Towards improving treatment for childhood OCD: Analyzing mediating mechanisms & non-response

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Chapter 5

Mediating mechanisms in cognitive behavioral therapy for childhood OCD: The role of dysfunctional cognition

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Abstract

It is generally assumed that restructuring dysfunctional cognitions is important for treating OCD. However, to date there hardly is any empirical support for this assumption, especially for childhood OCD. The aim of the present study was to examine whether changing dysfunctional beliefs is a mediating mechanism of cognitive behavioral therapy (CBT) for children and adolescents with OCD. Methods: Fifty-eight children and adolescents (8–18 years) with a primary diagnosis of OCD received 16 weekly sessions of CBT. Dysfunctional beliefs (OBQ-CV) and OCD severity (CY-BOCS) were measured pre-treatment, mid-treatment, post-treatment, and at 16-week follow-up. Results showed that both OCD severity and dysfunctional beliefs decreased during CBT. Furthermore, changes in OCD severity predicted changes in dysfunctional beliefs within the same time interval. We did not find that changing dysfunctional beliefs is a mediating mechanism in CBT, which indicates that cognitive restructuring procedures may be no necessary component in treatment for OCD in children and adolescents.
Introduction

A substantial number of children and adolescents suffer from obsessive-compulsive disorder (OCD) with prevalence estimates varying between 1–2% (Geller et al., 2012). Untreated, OCD often disrupts family, academic and social functioning and leads to serious impairment in children's psychosocial development (Piacentini, Bergman, Keller, & McCracken, 2003; Valderhaug & Ivarsson, 2005). The first-line treatment for youth with OCD is cognitive behavioral therapy (CBT) (Geller et al., 2012). Several studies have shown that CBT is moderately effective for childhood OCD with mean symptom reduction rates varying between 40–65% (e.g., Barrett, Healy-Farrell, & March, 2004; Bolton & Perrin, 2008; De Haan, Hoogduin, Buitelaar, & Keijsers, 1998; Freeman et al., 2008; The Pediatric OCD Treatment Study (POTS) Team, 2004). This indicates that a substantial number of children still have complaints after standard treatment.

An important step in the process of developing more effective and efficient treatment protocols is to establish the therapeutic mechanisms of change (e.g., Kazdin & Nock, 2003). However, despite the considerable number of CBT efficacy studies, the theoretical models on which CBT is based are seldom evaluated in children and adolescents and the active mechanisms of change are unknown.

In cognitive theories about the development and maintenance of OCD it is assumed that dysfunctional beliefs about normal intrusions are the core problem in OCD. Patients with OCD are assumed to interpret intrusions – in itself harmless thoughts – as potentially dangerous or predicting harm, resulting in anxiety and distress. Consequently, compulsive behaviors are performed in an attempt to prevent harm and neutralize anxiety. Cognitive models on OCD have become widespread since the publication of Salkovskis in 1985, who emphasized especially the role of inflated responsibility beliefs. Salkovskis proposed that treatment should be aimed at the modification of these dysfunctional beliefs. From that time on, research and treatment of OCD have been strongly influenced by cognitive models and several OCD-related dysfunctional beliefs have been identified and classified in six domains: inflated responsibility, overestimation of threat, overestimation of the importance of thoughts, beliefs about the importance of controlling one’s thoughts, intolerance of uncertainty, and perfectionism (Obsessive Compulsive Cognitions Working Group (OCCWG), 1997).
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There is ample evidence that such beliefs are associated with OCD in adults (for an overview see Frost & Steketee, 2002). Several studies showed a relation between dysfunctional beliefs and obsessive-compulsive (OC) symptoms in children (e.g., Barrett & Healy-Farrell, 2003; Bolton, Dearsley, Madronal-Luque, & Baron-Cohen, 2002; Evans, Milanak, Medeiros, & Ross, 2002; Farrell & Barrett, 2006; Libby, Reynolds, Derisley, & Clark, 2004; Magnúsdóttir & Smári, 2004; Mather & Cartwright-Hatton, 2004; Matthews, Reynolds, & Derisley, 2007; Muris, Meesters, Rassin, Merckelbach, & Campbell, 2001; Reeves, Reynolds, Coker, & Wilson, 2010; Ye, Rice, & Storch, 2008). In other studies results were mixed (Barrett & Healy-Farrell, 2003; Verhaak & De Haan, 2007; Wolters et al., 2011; Wolters et al., 2012).

However, studies showing a relation between dysfunctional beliefs and OC symptoms cannot reveal whether such beliefs cause OC symptoms. These beliefs could also be a consequence of OC symptoms, or co-occurring. With regard to children, two experimental studies have been conducted to examine whether dysfunctional beliefs and OC symptoms are causally related. It was hypothesized that an experimental manipulation of the child’s perceived responsibility would affect OC symptoms. These studies yielded mixed results (Barrett & Healy-Farrell, 2003; Reeves et al., 2010). For child as well as for adult samples, the question whether dysfunctional beliefs play a causal role in OCD is still unanswered.

A causal relation between dysfunctional beliefs and OC symptoms can also be demonstrated by analyzing whether changing dysfunctional beliefs is a mediating mechanism in treatment for OCD. To demonstrate mediation, a change in the mediator variable should precede a change in the outcome. Therefore, a repeated measurements design is necessary (Kazdin & Nock, 2003). Most treatment studies rely on a pre-post test design, which is not suitable for testing mediation. To the best of our knowledge, up to now only one child study used a repeated measurements design to examine whether changes in dysfunctional cognitions were associated with treatment effect. In this pilot study, Williams and colleagues (2002) followed six adolescents with OCD during the course of cognitive therapy (CT). Each session participants completed questionnaires about their OC symptoms and responsibility beliefs. Results showed that dysfunctional beliefs changed during CT. Furthermore, changes in dysfunctional beliefs and OC symptoms were related, as decreases in responsibility beliefs were associated with decreases in OC symptoms.
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(based on visual inspection and a correlation coefficient of .92–.95) (Williams, Salkovskis, Forrester, & Allsopp, 2002). However, temporal precedence was not demonstrated, and the direction of the relation between changes in dysfunctional beliefs and OC symptoms remained unclear.

