Abstract

Hoarding disorder (HD) is a new psychiatric diagnosis in DSM-5 and preliminary evidence suggests that cognitive-behavioral treatments are effective in treating this condition. However, it has been demonstrated that individuals with HD generally display poor compliance during treatment, which may lead to poor outcomes. Treatment compliance can be conceptualized as either within-session or between-session compliance, but currently there are no validated measures of within-session or between-session compliance specifically for HD. The aim of this study was to provide an initial validation of the CBT Compliance Measure (CCM) and the Patient Exposure/Response Prevention Adherence Scale for Hoarding (PEAS-H) in a sample of participants with HD who were undergoing group cognitive behavior therapy (CBT) for HD (N = 70). Both measures, which were administered at each relevant treatment session, demonstrated a unidimensional structure, good reliability, as well as predictive validity, and are thus promising in the measurement of within-session and between-session compliance with CBT for HD.

Keywords: Hoarding Disorder; Compliance; Cognitive Behavior Therapy

Measuring Within-Session and Between-Session Compliance in Hoarding Disorder: A

Preliminary Investigation of the Psychometric Properties of the CBT Compliance Measure

(CCM) and Patient Exposure/Response Prevention Adherence Scale for Hoarding (PEAS-H)

Cognitive-behavioral therapy (CBT) has been demonstrated to be efficacious in the

treatment for hoarding disorder (HD), with large pooled pre-treatment to post-treatment effect

sizes ($g = 0.82$) (Tolin, Frost, Steketee, & Muroff, 2015). However, despite these promising

results there is still significant room for improvement, as most patients who complete a course of

CBT for HD do not achieve clinical remission (Tolin et al., 2015). There is some preliminary

evidence to suggest that more severe HD symptoms, comorbid social anxiety symptoms, higher

levels of perfectionism, and male gender predict worse outcomes in HD treatment (Muroff,

Steketee, Frost, & Tolin, 2014), however further research is needed. Another contributing factor

to the poor outcomes for those with HD may be that many patients with HD show poor or

variable compliance with treatment (Tolin et al., 2019), and this is likely to affect treatment

outcomes.

Treatment compliance in CBT can be assessed in two ways: between-session compliance

and within-session compliance. Between-session compliance is conceptualized as the extent that

the patient is practicing homework (such as sorting and discarding possessions in the case of

HD) and adhering to CBT principles outside of the session. This may include both the quantity

and quality of homework tasks (Rees, McEvoy, & Nathan, 2005). Between-session compliance

with homework tasks has been linked to improved outcomes for patients across a number of

disorders. For instance, Simpson and colleagues found that between-session compliance with

homework in individuals with obsessive-compulsive disorder (OCD) predicted lower symptom

severity scores at post-treatment (Simpson et al., 2011) and six month follow-up (Simpson, Marcus, Zuckoff, Franklin, & Foa, 2012). Similarly, Burns & Spangler (2000) found that for individuals with depression, those who were more compliant with between-session homework improved more during the treatment than did those who were less compliant. The link between between-session homework compliance and outcome has not always been consistent, however. For instance, Callen et al. (2018) found that in two separate studies investigating the efficacy of CBT for depressive symptoms, homework compliance was related to outcome in one study, but not the other.

Specifically in HD, there is emerging evidence to suggest a relationship between homework compliance and outcome. For instance, Tolin, Frost, and Steketee (2007) found that 80% of participants in the upper 50% of homework compliance were rated as 'much improved' or 'very much improved' on the National Institute of Mental Health Clinician Global Impression Scale (Guy, 1976) at post-treatment, compared to only 20% of the individuals in the lower 50% of homework compliance group. Similarly, Ayers, Wetherell, Golshan, and Saxena (2011) found a large and significant correlation ($r = .74$) between homework compliance during treatment and outcome on the Saving Inventory-Revised (SI-R) (Frost, Steketee, & Grisham, 2004) at post-treatment.

