Manipulating beliefs about losing control causes checking behaviour

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ABSTRACT

Cognitive theories of obsessive-compulsive disorder (OCD) posit that maladaptive beliefs lead to the development of symptoms. However, psychometric studies have provided mixed evidence regarding whether beliefs about control over thoughts predict OCD symptoms above and beyond other obsessive beliefs. Clinical reports have documented concerns among those diagnosed with OCD regarding a potential loss of control over their thoughts and behaviour, indicating that broadening the scope of beliefs about control by integrating aspects of losing control may better explain their role in OCD. In this study, 133 undergraduate participants underwent a bogus EEG session and received (positive or negative) false feedback about the possibility that they may lose control over their thoughts and behaviour, and completed a task asking them to control the pace of pictures. As hypothesized, participants in the high (versus low) beliefs about losing control condition checked significantly more often which keys they should use to control the pictures, \( t(106.95) = 2.28, p = .02, d = .44 \), demonstrating that manipulating beliefs about control can impact checking behaviour when a potential loss of control is emphasized. Also, checking behaviour predicted a lower desire for control, such that compulsions may be seen as opportunities to re-establish disrupted control cognitions.

1. Introduction

Obsessive-compulsive disorder (OCD) is characterized by intrusive thoughts, images, or impulses (i.e., obsessions) and repetitive behaviour, mental acts, or rituals (i.e., compulsions), such as repeated washing and checking (American Psychiatric Association, 2013). OCD affects approximately 2.5% of the population (Angst, 1994; Kario, Golding, Sorenson, & Burnam, 1988) and has been listed as one of the top causes of disability worldwide (World Health Organization, 1999). Because changes in beliefs during cognitive-behaviour therapy (CBT) for OCD have been shown to be responsible for symptom reduction (e.g., Adams, Riemann, Wetterneck, & Cisler, 2012; Alcolado & Radomsky, 2016; O’Connor et al., 2005; Solem, Håland, Vogel, Hansen, & Wells, 2009; Wilhelm, Berman, Keshaviah, Schwartz, & Steketee, 2015; Woody, Whittal, & McLean, 2011), investigating the belief domains underlying the aetiology and maintenance of obsessions and compulsions has become increasingly important (e.g., Alcolado & Radomsky, 2011; Lind & Bosch, 2009; Obsessive Compulsive Cognitions Working Group, 1997, 2001, 2003, 2005). The aim of the current study was to broaden the conceptualization of beliefs about the need to control one’s thoughts by expanding the focus to include beliefs about the possibility of losing control over one’s thoughts and behaviour. Specifically, the causal relationship between beliefs about losing control and checking behaviour was assessed experimentally, as a way to further understand the role of dysfunctional beliefs in OCD symptomatology and, accordingly, to improve the efficacy of existing evidence-based psychological treatments.

Current cognitive theories of OCD posit that misinterpreting intrusive thoughts as overly significant leads individuals to engage in compulsive behaviour to prevent negative outcomes (e.g., Rachman, 1997, 1998, 2002; Salkovskis, 1985, 1999). Critically, specific maladaptive beliefs are thought to be responsible for these misappraisals of normal intrusive thoughts (Clark et al., 2014; Moulding et al., 2014; OCCWG, 1997, 2001, 2003, 2005; Radomsky et al., 2014). Early evidence for cognitive theory comes from experiments with manipulations of responsibility beliefs, showing that higher perceived responsibility causes increased discomfort, urges to check, and actual checking behaviour (e.g., Arntz, Voncken, & Goosen, 2007; Ladouceur, Rhéaume, & Aublet, 1997; Lopatka & Rachman, 1995; Shafran, 1997). Since then, several belief domains have been identified that play a role in the development and maintenance of OCD. These include three empirically-derived groups of beliefs related to OCD: beliefs about responsibility and threat overestimation, perfectionism and intolerance for uncertainty, and beliefs about the importance of and control over thoughts (OCCWG, 2005). Later, Alcolado and Radomsky (2011) provided support for the integration of negative beliefs about memory in cognitive models of OCD. Using a laboratory-based experimental
paradigm, they showed that negative (versus positive) beliefs about memory confidence lead to increased urges to check. Similarly, Hermans et al. (2008) demonstrated the importance of other meta-cognitive beliefs in predicting repetitive checking, such as confidence in one’s attention and perception.