Repeated measurements designs have been used in adult OCD studies to examine the role of cognitions in C(B)T (Anholt et al., 2008; Polman, Bouman, Van Geert, de Jong, & Den Boer, 2011; Rheaume & Ladouceur, 2000; Storchheim & O’Mahony, 2006; Woody, Whittal, & McLean, 2011). These studies have yielded equivocal results: changes in dysfunctional beliefs and OC symptoms can occur in tandem (e.g., Storchheim & O’Mahony, 2006), changes in beliefs may precede changes in compulsions (Rhéaume & Ladouceur, 2000), changes in beliefs or obsessions may follow changes in compulsions (Anholt et al., 2008; Rhéaume & Ladouceur, 2000), and beliefs and compulsions can also change in opposite directions (Polman et al., 2011). In addition, there may be individual differences in mediating mechanisms during treatment (Polman et al., 2011; Rheaume & Ladouceur, 2000). In conclusion, to date the relation between dysfunctional beliefs and OC symptoms is unclear.

The aim of the present study was to examine whether changing dysfunctional beliefs is a mediator of treatment outcome in CBT for children and adolescents with OCD. The study is a randomized waitlist controlled trial. Treatment, consisting of 16 weekly sessions CBT, was representative of treatment conducted in clinical practice in the participating centers. All patients were medication-free and had not recently received CBT for OCD. Dysfunctional beliefs and OCD severity were measured pre-treatment, mid-treatment, post-treatment and at 16-week follow-up. It was examined whether changes in dysfunctional beliefs preceded changes in OCD severity, whether changes in beliefs were a consequence of changes in OCD severity, or whether the relation was bidirectional. Based on cognitive models, we expected cognitive changes to precede changes in OCD severity.

Method

Design and procedure

The present study is part of a larger trial intended to study psychological and neurobiological processes and treatment in childhood OCD. The trial was
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approved by the Medical Ethics Committee of the Academic Medical Center (MEC 06/053), and registered in the Dutch Trial Register (NTR 717, ISRCTN 07851536). Participants were children and adolescents (8–18 years) who were referred for treatment of OCD to an academic centre for child and adolescent psychiatry (the Bascule, Amsterdam, n = 50; Curium, Leiden, n = 3; Accare, Groningen, n = 5), or a mental health care agency (Altrecht, Utrecht, n = 3). Inclusion criteria were a primary diagnosis of OCD according to DSM-IV TR criteria, complaints for at least six months, and a score of 16 or more on the Children’s Yale-Brown Obsessive Compulsive Scale (CY-BOCS; see below). Exclusion criteria were medication for OCD (SSRI, TCA or antipsychotic medication), CBT for OCD during the past six months, IQ below 80, and psychosis. During intake OC complaints and other psychiatric symptoms were evaluated by senior clinicians. A semi-structured interview (Anxiety Disorder Interview Schedule for DSM-IV - Child and Parent Version (ADIS-C/P); Silverman & Albano, 1996a, 1996b) was administrated to the child and parents independently by trained clinicians. IQ above 79 was indicated by a mean raw score ≥ 6 on the subtests Block design and Vocabulary of the Wechsler Intelligence Scale for Children (WISC-III; Kort et al., 2005), or – when available – a total IQ score. After informed consent was obtained, participants were randomly assigned to the active treatment condition (individual CBT) and the eight-week waitlist condition followed by CBT (50% waitlist, 50% CBT). Randomization was accomplished by the first author using a computer program with site, age (8–11 vs 12–18 years) and gender as stratification factors. Children and their parents were immediately informed about the outcome. CBT did not differ across conditions. To compensate for the waitlist condition, children who were referred for treatment of OCD were taken off from the natural waitlist of the institution between referral and intake and were immediately invited for an intake appointment. Additional waiting time due to the waitlist condition was thereby confined to a minimum.

Participants
Between January 2007 and June 2010, 73 children were screened for eligibility in the study and 61 children (84%) were included. Forty-four children were randomized: 24 children were allocated to the waitlist condition, 20 children to the immediate treatment condition. Seventeen children were not randomized because a waitlist could not be justified on ethical grounds because of severity of complaints (n = 7), or due to practical problems (n = 10) such as children...
were already in treatment for other problems or had already waited for a
considerable period before the intake procedure. Two children dropped out at
the first assessment (T0 and T1) because their OCD complaints were reduced
significantly and were in remission. As they did not meet inclusion criteria at
the first assessment, they were excluded from analyses. One child dropped
out at the pre-treatment assessment because he was not able to visit the clinic
due to family circumstances. As he had not received CBT and no pre-treatment
assessment was available, he was also excluded from analyses.