Within-session compliance in CBT is conceptualized as the extent that the patient complies with CBT techniques and demonstrates on-task behavior, as well as a commitment to the CBT approach during the session (for example, the client's willingness to challenge thoughts or behaviors in session). The literature on within-session compliance is limited. In a mixed anxiety group, Glenn et al. (2013) found that within-session compliance (defined as therapist-rated 'overall commitment to CBT this session') was related to treatment outcome, with those

classified as having low commitment showing poorer response at 18-months post-treatment. Other studies have attempted to measure within-session compliance, but have not studied the effect of within-session compliance on treatment outcome (e.g., Morgan et al., 2013). While there are currently no studies investigating within-session compliance in patients with HD, clinician reports suggest that these patients may have difficulties, including problems adhering to structured CBT interventions, failure to understand the treatment rationale or articulate clear goals, limited insight, arriving late for sessions, losing track of the session focus, arguing, or having difficulty answering questions appropriately (Tolin, Frost, & Steketee, 2012).

A major hindrance to understanding between-session and within-session compliance in HD is a lack of psychometrically sound measurement tools. Generally the measurement of compliance differs across studies, is based on a therapist rating of a single item, or is specific to a particular intervention within CBT. Currently, we are aware of two measures of between-session compliance in CBT, the Patient Adherence Scale for Exposure and Response Prevention (PEAS; Simpson et al., 2010), which is specific to the technique of exposure and response prevention (ERP) for OCD and the Therapist Compliance Checklist (Kornblith, 2000), which is an un-published measure.

The PEAS is a 3-item measure of between-session compliance that aims to assess the quality and quantity of homework completed (ERP practice) in individuals with OCD. The items assesses 1) the quantity of exposure; 2) the quality of exposure; and 3) the degree of response prevention (Simpson et al., 2010). This scale has demonstrated excellent inter-rater reliability (Simpson et al., 2010) and takes only minutes to score. While the PEAS is specifically designed for use with OCD, the structure of the measure is amenable to modification for use with other cognitive-behavioral treatments, including those for HD. For this population the wording can be

altered to reflect the quantity and quality of discarding, as well as the degree that the patient has resisted acquiring.

Similarly, we are aware of only one measure of within-session compliance, the Exposure and Response Prevention Session Adherence Scale (ESAS; Morgan et al., 2013), which is also specific to ERP for OCD. The ESAS is a 3-item scale to measure within-session compliance to ERP in a pediatric sample of individuals with OCD. The items measure 1) willingness to engage with exposure tasks; 2) ability to comply with response prevention rules, and; 3) within-session habituation. While the inclusion of within-session habituation as a measure of compliance is questionable (i.e., because within-session habituation is a metric of the patient's fear reduction during the session rather than their commitment to CBT techniques and approaches), the measure has demonstrated excellent inter-rater reliability in at least one previous study (Morgan et al., 2013). At this stage the relationship between scores on the ESAS (i.e., within-session compliance) and treatment outcome has not been established.

To our knowledge there is currently no research examining patient-level predictors of within-session compliance, and limited research examining predictors of between-session compliance. There is some evidence that diagnosis and comorbidity profile may affect between-session compliance. For example, Vincent and Hameed (2003) found that individuals receiving group CBT for insomnia who had a comorbid diagnosis of dysthymia demonstrated less between-session compliance than did those without dysthymia. Similarly, individuals with social anxiety disorder demonstrated higher between-session homework compliance than did individuals with mixed anxiety disorders (LeBeau, Davies, Culver, & Craske, 2013), indicating that there may be differences in compliance across diagnostic groups. Leung and Heimberg (1996) found no significant relationship between pre-treatment symptom severity and between-

session compliance in a sample of individuals with social anxiety disorder. However, Arendt, Thastum, and Hougaard (2016) found significant correlations between pre-treatment severity and self-reported between-session homework compliance for some measures of anxiety, but not others, in a group of young people receiving CBT for mixed anxiety disorders. Overall, the literature on the predictors of within-session and between-session compliance is scant, and an investigation into this research question is important in HD, as well as other diagnostic groups.

It has also been demonstrated that compliance is not necessarily a stable construct during treatment. For example, one study found that between-session homework compliance in patients receiving treatment for depression varied quite considerably over the course of treatment (Addis & Jacobson, 2000). Similarly, in other diagnostic groups the relationship between compliance and outcome has differed across various stages of treatment. Leung and Heimberg (1996) found that only between-session compliance in the latter part of the treatment was significantly related to lower social anxiety symptoms at post-treatment. For this reason, investigating compliance at different time-points throughout treatment (i.e., early-treatment compliance, mid-treatment compliance, and late-treatment compliance) is important.