OCD has also been theoretically conceptualized through notions of control (e.g., Carr, 1974; Clark & Purdon, 1993; McFall & Wollersheim, 1979; Reuven-Magril, Dar, & Liberman, 2008), and several authors have suggested that control cognitions are critical in OCD (e.g., Moulding & Kyrios, 2006; Moulding, Kyrios, Doron, & Nedeljkovic, 2009). For instance, Moulding and Kyrios (2007) have shown that one’s desire for control (i.e., motivation to control a given outcome or situation; Burger & Cooper, 1979; Deci & Ryan, 2006; Harter, 1978; Skinner, 1995; White, 1959) and one’s sense of control (i.e., perceived level of control over a given outcome or situation; Skinner, 1996) were tightly linked with obsessive-compulsive symptoms. In a community sample, they found that tendencies toward a higher desire for control and a lower sense of control were associated with greater obsessive-compulsive symptoms, and this was then replicated in a clinical sample of individuals diagnosed with OCD (Moulding, Doron, Kyrios, & Nedeljkovic, 2008). Thus, it has been posited that a “control mismatch”—when one’s perceived level of control does not match the desired level of control—could be partly responsible for OCD symptoms (Gelfand & Radomsky, 2013; Moulding & Kyrios, 2007; Moulding et al., 2008), such that a desire to re-establish one’s sense of control over anxiety-provoking events could motivate compulsions (Radomsky & Rachman, 2004; Reuven-Magril et al., 2008).

As mentioned above, cognitive theories and empirical investigations have instead placed great emphasis on beliefs about control over thoughts (e.g., OCCWG, 1997, 2001, 2003, 2005; Purdon & Clark, 2002; Tolin, Woods, & Abramowitz, 2003) or, in other words, the belief that full control over intrusive thoughts is important, desirable, and possible (OCCWG, 1997; Purdon & Clark, 2002; Salkovskis, 1985). However, correlational research has provided mixed evidence regarding whether this belief domain predicts specific OCD symptoms above and beyond other obsessive beliefs (e.g., Myers, Fisher, & Wells, 2008; Myers & Wells, 2005; OCCWG, 2003, 2005; Solem et al., 2009; Steketee, Frost, & Cohen, 1998; Wheaton, Abramowitz, Berman, Riemann, & Hale, 2010). Still, both anecdotal and clinical reports (e.g., Carr, 1974; Clark & Purdon, 1993; McFall & Wollersheim, 1979; Reuven-Magril et al., 2008) have consistently documented concerns among those diagnosed with OCD regarding a potential loss of control over their thoughts and behaviour (e.g., “Losing control over one’s thoughts will eventually lead to loss of control over my behaviour”; Clark & Purdon, 1993, p. 165). Likewise, Clark and Purdon have suggested that “perceived control over upsetting intrusions is best predicted by the belief that the thought might be acted upon...” (OCCWG, 1997, p. 672), capturing the idea that believing in a potential loss of control over one’s thoughts and/or behaviour might be directly related to a persistent need to control intrusions. This is also in line with the large body of research on the negative effects of thought control strategies in OCD, which can essentially be construed as behavioural manifestations of beliefs about control over thoughts (Clark & Purdon, 1993). For example, Wells and Davies (1994) and, later, Freeston and Ladouceur (1997) found that individuals with OCD engage in a number of thought control strategies (e.g., distraction, punishment, reappraisal), perhaps to prevent acting upon or losing control over their intrusive thoughts (Clark & Purdon, 1993; Rachman & Hodgson, 1980; Rachman, 1997, 1998). Interestingly, studies have shown that deliberate thought suppression can increase the frequency of intrusions in both nonclinical (e.g., Salkovskis & Campbell, 1994; Trinder & Salkovskis, 1994; Wegner, Schneider, Carter, & White, 1987) and clinical (e.g., Tolin, Abramowitz, Przeworski, & Foa, 2002) samples. In this way, thought suppression may potentially reinforce the impression that one is losing control over their thoughts.

The goal of the current study was to explore this broader cognitive domain of beliefs about control by integrating the possibility of losing control over one’s thoughts and/or behaviour, as this might better explain the development and maintenance of OCD symptoms. This is a broader, expanded view of control-related beliefs as compared to beliefs about control over thoughts (alone), and may have important implications for capturing the full range of beliefs and symptoms relevant to those struggling with OCD. This proposition was examined via an experimental manipulation of the expanded belief domain and its impact on checking behaviour. Indeed, along with repeated washing, checking is the most commonly reported compulsion in OCD (Ball, Baer, & Otto, 1996; Rachman & Hodgson, 1980), and was posited to reduce the anxiety individuals holding beliefs about losing control may experience by temporarily increasing their perceptions of control. In this experiment, beliefs about losing control were manipulated in a sample of undergraduates in the context of a bogs electroencephalography (EEG) session. More precisely, following the EEG session, participants were given positive or negative feedback about the possibility that they may lose control over their thoughts and behaviour. This manipulation was used to assess whether these beliefs would influence checking behaviour during a subsequent laboratory-based computer task asking participants to control the pace of pictures (adapted from Reuven-Magril et al., 2008).

It was hypothesized that participants provided with negative feedback about their performance during the EEG session (i.e., greater beliefs about losing control) would check more often which keys they should be using to control the pace of the pictures during the computer task, as compared to participants provided with positive feedback (i.e., lower beliefs about losing control). Experimental support for this relationship would potentially justify a broader understanding of beliefs about control by including aspects of losing control and would suggest useful treatment targets to improve the efficacy of CBT. It was further hypothesized that participants with greater beliefs about losing control would report a lower sense of control and a higher desire for control over the computer task’s pictures (i.e., a more pronounced and maladaptive control mismatch toward the pictures), as compared to participants with lower beliefs about losing control.

