td>0.064</td>
<td>0.257*</td>
</tr>
<tr>
<td>OBQ 44 total score</td>
<td>0.134</td>
<td>0.290**</td>
</tr>
<tr>
<td>III total score</td>
<td>0.139</td>
<td>0.304**</td>
</tr>
<tr>
<td>Modified CFTCQ</td>
<td>0.359**</td>
<td>0.435**</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
As Table 3 shows, anxiety correlated significantly with number of intrusions in both intervals. The modified CFTCQ also had significant correlations with intrusion frequency in both intervals. Measures of obsessionality and appraisals of target thought only had significant correlations with intrusion frequency in the second interval. This means that appraisals and OCD related pathology is related to increased thought intrusions in the thought suppression task in general.

**Discussion**

The aim of the present study was to investigate ironic effects of thought suppression of a personally relevant thought in a non-clinical sample, as well as potential mediating effects of working memory capacity (WMC) and proactive inhibition (PI). Additionally the relationship between mood, appraisals, obsessive symptoms and thought frequencies were investigated. The main hypotheses regarding ironic effects of thought suppression were partially supported. There was evidence for immediate enhancement effects, but only when participants suppressed the thought with cognitive load. This relationship was not mediated by WMC or PI. No rebound effects were found in this sample.

**Immediate Enhancement Effects of Thought Suppression**

It was predicted that suppression would lead to increased thought intrusions in the first interval compared to no suppression, that cognitive load would increase this effect and that this relationship would be mediated by WMC and PI. This study found partial evidence for the hypotheses regarding immediate enhancement of thought suppression. Greater thought frequency was observed in the group that suppressed with cognitive load, compared to the control group that did not suppress. However, suppression without load did not result in greater thought frequency compared to the control group, nor did suppression with cognitive load lead to significantly more intrusions than suppression without load. Thus, there was not sufficient evidence to conclude that suppression in general increased thought frequency, but the results suggest that it is suppression during cognitive load that leads to immediate enhancement of thoughts. This is an interesting result since it is speculated that cognitive load
impedes the suppression effort (Wegner, 1994). Presumably, this is because the resource dependent operating process gets interrupted by the cognitive load whereas the monitoring process (which is relatively independent of cognitive resources) does not (Wegner, 1994). Thus the monitoring process goes unhindered and finds the thought in consciousness, signalling suppression failure and bringing the thought into consciousness. The present findings are in line with this.

In this study the operating process was experimentally disrupted by inducing cognitive load. Participant’s cognitive resources were taxed which impeded successful suppression and subsequently immediate enhancement effects ensued. Presumably there simply weren’t enough cognitive resources to go around during suppression and thus the monitoring process signalled suppression failure, bringing the thought back into consciousness. This has special implications for OCD since there are indications that OCD patients may have a deficit in proactive inhibition (Bannon et al., 2002; Tolin et al., 2002). In a sense, such a deficit was mimicked in this study by inducing cognitive load and disrupting the operating process, which caused a surge of intrusive thoughts. However, since participants in this study were not OCD patients it is uncertain whether the manipulation was analogous to any cognitive load (or deficit) experienced by OCD patients when dealing with intrusive thoughts by suppressing them. This has implications for OCD since as Purdon (2001) argued, failed thought suppression can make a thought seem more important than before, since the failure to control a thought can be taken as evidence for the validity of the interpretation of the thought as important. According to cognitive-behavioural theories of OCD such negative interpretations are likely to make an intrusive thought even more frequent and salient (Rachman, 1998; Salkovskis, 1985).

Contrary to the hypotheses, the effect of cognitive load was not mediated by WMC or proactive inhibition. This is in stark contrast with the results of Bomyea and Amir (2011) who found that high WMC and PI led to fewer thought intrusions. There was however (as can be seen in Figures 1 and 2 of the Results section) a tendency for participants in the suppression-only group that also had poor inhibitory capabilities to have more intrusions in the suppression task than those with good inhibitory capabilities, although this effect was not statistically significant. The potential effect of PI on intrusive thoughts has important implications for OCD, for as Verwoerd et al. (2011) concluded; poor proactive inhibition could be a risk factor in developing obsessions, and as Bannon et al. (2002) showed, there are some indications that OCD patients may have substantially less PI than non-OCD patients. Additionally, as Ólafsson et al. (2013) showed, there is a tendency for those who have lower
PI to have more thought intrusions during thought suppression than those with higher PI. However, the sample in this study consisted of healthy university students and it is reasonable to assume that university students would have fairly good WMC and PI. It is possible that this particular sample of undergraduates simply didn’t have low enough WMC or PI to elucidate the hypothesised effect.