Currently the only published and validated measures of within-session and between-session compliance are for OCD populations, and there are no validated instruments to assess within-session and between-session compliance in CBT for individuals with other disorders, including HD. Given the moderate efficacy of CBT for HD, and the likely relationship between poor compliance and outcomes, it is imperative that psychometrically sound measures of within-session and between-session compliance are developed and evaluated to facilitate further research in this field. Therefore the aims of this study were to 1) provide a psychometric evaluation of two new measures of within-session and between-session compliance: the CBT

Compliance Measure (CCM), which was developed for transdiagnostic use, and a modification of the PEAS specifically for HD (PEAS-H); and 2) investigate predictors of within-session and between-session compliance in HD.

Method

Participants

The sample consisted of 70 patients with a primary HD diagnosis who participated in a 16-week group-based CBT treatment for HD as part of a randomized controlled trial investigating the neural mechanisms of treatment response in HD [REMOVED FOR PEER REVIEW]. To be included in the treatment study participants were required to be 1) aged 20-65; 2) have a primary diagnosis of HD; 3) score $\geq$ 4 ("moderately ill") on the Clinician's Global Impression-HD (Tolin, Gilliam, Davis, et al., 2018); 4) be on no psychiatric medications or on stable psychiatric medications for at least 8 weeks; 5) be willing and able to abstain from the use of stimulant or benzodiazepine medication on the day of fMRI testing; 6) be fluent in English; 7) have control over the current living environment (i.e., not living in someone else's home or an environment that restricts the items the client can retain); 8) be physically able to complete homework assignments; 9) be right handed; and 10) be able to complete study questionnaires. Participants were excluded from the treatment study if 1) they had previously received more than 10 sessions of CBT for HD; 2) were actively suicidal, had a previous suicide attempt, were engaging in self-harming behaviors, or were at risk of harming others; 3) had a current or past diagnosis of a serious mental illness such as a psychotic disorder, bipolar disorder, uncontrolled anorexia, or active substance use; 4) had been hospitalized in the past 12 months for a psychiatric condition; 5) had a history of anoxic or traumatic brain injury; 6) displayed evidence of severe cognitive dysfunction that would likely interfere with the ability to provide informed consent or

engage in CBT (based on the judgment of the independent evaluator); or 7) had non-removable metal in the body, claustrophobia, or other factors that would preclude functional magnetic resonance imaging (fMRI). The mean number of sessions attended was 12.17 ($SD = 4.11$) in the sample. Outcomes from the clinical trial are reported in a separate manuscript [REMOVED FOR PEER REVIEW]

Measures

The Diagnostic Interview for Anxiety, Mood, and Obsessive-Compulsive and Related Neuropsychiatric Disorders (DIAMOND) (Tolin, Gilliam, Wootton, et al., 2018). Diagnostic status was established using the DIAMOND, a structured diagnostic interview that is consonant with DSM-5 criteria. The DIAMOND demonstrates excellent inter-rater reliability ($\kappa = .86$) and test-retest reliability ($\kappa = .94$) for the HD diagnosis (Tolin, Gilliam, Wootton, et al., 2018). Inter-rater reliability was not assessed in this study.

The CBT Compliance Measure (CCM). The CCM is an 8-item clinician rating of within-session compliance with CBT structure and techniques. Items of the CCM measure the extent that the patient 1) espoused and understood the goals of treatment; 2) provided a report of progress; 3) used words and actions which adhered to the session agenda; 4) used comments that were appropriate to the topic; 5) cooperated with attempts to challenge thoughts and beliefs; 6) cooperated with attempts to change behaviors; 7) made appropriate reports of thoughts and feelings in the session; and 8) adhered to the time requirements of the session. The CCM is not specific to HD, and can be used to measure within-session compliance with CBT for any disorder. The scale is designed to be administered in sessions that are consistent with a CBT treatment plan and not in assessment sessions or possible 'crisis' sessions. The scale was developed by the final author [REMOVED FOR PEER REVIEW] and each item is measured on