2. Method

2.1. Participants

Participants were 136 undergraduate students recruited from Concordia University. They all received course credit for participating. The only inclusion criteria were the ability to understand, read, and communicate in English. Three participants’ data were omitted: one did not finish the protocol, one did not understand the instructions during the EEG session, and one did not understand the instructions of the computer task. The final sample consisted of 133 participants, with 67 in the high beliefs about losing control (HLC) condition and 66 in the low beliefs about losing control (LLC) condition. Participants’ mean age was 23.26 (SD = 5.23; range = 18–45) years and 91.7% of the sample was female. There were no significant differences between the two conditions in age, χ²(1) = −.02, p = .98, sex, χ²(1) = .84, p = .36, ethnicity, χ²(5) = 8.27, p = .14, or educational attainment, χ²(7) = 6.35, p = .50.

To ensure there were no significant differences between the two conditions with regard to relevant psychopathology symptoms and aspects of losing control, the Vancouver Obsessional Compulsive Inventory (VOCI; Thordarson et al., 2004), Obsessive Beliefs Questionnaire (OBQ-44; OCCWG, 2005), Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995), and an adapted version of Reid and Ware (1974) Internal-External Questionnaire—Self-Control Subscale (IEQ-SC; Tiggemann & Raven, 1998) were administered (see Measures below and Table 1 for means and standard deviations). No significant differences between conditions were found as evidenced by VOCI scores, t(131) = −.72, p = .47, the checking subscale of the
Table 1  Mean scores and standard deviations by condition (and total) on measures assessing relevant psychopathology symptoms and aspects of losing control.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>LLC</th>
<th>HLC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>VOCI</td>
<td>33.48</td>
<td>29.76</td>
<td>29.92</td>
</tr>
<tr>
<td>VOCI-C</td>
<td>2.00</td>
<td>4.69</td>
<td>3.09</td>
</tr>
<tr>
<td>OBQ-44</td>
<td>135.25</td>
<td>45.15</td>
<td>125.67</td>
</tr>
<tr>
<td>OBQ-44-IC</td>
<td>26.86</td>
<td>12.58</td>
<td>24.61</td>
</tr>
<tr>
<td>DASS-21</td>
<td>12.69</td>
<td>10.82</td>
<td>11.52</td>
</tr>
<tr>
<td>IEQ-SC</td>
<td>24.45</td>
<td>10.82</td>
<td>21.58</td>
</tr>
</tbody>
</table>


2.2. Measures

2.2.1. Vancouver Obsessional Compulsive Inventory (VOCI; Thordarson et al., 2004)

The VOCI is a 55-item measure of a broad range of symptoms related to OCD comprised of six subscales (i.e., contamination, checking, obsessions, hoarding, indecisiveness, and ‘just right’ experiences). Items are rated on a five-point scale ranging from 1 (“Not at all”) to 7 (“Always applies to me”). The VOCI’s total scale and subscales have good-to-excellent internal consistency in OCD, clinical control, and student populations (α’s = .79–.98; Radomsky et al., 2006; Thordarson et al., 2004). The inventory also has excellent retest reliability (r = .91; Radomsky et al., 2006), as well as convergent and divergent validity (Radomsky et al., 2006; Thordarson et al., 2004). In the current study, the VOCI exhibited excellent internal consistency (α = .96), and was administered to examine condition differences on reported OCD and checking symptomatology.

2.2.2. Obsessive Beliefs Questionnaire (OBQ-44; OCCWG, 2005)

The OBQ-44 is a 44-item measure assessing the extent to which one holds maladaptive beliefs considered relevant to the development and maintenance of OCD, comprised of three subscales: responsibility and threat overestimation, perfectionism and intolerance for uncertainty, and importance of and control over thoughts. Items are rated on a seven-point scale ranging from 1 (“Disagree very much”) to 7 (“Agree very much”). The OBQ-44 has been shown to have good-to-excellent internal consistency across the three subscales (α’s = .89–.93; OCCWG, 2005). Criterion, convergent, and divergent validity have also been shown to be good (OCCWG, 2005). In the current study, the OBQ-44 exhibited excellent internal consistency (α = .96), and was administered to examine condition differences on reported obsessive beliefs.

2.2.3. Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995)

The DASS-21 is a 21-item measure assessing the severity of possible symptoms of depression, anxiety, and stress (three subscales). Items are rated on a four-point scale ranging from 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”). The DASS-21 has been shown to have good-to-excellent internal consistency in both clinical and community samples (α’s = .87–.94; Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005), as well as good convergent and divergent validity (Crawford & Henry, 2003; Henry & Crawford, 2005; Lovibond & Lovibond, 1995). In the current study, the DASS-21 exhibited excellent internal consistency (α = .96), and was administered to examine condition differences on reported symptoms of depression, anxiety, and stress.