**Rebound Effects of Thought Suppression**

No significant rebound effect as measured by the repeated measures ANOVA was detected in this study and thus the hypotheses regarding thought rebound were not supported. One might have expected to find rebound effects for the group that suppressed with cognitive load since, for instance, Wegner and Erber (1992) found both immediate enhancement and rebound effects of thought suppression for their participants who suppressed with cognitive load. However, Wegner and Erber (1992) used a novel thought in their thought suppression task whereas the present study used a personally relevant negative thought. Considering the fact that a personally relevant negative thought was used in this study it is not entirely surprising that no significant rebound effects were found. Though research has not been conclusive on this subject, there are indications that rebound effects are less likely when using a personally relevant thought, rather than a novel, neutral thought (Kelly & Kahn, 1994; Purdon, 2001). Presumably, thought rebound of novel thoughts appear because participants who experience rebound have formed associations between the intrusive thought and stimuli in the environment when they try to suppress the novel thought in the laboratory (Wegner et al., 1987; Wenzlaff et al., 1991). These stimuli are present in the second interval when participants are no longer suppressing the thought which may remind them of the thought, thus making it appear more often. This is in keeping with Rachman’s (1998) account of processes which may make intrusive thoughts more frequent, in which associations are made between an intrusive thought and stimuli in the environment, which come to elicit the thought. According to Wenzlaff et al. (1991) thoughts generated when trying to suppress another thought can in and of themselves come to serve as reminders of thought one was trying to suppress. It is reasonable to assume that some stimuli in a laboratory, such as clocks or pictures could potentially generate thoughts with which to form associations. For instance, a picture of a man on the wall may generate thoughts of who the man might be, his physical characteristics etc. Should this tactic be employed to distract oneself from a thought then it is
quite likely that the thought would rebound once suppression attempts stopped and the participant saw the picture again. In this experiment, though, the experimenter took every precaution to keep any and all stimuli in the laboratory to an absolute minimum. The only thing in the participant’s visual range other than empty walls and partitions was a computer with the monitor switched off. Perhaps this lack of salient stimuli in the laboratory negated any potential rebound effects that might otherwise have occurred since there were much fewer stimuli with which to form associations.

However, as reported by Kelly and Kahn (1994), participants in their study who suppressed personally relevant thoughts made substantially more use of distracter thoughts that were unrelated to anything in the laboratory than those who suppressed novel thoughts. It is thus quite likely that the participants in this study did so as well, though it was not investigated here. Additionally Wegner et al. (1987) found that when they provided participants with a single distracter thought which was not related to anything in the laboratory the rebound effect was no longer observed. The personally relevant thoughts used in this study then were most likely not associated with anything in the laboratory, and thus there was nothing there to elicit the thought once suppression stopped. Since these were personally relevant intrusive thoughts it is reasonable to assume that the participants had already tried to suppressed the thought in their natural environment – meaning that whatever associations that may have been made between the thought and other stimuli were most likely not relevant in the laboratory - and thus no rebound effects appeared.

**OCD Symptoms, Mood, Appraisals and Thought Control Failures**

The correlations between the measures of mood, obsessionality, appraisals and thought intrusions indicate that there was a relationship between these variables. However, with the exception of HADS anxiety and the modified CFTCQ, they were only significant in the second interval, when there was no suppression. So the hypotheses were only partially supported. The fact that measures of anxiety and appraisals of thought control failures were significantly related to thought intrusion frequency is in keeping with Purdon’s (2001) argument that failed suppression and concerns about failed suppression are associated with distress and negative interpretations about thought control failure. It is surprising though that there would be a significant correlation for scores of the modified CFTCQ but not of the III with thought frequencies in the first interval. One would expect that interpretations of thought
control failures would be highly related to interpretations of the thought itself. It is possible, though, that the relationship between scores on the modified CFTCQ, HADS anxiety and thought frequencies in the first interval reflects that participants were anxious about their performance on the thought suppression task rather than the personal meaning of thought intrusions. Of course this would have to mean that the effects of this carried over to the next interval as well, when there was no suppression since the correlations were significant in both intervals.