A total of 58 children (the waitlist condition, the immediate CBT condition,
and the non-randomized group combined) received CBT, and 46 children (79%) 
completed the full 16 sessions. Three children dropped out at session eight or
earlier as they reported no complaints anymore and treatment was ended,
four children dropped out because they were not able or unwilling to visit the
clinic, two children dropped out due to referral to inpatient treatment for OCD
and/or co-morbid problems, for one child medication was added to CBT, and
two children dropped out because OC symptoms were in remission before the
16th treatment session and they went over to treatment for other problems.
Forty-three children completed the 16-week follow-up (T4) assessment: 41 of
the 46 treatment completers and two children for whom treatment was ended
at session eight because complaints were in remission at that time (see Figure
1 for the flow chart). The trial was ended because the intended number of
participants was reached.
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Figure 1. Flowchart

Assessed for eligibility (N=73)
- Excluded (n=12)
  - Not meeting inclusion criteria (n=7)
  - Declined to participate (n=1)
  - Decided not to go in treatment (n=1)
  - Other / reason not reported (n=3)

Included (N=61)

Waitlist (n=24)
- T0: pre-waitlist (n=23)
  - Lost to T0 (n=1)
  - Not meeting inclusion criteria anymore
  - Missing OBQ/CYBOCS (n=4)

Immediate CBT (n=20)
- T1: pre-CBT (n=19)
  - Lost to T1 (n=1)
  - Not meeting inclusion criteria anymore

Not randomised (n=17)
- Severity OCD (n=7)
- Practical reasons (n=10)

Not meeting inclusion criteria anymore
- Missing OBQ/CYBOCS (n=4)

Lost to T0 (n=1)
- Not able to come due to family problems
- Missing OBQ (n=3)

Lost to T1 (n=1)
- Not able to come due to family problems
- Missing OBQ (n=3)

Lost to T2 (n=5)
- Discontinued CBT: no complaints anymore (n=1)
- Failed to turn up at treatment appointments (n=1)
- Refused CBT (n=1)
- Referred to inpatient treatment (n=1)
- Medication added to CBT because unbearable situation at home (n=1)

Lost to T3 (n=5)
- Discontinued CBT, not able to come due to family reasons (n=1)
- Failed to turn up at treatment appointments (n=1)
- Switch of treatment focus to anxiety (n=2)
- Inpatient treatment because of increasing (co-morbid) complaints (n=1)
- Missing data T3 (n=4)
- Missing assessment: discontinued CBT, no OCD anymore (n=2) [back at T4]
- Missing OBQ (n=2)

Lost to T4 (n=5)
- Study drop out (postponed from study, CBT continued) (n=1)
- Inpatient treatment (n=2)
- Organizational reasons (n=2)
- Missing OBQ T4 (n=1)


**Mediating mechanisms in CBT for OCD**

**Treatment**

Treatment consisted of 16 weekly sessions of individual CBT described in the Dutch treatment manual ‘Bedwing je dwang’ (‘Control your OCD’; De Haan & Wolters, 2009). The treatment involves psychoeducation, an inventory and hierarchy of the obsessions and compulsions, exposure with response prevention (ERP), cognitive interventions (CT), and relapse prevention. ERP is introduced early in treatment (second session), followed by and combined with CT (introduced in the second or third session). Several optional cognitive interventions are described in the manual, ranging in complexity from simple (e.g., helping thoughts) to more sophisticated techniques (e.g., probability estimates and an inventory of pros and cons). Therapists were instructed to select the intervention that would most likely fit with a particular child depending on age, intellectual level, interest/motivation, and insight in their complaints. Guidelines for the selection of cognitive interventions are provided in the manual. ERP involved therapist-assisted practice, and exercises at home. Treatment was ended with relapse prevention. Children received a workbook that accompanied the treatment manual. Parents were involved in the therapy. Parent involvement, varying from attending part of some sessions to fully attending each session, was dependent on the child’s developmental level, preferences of the child and the parents, and clinical considerations. Treatment sessions lasted approximately 45–60 minutes. CBT was delivered by master level clinicians certified as cognitive behavioral therapists, and experienced in treating OCD in children. Most therapists had several years experience with this treatment protocol and had been closely associated with its refinement. All therapists were trained in the protocol and had previously treated at least one patient outside the study under supervision of one of the authors (EdH). Therapists attended group supervision every two weeks and optional individual supervision.

*Treatment adherence*

To examine treatment adherence, 25% of the session reports of each participant were evaluated by two independent raters. Raters scored whether the following components had been implemented: psychoeducation, inventory/hierarchy of complaints, ERP, CT, homework exercises, and relapse prevention. Criteria for adequate treatment adherence were: psychoeducation and an inventory of complaints during the first session, ERP and/or CT and homework exercises.
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during session 2–15, and relapse prevention for the last session. For 98.5% of the sessions these criteria were met. Raters agreed for 99% of the session reports, Cohen’s kappa was .75.

**Measures**

The *Anxiety Disorder Interview Schedule* for DSM-IV - Child and Parent Version (ADIS-C/P; Silverman & Albano, 1996a, 1996b) is a widely used, reliable and valid semi-structured interview evaluating prevalence and severity of DSM-IV diagnoses of anxiety disorders, mood disorders, ADHD and disruptive disorders. The ADIS-C/P was administered to parents and children independently by trained clinicians. When children fulfilled the criteria for a particular diagnosis, clinicians rated the severity of the complaints based on internal distress, interference in school, peer relationships, and family life on a nine-point scale ranging from 0 to 8. A clinician severity rating (CSR) of at least four is indicative of a diagnosis. The combined scores were used, i.e., the highest values of the child and the parent interview. To examine inter-rater reliability, interviews were videotaped and 19 interviews (random selection) were rated by two raters independently. Inter-rater reliability (Cohen’s kappa) was .93.