2.2.4. Internal-External Questionnaire, Adapted Self-Control Subscale (IEQ-SC; Reid & Ware, 1974; Tiggemann & Raven, 1998)

The IEQ-SC is an 8-item measure that assesses fears of losing control (e.g., doubts about being able to control one’s impulses, desires, and emotional behaviour). Items are rated on a seven-point scale ranging from 1 (“Doesn’t apply to me at all”) to 7 (“Always applies to me”). The IEQ-SC has been shown to have excellent internal consistency (α’s = .94–.95; Froyech, Vartanian, Grisham, & Touyz, 2016; Tiggemann & Raven, 1998) and convergent validity (Tiggemann & Raven, 1998). Items include, “I worry that something I cannot do is have complete mastery over all my behavioural tendencies” and, “I fear that there will be moments when I cannot subdue my emotions and keep them in check”. In this study, the IEQ-SC exhibited excellent internal consistency (α = .90), and was administered to examine condition differences on reported levels of fear of losing control.

2.2.5. Feedback questionnaire

Participants completed a manipulation check questionnaire following the bogus EEG session under the guise of providing the laboratory with feedback about the new EEG device. It was necessary to assess the efficacy of the experimental manipulation in this way to minimize suspicions about the true purpose of the study. Among several buffer items, participants were asked the following question: “On a scale from 0 to 100, do you believe it is possible for you to lose control over your thoughts and behaviour?” This item was used to assess the degree to which participants believed the false feedback about the possibility that they may lose control over their thoughts and behaviour, which was provided following the EEG session (i.e., participants in the HLC condition should believe they are more likely to lose control over their thoughts and behaviour compared to participants in the LLC condition).

2.2.6. Checking behaviour

Participants completed a computerized task asking them to control the pace of pictures appearing by trying different combinations of eight specific keys (adapted from Reuven-Magil et al., 2008; see Procedure for details). More precisely, participants were asked to try to make the pictures disappear as quickly as possible, before the pictures eventually disappeared on their own. In reality, they were presented with a pre-programmed series of pictures that elicited various degrees of control. Participants were told they could press the space bar at any time between each picture to check again which eight keys they should be using to control the pace of the pictures. The number of space bar presses was used as an index of checking behaviour.

2.2.7. Computer task ratings

Following the computer task, participants were asked to rate their desire for control over the pictures of the task: “On a scale from 0 to 100, how motivated were you to control the pictures?” They were also asked to rate their sense of control over the pictures of the task: “On a scale from 0 to 100, did it feel like you were the one controlling the pictures in general?” These questions were asked to assess participants’ perceived and desired level of control over the computer task’s pictures (as well as compute control mismatch scores) and to better understand the motivation behind checking behaviour during the computer task.
2.2.8. Credibility ratings
At the end of the protocol, participants were asked to rate the credibility of the experimental manipulation by answering two questions: “On a scale from 0 to 100, did you believe your brain waves were monitored during the EEG session?” and “On a scale from 0 to 100, did you believe the feedback provided following the EEG session regarding your capacity at being in control?” These questions were asked to ensure the experimental manipulation worked properly and was credible, and verify whether there were significant differences between the two conditions with regard to the believability of the false feedback.

2.3. Procedure
Participants were told they were participating in a study examining the associations between normal intrusive thoughts and the capacity to stay in control of one’s thoughts and behaviour as assessed by a brain activity device that captures frontal lobe brain waves. Following the informed consent process, participants were asked to report demographic information such as age, sex, ethnicity, and educational attainment.

Then, participants were told they would undergo an EEG recording session focusing on frontal lobe activation and that a device would monitor their ability to inhibit their thoughts. They were also told that the results would predict the extent to which they might lose control over their thoughts and behaviour. The EEG session was actually bogus and used to experimentally manipulate beliefs about losing control. In the current study, participants wore a NeuroSky® Mindwave™ Mobile EEG headset. To ensure the manipulation was believable, participants were asked to read a laminated brochure with realistic yet false information about the EEG device and how it records inhibitory capacities. Moreover, participants were asked to follow specific instructions to ‘calibrate’ the device to, once again, increase the believability. Specifically, they were asked to blink their eyes at specific moments (and they would see the NeuroSky® program detect their eye blinks) and to focus their attention on a specific stimulus (and they would see their attention level increasing on the screen). Afterwards, participants were instructed to inhibit any visual intrusive thoughts they would have for the next ten minutes, and to only allow themselves to have verbal intrusive thoughts (adapted from Rassin, Merckelbach, Muris, & Spaan, 1999). The experimenter pretended to activate the EEG software and, toward the end of the EEG session, randomly assigned participants to one of the two conditions.

Participants in the HLC condition were told the following: “Based on the EEG software, it appears that you were not very good at inhibiting your intrusive thoughts compared to a normative sample. People with results like yours are at a greater risk of losing control over their thoughts and over their behaviour in a variety of contexts, such as in anxiety-provoking situations. You may have noticed yourself that when you are nervous, like during an exam, your mind starts wandering or losing control over your thoughts and behaviour.” Then, the experimenter showed participants in the HLC condition a bogus graph of ‘their’ below-average performance. This experimental manipulation not only captured a need to control one’s thoughts, but also fostered the idea that losing control over one’s thoughts and behaviour might be possible.