a 5-point scale with 0 indicating the poorest within-session compliance with CBT and 4

indicating the highest within-session compliance with CBT. In the current study inter-rater

reliability was not examined, however, unpublished data collected by our team demonstrates that

the CCM has good inter-rater reliability for the total score when used with HD patients ($r = .83$)

and inter-rater reliability for individuals items ranges from $r = .54$ -.86[1]. Because multiple items

may be missing on the CCM depending on session content, the mean of the completed items is

used as the total score; thus, total scores range from 0-4. The CCM is provided in the Appendix.

The Patient Adherence Scale for Exposure and Response Prevention for Hoarding

Disorder (PEAS-H). The PEAS-H is a modified version of the original PEAS (Simpson et al.,

2010), described above, and was developed by the final author (REMOVED FOR PEER

REVIEW) in order to assess between-session compliance with sorting and discarding that is

specific to the treatment of HD. The scale is a 3-item clinician-rated measure and assesses 1) the

percentage of sorting and discarding the patient completed out of what was assigned; 2) the

quality of the patient's sorting and discarding; and 3) the degree to which the patient resisted

urges to acquire new items. Each item is rated on a 7-point scale, with concrete descriptors. For

example, a 6, or "very good" is defined as "sorting/discarding tasks performed as assigned by the

therapist (e.g., appropriate tasks, correct amount of time, no compulsions during or afterwards,

no safety aids") for each response option to minimize a tendency for clinicians to rate more

personally liked or friendly/nonintrusive patients as being more compliant. The mean of the

items is used as the total score and total scores range from 0-7. While inter-rater reliability could

not be evaluated for the current sample, unpublished data collected by our team demonstrates

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[1] Unfortunately we do not have complete demographic information for the IRR patients and thus cannot include them formally in the current study.

that the PEAS-H has acceptable inter-rater reliability for the total score ($r = .52$)[2]. The PEAS-H

is provided in the Appendix.

The Saving Inventory – Revised (SI-R; Frost, Steketee, & Grisham, 2004). The SI-R is a

23-item self-report measure of hoarding severity and was used as the primary symptom outcome

measure. The measure yields a total score, as well as a score on three subscales; 1) clutter, 2)

saving, and 3) acquiring. The SI-R demonstrates excellent internal consistency and test-retest

reliability in previous studies (Fontenelle et al., 2010; Frost, Rosenfield, Steketee, & Tolin, 2013;

Wootton et al., 2015). The internal consistency for the total score in the current sample was

excellent ($\alpha = .90$). The SI-R was used as the primary outcome measure for the study.

Several other self-report scales were used to assess clinical characteristics that are often

present in HD. These included measures of psychological distress, attentional problems and

emotion regulation, and were used as possible predictors of treatment compliance. These scales

are outlined below.

Depression Anxiety Stress Scales – 42 Item (DASS - 42; (Lovibond & Lovibond, 1995).

The DASS is a 42-item self-report scale of psychological distress and has 3 subscales measuring:

1) depression; 2) anxiety; and 3) stress. The scale is widely used and demonstrates adequate

psychometric properties in previous studies (Antony, Cox, Enns, Bieling, & Swinson, 1998;

Page, Hooke, & Morrison, 2007). Internal consistency in the current study was good to excellent

(total score: $\alpha = .95$; depression: $\alpha = .92$; anxiety: $\alpha = .83$; stress: $\alpha = .93$).

ADHD Symptom Scale (ADHDSS; Barkley & Murphy, 1998). The ADHDSS inattention

subscale is a 9-item self-report scale of inattentiveness. Scores on this scale range from 0-27,

with higher scores indicating greater inattentiveness. The ADHDSS shows adequate inter-rater

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[2] Unfortunately we do not have complete demographic information for the IRR patients and thus cannot include them formally in the current study.

reliability (Barkley & Murphy, 1998) as well as excellent internal consistency in HD samples (Frost, Steketee, & Tolin, 2011; Hartl, Duffany, Allen, Steketee, & Frost, 2005). Internal consistency in the current study was excellent (α = .91).

Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS is a 36-item self-report measure of emotion regulation. Total scores on the DERS range from 36-180 and higher scores indicate higher levels of emotional dysregulation. The DERS also has six subscales which reflect 1) lack of emotional awareness; 2) lack of emotional clarity; 3) difficulty regulating behavior when distressed; 4) difficulty engaging in goal-directed behavior when distressed; 5) unwillingness to accept certain emotional responses; and 6) limited access to strategies to improve distress. The DERS has demonstrated excellent internal consistency for the full scale and subscales in previous studies (Osborne, Michonski, Sayrs, Welch, & Anderson, 2017; Ritschel, Tone, Schoemann, & Lim, 2015). In the current sample the internal consistency was excellent for the full scale (α = .96).

Divergent validity of the CCM and PEAS-H was measured using the *Obsessive Compulsive Inventory - Revised (OCI-R; Foa et al., 2002).* Traditionally the OCI-R is an 18-item measure of DSM-IV symptoms of OCD. The scale has 15-items that reflect DSM-5 OCD symptoms (OCI-OCD), and 3-items that measure HD symptoms (OCI-HD). In this study the 15 item OCI-OCD was used, excluding the hoarding items. Total scores on the OCI-OCD subscale range from 0-60. The internal consistency of the OCI-OCD has been demonstrated to be excellent in past studies, alpha = .92 (Wootton et al., 2015) and in the current study Cronbach's alpha was .83. The OCI-R was used as a measure of divergent validity given OCD and HD are conceptually different disorders (American Psychiatric Association, 2013).

Treatment

The treatment provided was a 16-week (16-session) group CBT treatment program for HD (Tolin, Worden, Wootton, & Gilliam, 2017) that has been demonstrated to be effective in previous clinical trials (Ivanov et al., 2018; Tolin et al., 2019). The treatment protocol is divided into 4 modules addressing 1) decision making, organization and problem solving deficits; 2) emotion regulation deficits; 3) problematic thoughts and beliefs; and 4) motivational fluctuations. These treatment modules are designed to assist patients with their in-session sorting and discarding, which occurs in the majority of the treatment sessions. Patients are then required to continue their sorting and discarding at home for homework. The treatment program was delivered by a licensed psychologist with significant experience working with patients with HD and a postdoctoral fellow, who had limited experience working with patients with HD. All treatment sessions were 90 minutes long. In this study ratings on the CCM and PEAS-H were made collaboratively by the treating group therapists. Generally consensus between the two therapists was achieved for each item and any discrepancy was resolved through discussion between the therapists. Participant non-compliance was monitored throughout the treatment according to the protocol outlined in the treatment manual. Participants who missed more than three sessions, who failed to bring in items from home to facilitate in-session discarding, or who failed to complete their homework goal more than three times were removed from the treatment group.

Procedure

The DIAMOND was administered at pre-treatment to confirm diagnostic status and was administered by independent evaluators who were unrelated to the provision of treatment in the study. The DASS, DERS, and ADHDSS were administered at pre-treatment only. The SI-R and was administered at pre-treatment and at post-treatment to assess symptom severity. The CCM

and PEAS-H were rated collaboratively by the clinicians at the completion of each treatment session in order to assess within-session and between-session compliance, respectively. The CCM was rated after active treatment commenced (i.e., the treatment moved beyond psychoeducation) during sessions 3-16, while the PEAS-H was rated from sessions 4-15, as sorting and discarding were only relevant to those sessions.

Data analytic plan

Factor structure of the CCM was analyzed using exploratory factor analysis (EFA) in MPlus (Version 8) with Weighted Least Squares with Mean- and Variance-adjusted Test Statistic (WLSMV) estimation. The model was considered a good fit if: 1) the Standardized Root Mean Square Residual (SRMR) was less than .08; and 2) the Comparative Fit Index (CFI) was greater than .95 (Hu & Bentler, 1999). Given the number of items in the PEAS-H, factor structure was explored using principal components analysis (PCA) with direct oblimin rotation. Number of factors to be retained in the PCA was determined by parallel analysis (O'Connor, 2000). Internal consistency of the measures was assessed with Cronbach's alpha. For the analyses of factor structure and internal consistency analyses data from all administrations of the measure across the treatment for each participant were used.