The *Children’s Yale-Brown Obsessive Compulsive Scale* (CY-BOCS; Scahill et al., 1997) is a clinician-rated semi-structured interview evaluating the severity of OC symptoms. The CY-BOCS contains a symptom checklist and a severity scale. The severity scale is divided into an obsession and a compulsion subscale. Each subscale contains five items concerning frequency/time, interference, distress, resistance, and control. Items are rated by the clinician on a five-point scale from 0 to 4. The total score, the sum of both subscales, ranges from 0 to 40. A total score of 16 or more is considered as clinically significant (e.g., The POTS Team, 2004). The CY-BOCS demonstrated good reliability (Cronbach’s $\alpha = .87$) and adequate divergent and convergent validity (Scahill et al., 1997). Cronbach’s $\alpha$ (T1–T4) in the present study ranged from .81 to .96. To examine inter-rater reliability, interviews were videotaped and 46 interviews (random selection) were rated by three raters (investigators and therapists) independently. Inter-rater reliability (intraclass correlation coefficient) was .98.

The Dutch version of the *Obsessive Belief Questionnaire - Child Version* (OBQ-CV; Wolters et al., 2011) was used. The OBQ-CV is a self-report questionnaire about OCD-related dysfunctional beliefs. The questionnaire consists of 44 items representing three subscales: Responsibility/Threat Estimation (RT),
Perfectionism/Certainty (PC), and Importance/Control of Thoughts (ICT). Answers are scored on a five-point scale, ranging from 1 (never) to 5 (always). Higher scores indicate more obsessive beliefs. Cronbach’s alpha of the Dutch version of the OBQ-CV was .95, and test-retest reliability was adequate (Wolters et al., 2011). Cronbach’s α (T1–T4) in the present study ranged from .96 to .98.

**Assessments**

In the waitlist condition, children were assessed pre-waitlist (T0), post-waitlist/pre-treatment (T1), mid-treatment (eight sessions CBT; T2), post-treatment (16 sessions CBT; T3) and at 16-week follow-up (T4). Children allocated to the CBT condition were assessed at T1, T2, T3, and T4. During the assessments the CY-BOCS and the OBQ-CV were administrated. For the purpose of an effectiveness study, additional measures were completed, but these are not further described here.

**Statistical analyses**

The intention-to-treat principle was used for the analyses, unless otherwise mentioned. For missing data at the level of missing items, missing values on the OBQ-CV were replaced by the individual mean of all valid items. The OBQ-CV was considered as missing completely in case of more than five missing items. Cases with missing measures or assessments were compared to complete cases on age, gender, pre-treatment OCD severity (CY-BOCS) and pre-treatment dysfunctional beliefs (OBQ-CV). There were no significant differences between groups. Patterns of missing data were inspected using the Missing Value Analysis (MVA) command and Little’s Missing Completely At Random (MCAR) test in SPSS. Little’s MCAR test did not reach significance. We found no evidence for Missing Not At Random (MNAR). Missing assessments (OBQ-CV, CY-BOCS) were imputed using the expectation-maximization (EM) algorithm in LISREL version 8.8. Fifty-eight participants were included in the analyses.

We investigated the effect of CBT over time using linear mixed model analyses in SPSS 19.0 with time (T1–T4) as independent variable and CY-BOCS/OBQ-CV as dependent variable. Analyses were performed with both an unstructured covariance matrix and an autoregressive heterogeneous matrix. Fit of both models were compared using the -2 log likelihood values. When results reveal no significant difference in fit between models, preference is
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given to the autoregressive heterogeneous matrix as this matrix provides a more parsimonious model.

To examine whether changes in the CY-BOCS and OBQ-CV may be attributed to treatment, we compared the effect of 8 sessions CBT (T1, T2) to 8 weeks waitlist (T0, T1). For the CY-BOCS and the OBQ-CV a mixed design ANOVA was performed with time (pre, post) as within subjects factor and condition (waitlist, CBT) as between subjects factor.

Whether changing dysfunctional beliefs is a mediator of treatment outcome was examined using a series of Latent Different Score (LDS) models. Analyses were conducted with LISREL version 8.8. Model fit was estimated using Maximum Likelihood.

Several models have been proposed to examine change over time (e.g., McArdle, 2009; Plewis, 1996). These models can be classified in three main types: autoregressive (AR) models, latent growth curve (LGC) models, and latent difference score (LDS) models. Moreover, in the last decades several hybrid models have been formulated, such as the Dynamic Latent Difference Score Model (Ferrer & McArdle, 2003) and the Autoregressive Latent Trajectory Model (Bollen & Curran, 2004) which combine features of AR and LGC models. LDS models are recommended for examining within-individual change over time in situations in which change may not be constant for each interval in the model (e.g., Selig & Preacher, 2009). Latent difference score (or ‘gain score’) variables represent the difference between two successive latent true scores. Each latent true score variable is composed of the preceding latent true score and an accumulation of latent changes over time (see Figure 2). Similar to LGC models, LDS models allow for examination of within-individual change as well as individual differences in the within-individual change (McArdle & Hamagami, 2001; Selig & Preacher, 2009). An advantage of LDS models is that trajectories over time are free to vary, which means that there are no restrictions on the nature of change over time, whereas in LGC models these trajectories are described by mathematical formulas. In contrast to AR models, in LDS models changes are not restricted to residual changes. Therefore, LDS models allow for testing dynamic relationships between dysfunctional beliefs and OC symptoms without imposing a particular change mechanism on the data. The Dynamic Latent Difference Score Model (Ferrer & McArdle, 2003) was also taken into consideration. However, in these models change scores are composed of a systematic trend-like component (as in LGC models), and
a component explained by the previous assessments (as in AR models). Both components impose restrictions on change trajectories over time. As we had no specific hypothesis concerning the change trajectories over time of both variables, we preferred the LDS model to study the dynamic interplay between changes in dysfunctional beliefs and OCD severity.