Participants in the LLC condition were told the following: “Based on the EEG software, it appears that you were very good at inhibiting your intrusive thoughts compared to a normative sample. People with results like yours are usually good at staying in control of their thoughts and of their behaviour in a variety of contexts, and even in anxiety-provoking situations. You may have noticed yourself that even when you are nervous, like during an exam, you usually find the answer to a question right away and your mind stays on task while you answer. Again, it appears that you are less likely than others to lose control over your thoughts and behaviour.” Then, the experimenter showed participants in the LLC condition a bogus graph of ‘their’ above-average performance. All participants completed a bogus feedback questionnaire—which included a manipulation check question—under the guise of providing comments about the new EEG device (see Measures).

Afterwards, participants were told they would complete a computer task (adapted from Reuven-Magrill et al., 2008) to assess a number of cognitive skills. During the task, they were presented with a series of pictures and were instructed to try to control the pace of the pictures by finding the right combinations of eight specific keys: “m”, “n”, “y”, “d”, “p”, “r”, “t”, and “q”. In other words, participants were asked to try to shorten the presentation time of the pictures, before they eventually disappeared on their own. They were also told that combinations should contain three to eight letters. In reality, the presentation time of each picture was pre-programmed to elicit various degrees of control. Forty neutral pictures (e.g., furniture, clothing, accessories) were presented. Each picture was presented for 2–5 s, followed by a white screen with a blue plus (+) sign. Each trial lasted 6 s, meaning that the white screen with the blue plus (+) sign could be presented for a duration of 1–4 s. For the first 20 pictures, the presentation time of the pictures gradually increased from 2 to 5 s. For the last 20 pictures, the presentation time gradually decreased from 5 to 2 s, as a way to increase perceived control for all participants. Indeed, previous work on illusion of control (Presson & Benassi, 2003; Reuven-Magrill et al., 2008) noted that gradually decreasing the presentation time of the pictures provided participants with false positive feedback about their performance, such that they slowly started noticing and believing that they were able to make the pictures disappear faster than before (as instructed). The experimenter reminded participants they could press the space bar at any time between each picture to check again which keys they should be using to control the pace of the pictures (i.e., checking behaviour). Pressing the space bar did not impact the presentation time of the pictures in any way. Following the task, all participants completed ratings of their desire for control and sense of control over the task’s pictures (see Measures).

At the end of the protocol, participants were asked to complete a series of well-validated and frequently used questionnaires, which included two credibility ratings (see Measures for the complete list). Finally, participants were fully debriefed and a second consent form was given so they could consent to the use of their data after hearing about the deception.

3. Results
3.1. Data screening
There were two univariate outliers on the main dependent variable (i.e., checking behaviour). Based on Tabachnick and Fidell (2007) guidelines, each outlying score was replaced with the next highest score within 3.29 SD of the mean for this variable. The data were assessed for normality, and were found to have acceptable skewness and kurtosis on most variables (Kline, 2009), except for age, which was positively skewed (2.59, SE = .21) and leptokurtic (7.00, SE = .42), and for checking behaviour, which was positively skewed (2.04, SE = .21) and leptokurtic (3.78, SE = .42). Such findings were expected given the nature of the sample and the computer task’s instructions (i.e., checking which keys should be used to control the pace of the pictures was not mandatory but only proposed in the instructions).

3.2. Manipulation check
To ensure the experimental manipulation was effective in producing different degrees of beliefs about losing control between the two conditions, an independent samples t-test was conducted using the manipulation check rating as the dependent variable. As expected, there was a significant difference between the two conditions, t(131) = 3.11,
Table 2
Mean scores and standard deviations by condition on experimental variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>LLC</th>
<th>SD</th>
<th>HLC</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulation check</td>
<td>53.83</td>
<td>25.76</td>
<td>67.42</td>
<td>24.63</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Checking behaviour</td>
<td>5.33</td>
<td>7.64</td>
<td>9.55</td>
<td>13.02</td>
<td>.02</td>
</tr>
<tr>
<td>Desire for control</td>
<td>74.15</td>
<td>21.92</td>
<td>63.33</td>
<td>29.72</td>
<td>.02</td>
</tr>
<tr>
<td>Sense of control</td>
<td>30.89</td>
<td>25.42</td>
<td>31.46</td>
<td>25.69</td>
<td>.90</td>
</tr>
<tr>
<td>Control mismatch</td>
<td>-43.26</td>
<td>31.59</td>
<td>-32.54</td>
<td>28.46</td>
<td>.04</td>
</tr>
<tr>
<td>Task credibility</td>
<td>79.73</td>
<td>25.00</td>
<td>82.90</td>
<td>21.59</td>
<td>.14</td>
</tr>
<tr>
<td>Feedback credibility</td>
<td>75.52</td>
<td>26.18</td>
<td>68.28</td>
<td>31.46</td>
<td>.26</td>
</tr>
</tbody>
</table>

Note. Control mismatch scores (i.e., discrepancy between one’s sense of control and desire for control) were computed by subtracting reported desire for control scores from reported sense of control scores (with more negative discrepancies indicating a more pronounced control mismatch). LLC = low beliefs about losing control condition. HLC = high beliefs about losing control condition.