Regarding the lack of significant correlations between interpretations of the thought, obsessive symptoms and thought intrusion frequency in the first interval, it is possible that the effect of thought suppression was so great in the first interval that it overrode the effects of appraisals of the target thought and OCD symptoms. Cognitive-behavioural theories of OCD state that appraisals of an intrusive thought and OCD-related beliefs and behaviours make intrusive thoughts more frequent (Rachman 1998; Salkovskis, 1985; Salkovskis, 1989; Salkovskis, Forrester & Richards, 1998; Salkovskis et al., 2000). Even though the effect of OCD symptoms and thought appraisals was not particularly strong in this sample, it may represent an effect of OCD symptoms and appraisals which might be stronger in OCD patients.

Limitations and Future Directions
A number of limitations to the current study should be considered. Firstly, the participants were all female students and if there are any systematic gender differences in the general population, then this would not be reflected in this study. Secondly even though this study sought to investigate processes that pertain to obsessive-compulsive disorder the participants in this study were all healthy undergraduate students. The testing session took between 90 to 120 minutes per participant without any breaks. It consisted of participants completing six questionnaires and then two neuropsychological tests (Aospan, AB-AC paired associates) before completing the suppression task. Some participants indicated slight fatigue by the end of the testing session which might have influenced the results, though no participant requested a break. Although any such effects would not systematically influence the results for any particular group, it is possible that fatigue could have diminished any mediating effects of WMC and PI on thought intrusions. This is purely a speculative point but it is a possibility that needs to be considered in future studies. Regarding PI, there was a trend towards
significance in the first interval, though it was not statistically significant. It is possible that a difference could be detected in a larger sample or with a slightly different research design, such as shorter testing sessions.

Participants engaged in the second interval of the suppression task as soon as they had completed a short questionnaire measuring anxiety, stress, sadness, suppression effort and how often the participant felt the thought came to mind (see Method). It is possible (though entirely speculative) that this is not long enough to see rebound effects of personally relevant material. Perhaps suppressing a personally relevant thought in a laboratory environment could lead to rebound effects more slowly than suppressing a novel thought. Scores from the modified CTFCQ indicated that failing to suppress the thought in the laboratory increased concerns about responsibility for and possible consequences of the thought. This could make the thought more intrusive and elicit more frequent suppression attempts in their natural environment. A personally relevant thought may already have established reminders which are simply not available in the laboratory. If that is the case then participants would need to be exposed to these reminders in their day-to-day life in order to determine if there are any rebound effects. So it would be interesting to conduct at study with a monitoring – suppression – monitoring research design of suppression of personally relevant thoughts span few days while also investigating the role of cognitive load and appraisals. A suggestion would be to divide participants into groups based on high and low negative appraisal on the one hand and suppression with/without load and a control group on the other hand.

Summary and conclusions

Thought suppression efforts of a personally relevant negative thought were impeded by cognitive load in this sample. Most studies on thought suppression have not utilised cognitive load when suppressing personally relevant negative thoughts. As has been mentioned previously studies using novel thoughts have been more likely to find ironic effects of thought suppression than studies using personally relevant thoughts, which have mostly found support for negative effects on mood rather than thought intrusion frequencies. Although this study did not find conclusive support for a negative effect on mood it is reasonable to assume that failure to suppress a personally relevant negative thought would have a negative impact on mood and interpretations of the thought (see Purdon, 2001). This (according to cognitive appraisal theories of OCD) is likely to make the thought more frequent and intrusive
(Rachman, 1998; Salkovskis, 1985). Additionally, negative mood is viable to make thought suppression more difficult (Wenzlaff et al., 1988) which should call upon more suppression attempts. Moreover the very act of suppression when in a negative mood could reinstate the negative mood at a later time, which once again could make suppression more difficult (Wenzlaff et al., 1991). This is supported by the high incidence of comorbid mood- and anxiety disorders in OCD patients (Ruscio et al., 2009; Torres et al., 2006). Granted, mood was not of primary interest in this study, yet it stands to reason that a negative mood and negative appraisals of a thought could serve to impede suppression efforts, perhaps in a way similar to that induced by cognitive load in this sample.
References


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Appendix A

Normal Q-Q Plot of logarithmically transformed distribution of thought intrusions in the first interval

Figure A1. QQ plot of logarithmically transformed distribution of thought intrusions in the first interval.
Figure A2. QQ plot of logarithmically transformed distribution of thought intrusions in the second interval.