To restrict the number of free parameters in the LDS models, we used the total scores of the OBQ-CV and the CY-BOCS as single indicators, instead of subscale or item scores. We corrected for measurement error by specifying error variances based on the reliability of the scales.\(^6\) Reliability was based on Stratified Alpha (Nunnally & Bernstein, 1994), which is recommended for composite scales (Osburn, 2000). Figure 2 shows a schematic picture of the LDS model.

Several hypotheses were examined using multivariate LDS models. For both the OBQ-CV and the CY-BOCS four time points were included: pre-treatment (T1), mid-treatment (T2), post-treatment (T3), and follow-up (T4). We started with a Baseline Model in which latent changes between dysfunctional beliefs and OC symptoms were unrelated (see panel A in Figure 3). When the Baseline Model is rejected, several hypotheses can be tested concerning the relations between changes in both constructs. First, we tested whether changes in dysfunctional beliefs preceded changes in OCD severity (Lagged Effects Mediation Model). In this model, lagged effects between dysfunctional beliefs at time X on OCD severity at time X+1 were specified (see panel B in Figure 3). Second, we tested for the reversed effect: whether changes in dysfunctional beliefs at time X+1 were the result of changes in OCD severity at time X (Lagged Effects Reversed Model; see panel C in Figure 3). Third, because intervals between successive time points were relatively long (e.g., eight weeks), we also tested a synchronous model. In this model, which is referred to as Synchronous Mediation Model, effects of changes in dysfunctional beliefs at time X on changes in OCD severity at time X were specified (see panel D in Figure 3). It is important to note that a synchronous model does not necessarily imply that effects occur exactly at time X. Instead, the model implies that effects may have occurred somewhere between time X and the previous assessment (Dwyer, 1983). However, synchronous models provide less strong support for mediation than lagged models as the assumption of time precedence for cause-effect relations is not met. Again, we also tested the reversed effect:

\(^6\) Unique variances were calculated by Var(X)*(1-reliability) (Bollen, 1989).
whether changes in OCD severity predicted changes in beliefs within the same time interval (Synchronous Reversed Model; see panel E in Figure 3). Finally, we tested whether there was a bi-directional relation between changes in beliefs and changes in OCD severity (Synchronous Reciprocal Model; see panel F in Figure 3).

Several fit indices were selected to evaluate model fit: the minimum fit function chi-square statistic (Olsson, Foss, & Breivik, 2004), the Akaike Information Criterion (AIC), the Root Mean Square Error of Approximation (RMSEA), and the Comparative Fit Index (CFI). Although the chi-square statistic is often used to evaluate model fit, it has some disadvantages (e.g., the value decreases when parameters are added to the model, and given sufficient power even trivial discrepancies between model and data will lead to rejection of the model). Therefore, we also report the AIC, because this index takes parsimony as well as fit into account (Jöreskog & Sörbom, 1993). Low AIC and chi-square values indicate good model fit. Furthermore, RMSEA values below .06 or .08, and CFI values above .90 or .95, are generally assumed to indicate good fit (Hu & Bentler, 1999; Kline, 2005). The chi-square difference test (the change of $\chi^2$ relative to the change in degrees of freedom) was used to test whether an alternative model leads to a significant improvement with regard to the original model (Kline, 2005).
Figure 2. Schematic picture of the (synchronous reversed) LDS model

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\( Y_1 = \text{OBQ T1} \quad Y_7 = \text{CY-BOCS T7} \quad \xi_1 = Y_1 \)
\( Y_2 = \text{OBQ T2} \quad Y_8 = \text{CY-BOCS T8} \quad \xi_2 = Y_1 - Y_2 \)
\( Y_3 = \text{OBQ T3} \quad Y_9 = \text{CY-BOCS T9} \quad \xi_3 = Y_2 - Y_3 \)
\( Y_4 = \text{OBQ T4} \quad Y_{10} = \text{CY-BOCS T10} \quad \xi_4 = Y_3 - Y_4 \)
\( Y_5 = \text{CY-BOCS T1} \quad \xi_5 = Y_5 \)
\( Y_6 = \text{CY-BOCS T2} \quad \xi_6 = Y_6 - Y_5 \)
\( \xi_7 = Y_7 - Y_6 \)
\( \xi_8 = Y_8 - Y_7 \)
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Figure 3. Schematic picture of the LDS models

A. Baseline Model

B. Lagged Effects Mediation

C. Lagged Effects Reversed

D. Synchronous Mediation

E. Synchronous Reversed

F. Synchronous Reciprocal

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\[ \xi_1 = \text{OBQ T1} \]
\[ \xi_2 = \text{OBQ T2} - \text{OBQ T1} \]
\[ \xi_3 = \text{OBQ T3} - \text{OBQ T2} \]
\[ \xi_4 = \text{OBQ T4} - \text{OBQ T3} \]
\[ \xi_5 = \text{CY-BOCS T1} \]
\[ \xi_6 = \text{CY-BOCS T2} - \text{CY-BOCS T1} \]
\[ \xi_7 = \text{CY-BOCS T3} - \text{CY-BOCS T2} \]
\[ \xi_8 = \text{CY-BOCS T4} - \text{CY-BOCS T3} \]

Sample size

There are no clear guidelines for the required sample size in structural equation modeling, as sample size requirements are affected by many factors, such as model complexity and estimation algorithm (Kline, 2005). Kline recommends a ratio of the number of participants to the number of free parameters of 20:1, or at least a 10:1 ratio. In the LDS models estimated in the present study the
number of free parameters varied between 23 and 27. However, most of these parameters were simple functions of the covariances of the observed variables and therefore not freely estimated. The number of parameters that were freely estimated varied between 3 and 6. Given the low number of structural parameters, the present sample size ($N = 58$) is considered acceptable.