Convergent validity was assessed by measuring the correlation between the mean scores on the two forms of compliance across sessions. Predictive validity of the measures was analyzed by correlating the mean scores on the CCM and PEAS-H across the sessions with pre-treatment to post-treatment change score on the SI-R and its subscales. For these analyses we used the mean of the attended CCM and PEAS-H sessions and the patient's last available SI-R score to calculate treatment change for those who did not complete the entire course of treatment.

Discriminant validity was assessed by correlating scores mean scores on the CCM and PEAS-H with total scores on the pre-treatment OCI-OCD.

Multiple hierarchical regressions were used to predict change in HD symptoms from pre-treatment to post-treatment using the CCM and PEAS-H mean scores while controlling for baseline symptoms severity (pre-treatment score on the SI-R). We also examined if any baseline baseline demographic variables (age or gender), symptom severity (SI-R total at pre-treatment), comorbidity profile (DASS depression score, ADHD symptom score), or emotion regulation difficulties (DERS total score) could predict the mean CCM and PEAS-H score across treatment using multiple linear regression.

Results

As shown in Table 1, the sample was primarily female and White, with an average age of 54 years. Comorbid psychiatric disorders, particularly the depressive disorders, were common and participants had an average 2.07 (SD = 1.84) comorbid diagnoses. The average score on the CCM across all treatment sessions was 3.30 (SD = 0.54) and ranged from 1.75 – 4.00. The average score on the PEAS-H across all treatment sessions was 4.77 (SD = 1.18) and ranged from 1.00 – 6.67.

CBT Compliance Measure (CCM)

Factor Structure and Reliability. Results demonstrated that a single-factor model provided a good fit to the data: χ^2 (20) = 126.61, $p < .001$; RMSEA = .08; SRMR = .05 and CFI = .99. Factor loadings were all significant and ranged from .44 (Item 5) - .98 (Item 3 and Item 4). Table 2 outlines the means, standard deviations and factor loading of the 8 items. Internal consistency of the CCM was good ($\alpha = .86$).

Validity. The mean CCM rating was positively and significantly correlated with change on the SI-R total score from pre-treatment to post-treatment ($r = .37, p < .01$), indicating that patients with greater within-sesion compliance showed a more favorable response to treatment. Similar relationships were found for all SI-R subscales (clutter, $r = .31, p = .01$; saving, $r = .34, p < .01$; acquiring, $r = .36, p < .01$). Scatterplots are shown in Figure 1. We also examined the relationship between improvement in HD symptoms at post-treatment and early within-session compliance (i.e., mean scores on the CCM from session 3-7), mid within-session compliance (i.e., mean scores on the CCM from session 8-12), and late within-session compliance (i.e., mean scores on the CCM from session 13-16). Early, mid, and late within-session compliance were all significantly correlated with change in SI-R total score from pre-treatment to post-treatment (early: $r = .35, p < .01$; mid: $r = .26, p = .05$; late: $r = .49 \ p < .001$). Discriminant validity was assessed by correlating the CCM with the OCI-R. There was a small and non-significant correlation between the two measures ($r = .14, p > .05$).

Factors that Contribute to Within-Session Compliance. We examined if any baseline demographic variables (age or gender), symptom severity (SI-R total at pre-treatment), comorbidity profile (DASS depression score, ADHD symptom score), or emotion regulation difficulties (DERS total score) could predict the mean CCM score across treatment using a multiple linear regression. The multiple linear regression was not significant ($F_{(6,63)} = 1.60, p > .05$), indicating that the selected variables did not predict within-session compliance in this sample.

The Patient Adherence Scale for Exposure and Response Prevention for Hoarding Disorder (PEAS-H)

Factor Structure and Reliability. Parallel analysis suggested that one factor be retained for the PEAS-H; thus the PCA was run to extract a single factor. The KMO statistic was .57 and Bartlett's test of sphericity was significant ($\chi^2_{(3)}$ = 1033.47, p <.001). The factor explained 69% of the variance. Table 3 outlines the means, standard deviations, and factor loading of the 3-item PEAS-H scale. The internal consistency for the PEAS-H was adequate in the current sample (α = .76).