*p < .05.
**p < .001.
* n = 66.
* n = 67.

p < .001, d = .54, such that participants in the HLC condition believed to a greater extent that losing control over their own thoughts and behaviour was possible, as compared to participants in the LLC condition (see Table 2 for means and standard deviations).

3.3. Checking behaviour

An independent samples t-test was conducted to assess condition differences on the main dependent variable (see Fig. 1). As hypothesized, there was a significant difference between the two conditions, t(106.95) = 2.28, p = .02, d = .44, such that participants in the HLC condition (M = 9.55, SD = 13.02) checked significantly more often which keys they should use to control the pace of the pictures during the computer task (i.e., greater number of space bar presses), as compared to participants in the LLC condition (M = 5.33, SD = 7.64).

3.4. Computer Task Ratings

Independent samples t-tests were conducted to examine condition differences on reported desire for control and sense of control over the computer task’s pictures. There was a significant difference between the two conditions on desire for control, t(121.42) = −2.39, p = .02, d = .43; surprisingly, following the computer task, participants in the HLC condition reported a lower desire for control over the task’s pictures, as compared to participants in the LLC condition. However, there were no significant differences between the two conditions on reported sense of control over the pictures, t(131) = .13, p = .90, d = .02. By subtracting reported desire for control scores from reported sense of control scores, control mismatch scores were computed (with more negative discrepancies indicating a more pronounced control mismatch). An independent samples t-test was conducted to assess condition differences on this computed variable. There was a significant difference between the two conditions, t(131) = 2.06, p = .04, d = .36. Following the computer task, participants in the HLC condition were reportedly experiencing a more adaptive (i.e., less pronounced) control mismatch toward the pictures, as compared to participants in the LLC condition (see Table 2 for means and standard deviations of desire for control, sense of control, and control mismatch scores).

3.5. Checking behaviour and desire for control

Because desire for control scores were in the unexpected direction (see Computer Task Ratings), a zero-order Pearson’s correlation was conducted to assess whether checking behaviour during the computer task predicted desire for control scores reported following the task. A significant moderate negative correlation between checking behaviour and desire for control was found, r(131) = −.30, p < .001, such that the more participants in the whole sample checked during the task, the lower their desire for control over the pictures was following the task.

3.6. Credibility ratings

Independent samples t-tests were conducted to examine potential condition differences on both credibility ratings of the manipulation. As expected, there were no significant differences between the two conditions on the first, t(131) = .78, p = .44, d = .14, or second, t(127.46) = −1.44, p = .15, d = .26, credibility checks, such that participants in both conditions believed to a similar degree that their brain waves were monitored during the bogus EEG session, and believed to a similar degree the false feedback provided following the EEG session (see Table 2 for means and standards deviations).

4. Discussion

This research examined an expanded view of a well-established belief domain—namely, beliefs about control over thoughts—which, according to cognitive theory, has been posited to contribute to the aetiology and maintenance of OCD symptoms (e.g., OCCWG, 1997). Nonetheless, mixed correlational evidence (e.g., Myers et al., 2008; OCCWG, 2003, 2005) and the absence of experimental data supporting such specific links between these beliefs and OCD symptomatology led us to expand on beliefs about control by integrating aspects of losing control into their conceptualization. More precisely, the causal relationship between beliefs about a potential loss of control over one’s thoughts and behaviour and actual checking was experimentally examined. We also aimed to foster a better understanding of the motivation behind checking behaviour by assessing desire for control and sense of control over neutral visual stimuli during a computer task, following the experimental manipulation. As expected, we found that participants provided with negative feedback about the possibility that they might lose control over their thoughts and behaviour (i.e., high beliefs about losing control) checked significantly more often which keys they should be using to control the pace of the pictures during the subsequent computer task, as compared to participants provided with positive feedback (i.e., low beliefs about losing control). Surprisingly, following the task, participants in the HLC condition reported a significantly lower desire to control the pace of the pictures, as opposed to participants in the LLC condition. Furthermore, reported levels of perceived control over the pace of the pictures did not significantly differ.

Fig. 1. Mean number of space bar presses (i.e., checking behaviour) during the computer task by condition. LLC = low beliefs about losing control condition. HLC = high beliefs about losing control condition. *p < .05.
between the two conditions. We also found that participants in the HLC condition experienced a significantly more adaptive (i.e., less pronounced) control mismatch toward the computer task’s pictures, as compared to participants in the LLC condition. However, as described below, participants were asked to report their desire for control over the pictures after engaging in checking behaviour, which may have influenced ratings. In support of this hypothesis, a significant negative correlation was found between checking behaviour (during the computer task) and desire for control over the pictures (reported following the computer task), which may indicate that compulsions are seen as opportunities to re-adjust one’s desire for control and potentially alleviate a control mismatch. Still, reported sense of control over the pictures did not differ between conditions, which was most likely an artifact and limitation of the computer task. Having eight keys to choose from to ‘control’ the pictures decreased the probability of producing combinations that could consistently match the pre-programmed pattern of pictures.