**Results**

**Demographic and clinical characteristics**
Clinical characteristics of the sample are shown in Table 1. Overall, our sample was comparable to samples in other studies (e.g., The POTS Team, 2004). There were no significant differences between the waitlist, CBT and the non-randomized group in baseline characteristics.

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<th>Table 1. Baseline characteristics of participants</th>
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*Note.* There were no significant differences between patients randomized to the waitlist condition, those randomized to the CBT condition, and patients that were not randomized at $p < .05$. 

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**Effect of treatment**

Results of the linear mixed model analysis revealed a main effect of time (T1–T4) on CY-BOCS score, $F(3, 45.88) = 78.72, p < .001$. Table 2 shows the parameter estimates for each measurement compared to baseline (T1). CY-BOCS scores significantly decreased during CBT, there was a trend for a decrease during the 16-week follow-up period.

Results of the linear mixed model analysis revealed a main effect of time (T1–T4) on OBQ-CV score, $F(3, 48.05) = 7.99, p < .001$. Table 3 shows the parameter estimates for each measurement compared to baseline (T1). OBQ-CV scores significantly decreased during CBT, and not during the 16-week follow-up period.

### Table 2. CY-BOCS: parameter estimates compared to baseline (T1)

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>SE b</th>
<th>95% CI</th>
<th>Pairwise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2 (8 sessions CBT)</td>
<td>-6.26</td>
<td>0.84</td>
<td>-7.94; -4.56</td>
<td>T2 &lt; T1 ($p &lt; .001$)</td>
</tr>
<tr>
<td>T3 (16 sessions CBT)</td>
<td>-12.92</td>
<td>1.18</td>
<td>-15.30; -10.54</td>
<td>T3 &lt; T2 ($p &lt; .001$)</td>
</tr>
<tr>
<td>T4 (16-week follow-up)</td>
<td>-14.67</td>
<td>1.00</td>
<td>-16.68; -12.65</td>
<td>T4 &lt; T3 ($p = .10$)</td>
</tr>
</tbody>
</table>

### Table 3. OBQ-CV: parameter estimates compared to baseline (T1)

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>SE b</th>
<th>95% CI</th>
<th>Pairwise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2 (8 sessions CBT)</td>
<td>-7.05</td>
<td>2.41</td>
<td>-11.88; -2.22</td>
<td>T2 &lt; T1 ($p &lt; .01$)</td>
</tr>
<tr>
<td>T3 (16 sessions CBT)</td>
<td>-15.88</td>
<td>3.54</td>
<td>-22.99; -8.77</td>
<td>T3 &lt; T2 ($p &lt; .01$)</td>
</tr>
<tr>
<td>T4 (16-week follow-up)</td>
<td>-14.40</td>
<td>3.21</td>
<td>-20.85; -7.95</td>
<td>T4 = T3 ($p &gt; .05$)</td>
</tr>
</tbody>
</table>

**Waitlist versus CBT**

For the CY-BOCS and OBQ-CV a mixed design ANOVA was performed with time (pre, post) as within subjects factor and condition (waitlist, CBT) as between subjects factor.

Results for the CY-BOCS showed a significant main effect of time, $F(1, 39) = 7.77, p < .01$, and a significant interaction effect between time and condition on the CY-BOCS, $F(1, 39) = 6.05, p < .05$. These results indicate that post-scores differed from pre-scores, and this effect differed across conditions. Parameter estimates showed that while there was no significant difference in CY-BOCS between conditions pre-waitlist/-CBT; at the post-assessment CY-BOCS scores were significant lower for the CBT than for the waitlist condition, $t(40) = 2.30, p < .05, B = 4.07$. 

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Results for the OBQ-CV showed a significant effect of time, $F(1, 39) = 4.87, p < .05$. The main effect of condition and the interaction effect between time and condition did not reach significance. The results indicate that OBQ-CV scores decreased over time, independent of condition (waitlist, or first eight sessions CBT).

**Mediation analysis**

Table 4 shows the means, standard deviations, and correlations between the CY-BOCS and OBQ-CV scores for all assessments (missing values were imputed).

| Table 4. Descriptives of the CY-BOCS and OBQ-CV scores |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | $M$ | $SD$ | $Pearson\ correlation\ (r)$ |
| | CB 1 | CB 2 | CB 3 | CB 4 | OBQ 1 | OBQ 2 | OBQ 3 | OBQ 4 |
| CB 1 | 24.71 | 5.04 |  |  |  |  |  |  |
| CB 2 | 18.43 | 5.93 | .41** |  |  |  |  |  |
| CB 3 | 11.90 | 8.86 | .51** | .76** |  |  |  |  |
| CB 4 | 10.10 | 6.43 | .41** | .68** | .72** |  |  |  |
| OBQ 1 | 107.76 | 29.85 | .44** | .38** | .25 | .30* |  |  |
| OBQ 2 | 100.76 | 33.65 | .33* | .52** | .38** | .37** | .88** |
| OBQ 3 | 91.90 | 34.46 | .45** | .63** | .62** | .50** | .75** | .85** |
| OBQ 4 | 93.40 | 30.99 | .35** | .53** | .41** | .44** | .79** | .87** | .89** |

Note: CB = CY-BOCS; OBQ = OBQ-CV; 1 = T1, 2 = T2, 3 = T3, 4 = T4.

Several dual LDS models were fitted to examine (temporal) relations between changes in dysfunctional beliefs (OBQ-CV) and OCD severity (CY-BOCS) during CBT and 16-week follow-up. Figure 2 shows a simplified schematic version of each model. Table 5 shows fit indices for all models.