Validity. Mean PEAS-H rating (session 4-15) was significantly correlated with pre-treatment to post-treatment SI-R total change scores (r = .55, p < .001; scatterplot shown in Figure 2). There was also a positive significant correlation for each of the SI-R subscales (r = .49, p <.001; .50, p < .001; and .53, p <.001, for the clutter, saving, and acquiring subscales respectively). These results indicate that patients with greater between-session compliance showed a larger reduction in HD symptoms at post-treatment. We examined the relationship between improvement in HD symptoms at post-treatment and early between-session compliance (i.e., mean scores on the PEAS-H from session 4-7), mid-treatment between-session compliance (i.e., mean scores on the PEAS-H from session 8-11) and late between-session compliance (i.e., mean scores on the PEAS-H from session 12-15). Early between-session compliance was significantly correlated with the SI-R total change score from pre-treatment to post-treatment (r = .43, p < .001) as was between-session compliance in the middle of treatment (r = .49, p <.001) and later sessions (r = .38, p <.01). Discriminant validity was assessed by correlating the PEAS-H with the OCI-R. There was a small and non-significant correlation between the PEAS-H and the OCI-R (15 item version) (r = .11, p > .05).

Factors that Contribute to Between-Session Compliance. We examined if any baseline demographic variables (age or gender), symptom severity (SI-R total at pre-treatment),

comorbidity profile (DASS depression score, ADHD symptom score), or emotion regulation difficulties (DERS total score) could predict the mean PEAS-H score across treatment using a multiple linear regression. The multiple linear regression model accounted for a significant amount of variance in between-session compliance, $R^2 = .21$, Adjusted $R^2 = .13$, ($F_{(6,63)} = 2.54$, $p = .03$), with approximately 20% of variance in between-session compliance accounted for by the predictor variables. It was found that the regression coefficient for age was significantly different from zero ($\beta = .35$, $p = .01$), indicating older patients demonstrated better between-session treatment compliance than did younger patients. No other variables were significantly different from zero.

Relationship between the CCM and PEAS-H

To measure convergent validity the scores across each session for the measure of within-session compliance (CCM) and between-session compliance (PEAS-H) were compared using Pearson's correlation coefficient. There was a positive and significant correlation between the mean CCM and PEAS-H ratings ($r = .52$, $p < .001$), suggesting a moderate relationship between within- and between-session compliance in this sample. This relationship was also seen in early- ($r = .50$, $p < .001$), mid- ($r = .39$, $p < .01$), and late-treatment ($r = .46$, $= < .001$) compliance. The correlation between each of the scales from session 4-15 is outlined in Figure 3. A multiple hierarchical regression, controlling for pre-treatment HD severity (SI-R pre-treatment), was performed to predict SI-R reduction at post-treatment from the mean CCM and mean PEAS-H. Both models were significant (CCM: $F_{(2,67)} = 17.79$, $p < .001$; PEAS-H $F_{(2,67)} = 35.96$, $p < .001$). Approximately one third of the variance ($R^2 = 0.35$) in outcome on the SI-R was explained by within-session compliance using the CCM, and approximately half of the variance in outcome ($R^2 = 0.51$) was explained by between-session compliance using the PEAS-H.

Discussion

The aim of this study was to provide a preliminary psychometric analysis of two new measures that are relevant to the study of HD: a measure of within-session treatment compliance (CCM) and a measure of between-session compliance (PEAS-H). The development and evaluation of such measures has important implications for future research in the field of HD, as there is a need to improve CBT treatment outcomes in this patient group (Tolin et al., 2015). Overall, both measures performed well, demonstrating adequate reliability and validity in a sample of individuals with HD receiving group CBT.

The measures of compliance were moderately correlated with each other overall, but the relationship between the two differed across the treatment weeks indicating that these concepts, while likely related, are not the same, and those high on within-session compliance may not demonstrate high levels of between-session compliance, and vice versa. Additionally, while both the CCM and PEAS-H are indicators of compliance, the therapeutic interventions assessed in the measures differ. The CCM focuses on both cognitive and behavioral interventions, while the PEAS-H focuses exclusively on behavioral interventions, and this could be a factor that effects the relationship between these two measures. Future studies may also wish to investigate compliance cut-scores on the CCM and PEAS-H to indicate 'low', 'moderate' and 'high compliance' for individuals with HD.