Overall, these findings support the notion that believing in the possibility of losing control over one’s thoughts and behaviour can lead to the development of checking behaviour—one of the most common compulsions in OCD (Ball et al., 1996; Rachman & Hodgson, 1980). This is in line with recent research by Froreich et al. (2016) who reported a positive association between the fear of losing control and OCD symptoms in a non-clinical sample. Results from the current study are also supported by anecdotal reports of individuals with OCD who exhibit concerns about a potential loss of control (e.g., Carr, 1974; Clark & Purdon, 1993; McFall & Wollersheim, 1979; Reuven-Magril et al., 2008) and by Sanavio (1988) Padua Inventory, which includes “urges and worries of losing control over motor behaviors” as one of the four factors.

Interestingly, it seems that asking participants to report their desire for control over the pictures following the computer task might have influenced scores in the unexpected direction. Indeed, participants in the HLC (versus LLC) condition engaged in significantly more checking during the computer task and reported a significantly lower desire for control over the pictures (and a significantly more adaptive control mismatch) once the task was over. Results also showed that, for the whole sample, greater checking behaviour during the task predicted a lower desire for control over the pictures following the task. Previous work by Braith, McCullough, and Bush (1988) has shown that a fear of losing control (during a relaxation session) was associated with a greater desire for control following the relaxation session. Perhaps permitting participants to engage in checking behaviour in the current study allowed them to re-establish their perceptions of control and, accordingly, alleviate a previously inflated desire for control. This hypothesis is in line with theories proposing that individuals with OCD see uncontrollable life events as unbearable and threatening (e.g., McLaren & Crowe, 2003), and compensate by redirecting their control attempts toward repetitive actions and thoughts (i.e., controlling by proxy; Radomsky & Rachman, 2004; Reuven-Magril et al., 2008). Based on the findings, such control attempts (e.g., repetitive checking) may potentially lessen one’s desire for control and appease discrepancies between perceived and desired levels of control (i.e., control mismatch). The fact that such results were found using neutral and non-threatening pictures further supports the suggestion that control attempts may foster repeated mundane and everyday actions like hand washing (Reuven-Magril et al., 2008), arranging, and ordering (Radomsky & Rachman, 2004). This is in line with previous research showing that individuals with OCD report greater perceived responsibility for harm even in non-threatening situations, as compared to control participants (Foà, Amir, Bogert, Molnar, & Przeworski, 2001; Lopata & Rachman, 1995).

No study is without limitations and the current research is no exception. First, the use of a non-clinical undergraduate sample, mainly composed of females, limits the generalizability of findings. Still, cognitive domains relevant to OCD and other psychopathologies are thought to fall on a continuum in the general population (e.g., Abramowitz et al., 2014; Gibbs, 1996) and may be studied experimentally and psychometrically at the lower end of this continuum (e.g., Abramowitz et al., 2014; Alcolado & Radomsky, 2011; Froreich et al., 2016; Gelfand & Radomsky, 2013; Gibbs, 1996; Ladouceur et al., 1997; Moulding & Kyrios, 2007; Tolin et al., 2003). Second, there is a possibility that the negative feedback provided during the manipulation impacted participants’ mood, which may have affected motivation and checking behaviour. However, checking during the computer task did not impact the presentation time of the pictures in any way and participants were well aware that the pictures would eventually disappear on their own, even without pressing any keys. Therefore, the sole purpose of checking was to ensure that the correct keys were being used to make the pictures disappear faster than they would on their own. In this way, a lack of motivation would have most likely resulted in fewer checking attempts and key presses in general. Third, there were no pre-task ratings of participants’ desire for control over the pictures, which restricts firm conclusions about the impact of compulsions on control cognitions. That said, repeating questions on a specific concept might have given rise to the purpose of the study and/or biased subsequent ratings. Fourth, participants were not queried about their knowledge of EEG devices, such that some participants may have found the manipulation less credible because of their own experience with brain activity equipment. Finally, despite non-significant differences between conditions on credibility checks, mean scores of these variables had relatively high standard deviations, such that some participants, in both conditions, did not fully believe the bogus aspects of the study. Five participants reported a score of zero on at least one of the two credibility checks, whereas no participant reported a score of zero on the manipulation check.

Despite limitations, this study employed an original laboratory-based methodology to experimentally manipulate beliefs about losing control. EEGs and other related techniques such as brain imaging devices have been utilized in past psychology research as tools for experimental manipulations, and have been quite effective (e.g., Olson, Landry, Appourchaux, & Raz, 2016; Rassin et al., 1999). Our design allowed the demonstration of a direct causal association between a control-related belief domain and checking behaviour, in a sample of non-clinical participants. Previous correlational studies (e.g., Moulding & Kyrios, 2007) had suggested that control cognitions were not related to checking compulsions, as opposed to contamination symptoms, which shows again an advantage of experimental designs. Critically, the manipulation in the present experiment was found to influence checking behaviour, as opposed to urges to check. Behavioural responses are much harder to observe in experiments and laboratory settings; therefore, a majority of studies have focused on urges instead (e.g., Alcolado & Radomsky, 2011; Cuttier, Sirotos-Delise, Alcolado, Radomsky, & Taylor, 2013; Lopata & Rachman, 1995).