The Baseline Model (Model 1 in Table 5) in which changes in dysfunctional beliefs and changes in OCD severity were unrelated, did not fit the data well as indicated by a high and significant chi-square and the high AIC and RMSEA. Next, we tested a series of models that specified different possible relations between changes in beliefs and OCD severity. The Lagged Effects Mediation Model (Model 2) did not significantly improve model fit, as indicated by the non-significant chi-square difference test ($\Delta \chi^2 = 1.57, df = 2, p = .46$) and the high value of the RMSEA. The Lagged Effects Reversed Model (Model 3), testing the alternative hypothesis that a change in beliefs is the result of a change in OCD severity, showed some improvement to the Baseline Model (results showed a trend for the chi-square difference test: $\Delta \chi^2 = 5.53, df = 2, p = .06$),
but model fit was still inadequate according to the fit indices. The inadequate fit of the lagged effects models could be explained by the relatively long time interval between assessments. Therefore, we estimated a series of synchronous models which allow shorter time intervals between cause and effect. The synchronous models (Models 4, 5) fitted the data significantly better than the Baseline Model (indicated by the significant chi-square difference tests), and showed acceptable fit indices. Best model fit was found for the Synchronous Reversed Model (Model 5) which showed excellent fit values on all goodness of fit measures (low and non-significant chi-square, RMSEA < .05, and CFI > .95), and the lowest value of the AIC. The Synchronous Reciprocal Model (Model 6) is nested in the Synchronous Reversed Model. Model 6 did not show significant improvement to Model 5 as indicated by the non-significant chi-square difference test, and three path coefficients were non-significant (all reflecting an effect of the OBQ-CV on the CY-BOCS) indicating that this model was overfitted. Therefore this model was rejected.

Table 5. Fit indices

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$ (p value)</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI RMSEA</th>
<th>close fit RMSEA (p value)</th>
<th>AIC</th>
<th>CFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Baseline Model</td>
<td>54.38 (&lt;.001)</td>
<td>15</td>
<td>0.18</td>
<td>0.12–0.24</td>
<td>.001</td>
<td>84.37</td>
<td>0.92</td>
</tr>
<tr>
<td>2) Lagged Effects Mediation</td>
<td>52.81 (&lt;.001)</td>
<td>13</td>
<td>0.20</td>
<td>0.14–0.27</td>
<td>&lt;.001</td>
<td>88.75</td>
<td>0.92</td>
</tr>
<tr>
<td>Difference model 2 vs model 1</td>
<td>1.57 (.46)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Lagged Effects Reversed</td>
<td>48.85 (&lt;.001)</td>
<td>13</td>
<td>0.19</td>
<td>0.13–0.26</td>
<td>&lt;.001</td>
<td>86.80</td>
<td>0.93</td>
</tr>
<tr>
<td>Difference model 3 vs model 1</td>
<td>5.53 (.06)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Synchronous Mediation</td>
<td>20.77 (.05)</td>
<td>12</td>
<td>0.11</td>
<td>0.00–0.19</td>
<td>.14</td>
<td>67.72</td>
<td>0.98</td>
</tr>
<tr>
<td>Difference model 4 vs model 1</td>
<td>33.61 (&lt;.001)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Synchronous Reversed</td>
<td>9.02 (.70)</td>
<td>12</td>
<td>0.00</td>
<td>0.00–0.10</td>
<td>.81</td>
<td>56.75</td>
<td>1.00</td>
</tr>
<tr>
<td>Difference model 5 vs model 1</td>
<td>45.35 (&lt;.001)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Synchronous Reciprocal</td>
<td>4.19 (.90)</td>
<td>9</td>
<td>0.00</td>
<td>0.00–0.06</td>
<td>.93</td>
<td>58.17</td>
<td>1.00</td>
</tr>
<tr>
<td>Difference model 6 vs model 5</td>
<td>4.83 (.19)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In summary, the best fitting model was the Synchronous Reversed Model. Results for this model showed significant, positive effects of the CY-BOCS on the OBQ-CV at each assessment point. Parameter estimates were 0.18 (SD .04) for $\Delta$CY-BOCST1-T2 $\Delta$OBQ T1-T2; 0.20 (SD .04) for $\Delta$CY-BOCS T2-T3 $\Delta$OBQ T2-T3; and 0.16 (SD .03) for $\Delta$CY-BOCS T3-T4 $\Delta$OBQ T3-T4. Squared multiple correlations were .43; .36; and .42 respectively (see Figure 2 for this model).

Discussion

The aim of the present study was to examine whether changing dysfunctional beliefs is a mediating mechanism in CBT for childhood OCD. Fifty-eight children with OCD (8–18 years old) received 16 weekly sessions of CBT. Dysfunctional beliefs and OCD severity were measured pre-treatment, mid-treatment, post-treatment and at 16-week follow-up. According to cognitive models, we expected cognitive changes to precede changes in OCD severity. Results showed that both OCD severity and dysfunctional beliefs decreased during CBT. No support was found for the hypothesis that a change in beliefs is a mediating mechanism. The model representing the hypothesis that changes in dysfunctional beliefs precede changes in OCD severity showed inadequate fit: results indicated that changes in OCD severity predicted changes in dysfunctional beliefs. Thus, changes in OCD severity may explain changes in dysfunctional beliefs rather than the reverse. More specifically, changes in OCD severity explained 43% of the change in beliefs at mid-treatment, change in OCD severity between mid- and post-treatment explained 36% of the change in beliefs in the same time interval, and change in OCD severity between post-treatment and follow-up explained 42% of the change in beliefs in this time interval. Our findings are in part consistent with some studies in adult samples (e.g., Anholt et al., 2008; Rheaume & Ladouceur, 2000), and cast doubt on the assumption of Salkovskis and other cognitive theorists that changing beliefs plays a key role in the treatment of OCD. However, we cannot conclude that a decrease in dysfunctional beliefs is an effect of a decrease in OCD severity, as a cause-effect relation over time was not demonstrated.

There are several possible explanations why a relation between a change in beliefs and a change in symptomatology could not be demonstrated across time intervals in the present study. First, this could be related to the study
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design. The time interval between assessment points was rather long (i.e., eight weeks during CBT), and change processes may have occurred in-between assessment points. In addition, dysfunctional beliefs and OCD severity may be influenced by other processes than CBT. As a result, a relation over time may be substantively weakened by unknown interfering variables and detecting mediation over a relatively long time interval will be difficult. Third, although it seems theoretically sound to propose that a decrease in dysfunctional beliefs is followed by a decrease in symptoms, it is questionable whether these processes can be disentangled over time. For example, as soon as thought processes change and the patient does not overestimate the importance of an intrusion anymore, there will be no raise in anxiety, and consequently the patient feels no urge to perform compulsions. When these processes occur in acute response to the changed cognition, no temporal lag can be observed between cognitive change and OC symptoms (see also Hollon & DeRubeis, 2009).

In the present study, a waitlist control condition was incorporated to examine whether cognitive changes were specifically related to CBT and not to the passage of time. Results showed a decrease in dysfunctional beliefs both for CBT and the waitlist condition. Therefore, cognitive changes in our study may have been caused by treatment, but also by passage of time. Alternatively, it is possible that in the waitlist condition the expectancy of being treated may have produced changes in the children’s thinking about their OC symptoms. In addition, during the intake procedure children and parents were informed about the treatment, which may have raised some new ideas about OCD symptomatology and thereby may have already changed some dysfunctional beliefs. It is interesting that no significant change in OCD severity was found in the waitlist condition. This raises further questions about the relation between dysfunctional beliefs and OC symptoms. The fact that OBQ-CV scores changed during the waitlist deserves further examination.

To measure thought processes is a complicated task. The OBQ-CV was selected as adequate reliability and validity had been demonstrated in clinical childhood OCD samples and a community sample (Coles et al., 2010; Wolters et al., 2011). Furthermore, a strong feature of the OBQ-CV is that it includes all dysfunctional belief domains assumed to be relevant in OCD. Consequently, the chance of missing essential beliefs is lower for the OBQ-CV than for other available questionnaires, although even for the OBQ-CV it cannot be excluded. In addition, cognitive processes may rely on conscious thoughts as well as on unconscious,
Mediating mechanisms in CBT for OCD

automatic thoughts. Explicit measures, such as the OBQ-CV, measure beliefs that are accessible for personal introspection. Implicit tasks are needed to shed light on the role of unconscious, automatic thoughts (see Fazio & Olson, 2003).

A fourth issue that deserves discussion is that not all OCD patients may experience more dysfunctional beliefs than non-clinical individuals (e.g., Calamari et al., 2006; Taylor et al., 2006). Indeed, baseline OBQ-CV scores in our sample showed a wide range (55–159), indicating that there are substantial individual differences in dysfunctional beliefs. Consequently, one could imagine that cognitive mediating processes in CBT may also differ across individuals, a hypothesis that is supported by a study in adult OCD patients concerning the role of dysfunctional beliefs in CBT (Polman et al., 2011).

Although the present study has several strengths such as a longitudinal design with a mid-treatment assessment, a representative sample of youth with OCD, and the use of a treatment protocol that has already been implemented in clinical practice, the study also has some limitations.

First, not all children could be randomly allocated to either the waitlist or the CBT condition. Although results showed no significant differences in baseline characteristics between the waitlist, the CBT, and the non-randomized group, we cannot exclude the possibility that the non-randomized group represented a specific subsample.

Second, the advantage of the OBQ-CV covering different belief domains may also be a disadvantage. Some children may experience dysfunctional beliefs in only one specific domain, resulting in a relatively low OBQ-CV total score. In these cases only small changes can be found, and even if dysfunctional beliefs change during treatment it will be difficult to demonstrate (mediation) effects over time.

Third, the sample size of the present study did not allow to adding additional variables to the models, and consequently we were not able to control for effects of OCD subtype or developmental level for example. However, in an efficacy study based on the same sample, results showed no effect of age on treatment outcome (see Chapter 6 of this thesis). Similar, no effect of age on OBQ-CV score was found in a clinical OCD sample which was mainly the same sample as used in the present study (Wolters et al., 2011). These findings make it less likely that results would have been different when age was included.

Notwithstanding these limitations, some clinical implications and recommendations for future research can be derived from the present study.
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Based on the present results, we conclude that restructuring dysfunctional beliefs may be no necessary component in the treatment of OCD in children and adolescents.

For future studies it would be interesting to include more in-treatment assessment points. To gain more insight in change processes of dysfunctional beliefs and OC symptoms, these constructs could be measured each session or even every day during treatment. Before large randomized controlled trials are to be conducted, case-based time-series designs may be better used to closely follow changes over time within individuals (see for example Polman et al., 2011; Rheaume & Ladouceur, 2000; Storchheim & O’Mahony, 2006). Although seldom used, these designs are recognized as fair methodological approaches for treatment studies (e.g., Borckardt et al., 2008). Furthermore, besides a standardized explicit measure of dysfunctional beliefs, idiosyncratic measures and implicit measures could also be included in the study design. Finally, it would be interesting to examine potential moderating variables, for example OCD subtype and children with and without obsessions (tic-related OCD), in combination with potential mediating variables. Mediating mechanisms may differ across patients, and as there are large individual differences in treatment effect for OCD, it would be interesting to detect what treatment works for whom. It would be impossible for a single study to address all of these recommendations. But several studies could focus on specific issues, and together shed more light on the mechanisms of change in CBT for OCD.