Future research should examine the role of beliefs about control over thoughts and, importantly, about losing control over a range of domains (e.g., thoughts, behaviour, emotions, bodily functions) in OCD and related problems by employing more ecologically valid manipulations and methods. Because contamination symptoms and control cognitions have been shown to be tightly associated (e.g., Gelfand & Radomsky, 2013; Moulding & Kyrios, 2007), washing and cleaning tasks could be utilized to examine perceptions of control over germs following a manipulation of beliefs about losing control. To foster a better understanding of the causal relationship between control

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1 We repeated relevant analyses after removing five participants who provided a score of zero on at least one of the two credibility checks. This did not change any of the findings reported above: the manipulation check variable produced significant condition differences with p < .001; the checking behaviour, desire for control, and control mismatch variables produced significant condition differences with p < .05; and there were no significant differences in sense of control, task credibility, or feedback credibility variables with p > .10.
cognitions and checking behaviour, future work should compare how perceived and desired levels of control vary depending on whether participants are allowed (versus not allowed) to engage in neutralizing behaviour. In addition, psychometric analyses will be extremely important to understand basic associations between beliefs about losing control and other variables, such as OCD symptoms, anxiety, and other aspects of control-related cognition.

Researchers have previously identified maladaptive beliefs maintaining obsessive symptoms (e.g., Alcolado & Radomsky, 2011; Carr, 1974; Chiang, Purdon, & Radomsky, 2016; McFall & Wollersheim, 1979; OCCWG, 1997, 2001, 2003, 2005; Rachman, 1993, 1997; Salkovskis, 1985), and results of the present study support the broadening of beliefs about control over thoughts in current cognitive models of OCD (e.g., Rachman, 1997, 1998, 2002; Salkovskis, 1985, 1999). This would allow for a more comprehensive understanding of the disorder, improved case conceptualizations of patients and, ideally, better treatment outcomes. Because changes in beliefs have been shown to cause reduction in symptoms (e.g., Adams et al., 2012; Alcolado & Radomsky, 2016; O’Connor et al., 2005; Solem et al., 2009; Wilhelm et al., 2015; Woody et al., 2011), aspects of losing control should potentially be targeted more thoroughly when addressing beliefs about control over thoughts during CBT. Although effective psychological and pharmacological treatments already exist for OCD (Abramowitz, 2006; National Institute for Health & Clinical Excellence, 2005), improvements are essential given the high number of individuals left unwell post-treatment (e.g., Foa et al., 2005; van Oppen, van Balkom, de Haan, & van Dyck, 2005). At this early stage, both research with ecologically valid methods and intervention studies are warranted before proposing concrete treatment strategies. Still, behavioural experiments (and other cognitive restructuring techniques) challenging negative beliefs about losing control over one’s thoughts and/or behaviour could be assessed, and their efficacy could be empirically tested in future research. For example, to target beliefs about losing control over one’s behaviour, patients could be asked to compare the number of times they actually lost control when walking around with (versus without) a knife in their pocket. Clinically-oriented research could have implications for other anxiety-related problems and mental disorders that are also marked by fears of losing control, such as panic disorder (American Psychiatric Association, 2013; Clark et al., 1997; Clark, 1986), social anxiety disorder (Mattick & Clarke, 1998; Turner, Beidel, Dancu, & Keys, 1986), anorexia nervosa (Pyle, Neuman, Halvorson, & Mitchell, 1991), bulimia nervosa (Fairburn & Garner, 1986; Tiggemann & Raven, 1998), and binge eating disorder (Bennett & Dodge, 2007; Colles, Dixon, & O’Brien, 2008).

4.1. Summary

This research provided evidence for integrating aspects of losing control into control-related belief domains already included in current cognitive formulations of OCD (e.g., OCCWG, 1997). Specifically, in an undergraduate student sample, it was shown that believing in the possibility of losing control over one’s thoughts and behaviour caused repeated checking, a common compulsion in OCD (Ball et al., 1996; Rachman & Hodgson, 1980). It was also found that greater checking behaviour predicted a lower desire for control, indicating that individuals with OCD may perceive compulsions as opportunities to temporarily re-balance disrupted control cognitions such as an inflated desire for control (Radomsky & Rachman, 2004; Reuven-Magril et al., 2008). Results supported the possibility of targeting beliefs about losing control during CBT.

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Contributors

Jean-Philippe Gagné and Adam S. Radomsky designed the study and wrote the protocol. Jean-Philippe Gagné conducted literature searches and the statistical analyses and wrote the first draft of the manuscript, which was revised by Adam S. Radomsky. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

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