To our knowledge, the CCM is the first standardized measure of within-session compliance to CBT that can be used for any diagnostic group. The results of the current study indicate that in a sample of individuals with HD, the measure demonstrates high internal consistency and is related to HD symptom change following CBT, accounting for approximately one third of the variance in outcome after controlling for pre-treatment severity. This finding is

consistent with studies in other diagnostic groups that have found that within-session compliance with treatment can contribute to improved treatment outcomes (Glenn et al., 2013). However, there is very limited data on the contribution of within-session compliance to treatment outcome in the literature generally, and this finding requires further investigation in future studies in HD samples, as well as other diagnostic groups, in order to enhance treatment planning. The development of the CCM may allow researchers to investigate the relative effect that within-session compliance has on treatment outcomes across a wide variety of diagnostic groups.

The PEAS-H is a HD specific adaptation of the existing PEAS (Simpson et al., 2010), a measure of between-session compliance in OCD. Similar to the original PEAS, the PEAS-H demonstrated adequate internal consistency, and significantly predicted HD symptom change following treatment, explaining approximately one half of the variance in outcome at post-treatment after controlling for pre-treatment severity. This finding is consistent with the wider emerging HD literature which demonstrates that those individuals with higher between-session compliance are likely to have more improved outcomes at post-treatment (Ayers et al., 2011; Tolin et al., 2007) and is also consitent with outcomes in other diagnostic groups (Addis & Jacobson, 2000; Hara, Aviram, Constantino, Westra, & Antony, 2017; LeBeau et al., 2013; Vincent & Hameed, 2003).

Importantly, early CCM and PEAS-H scores correlated highly with post-treatment outcome. This finding is consistent with other studies in the literature that have found that post-treatment outcome is related to within-session compliance variables such as acceptance of the CBT treatment rationale, as well as early between-session compliance with homework tasks (Addis & Jacobson, 2000). Further research investigating whether early within-session and between-session treatment compliance can predict outcome in HD, as well as other psychiatric

disorders, is warranted. This may be a variable that could assist clinicians in understanding who is likely to benefit from treatment, allowing them to plan interventions accordingly (i.e., stepping up intensity of treatment or adding a motivational component to the treatment for those low on compliance early in treatment).

In our sample, within-session compliance could not be predicted by demographic information, baseline symptom severity, comorbidity profile, or level of emotion dysregulation. Thus, it is important to examine other possible predictors of within-session compliance in individuals with HD in future studies as this field progresses. Possible variables of interest may be related to level of cognitive impairment or presence of a personality disorder. The regression model was significant for between-session compliance, with age the only significant predictor, with older patients demonstrating higher between-session compliance. This finding is inconsistent with Ayers et al. (2011) who found that younger individuals tended to respond better to a CBT intervention for HD. Given the limited sample size and age range in this study (participants in this study were required to be aged between 20-65), this finding requires replication in future studies. Future studies should aim to understand the relationship between age and treatment response, as it is possible that the relationships is not linear.

While this study demonstrates the preliminary reliability and validity of two new measures of treatment compliance in patients with HD with a high number of comorbidities, there are a number of notable limitations. The most significant limitation was that the inter-rater reliability of the CCM and PEAS-H was not examined in this study. While unpublished data collected from our laboratory supports the inter-rater reliability of these measures, these estimates are modest, especially for the PEAS-H ($r = .52$), and thus a formal evaluation of inter-rater reliability of the CCM and PEAS-H is needed in future studies. This is essential given that

other variables, such as therapeutic alliance, may affect the clinician's rating on the measure. Further studies examining these measures may also wish to examine therapeutic allince and its impact on ratings on the CCM and PEAS-H. Additionally, as other measures of within-session and between-session compliance become available, convergent validity of the CCM and PEAS-H should be assessed with like measures, and the discriminant validity of the CCM and PEAS-H can also be tested against a variety of other measures or constructs in future studies.

Second, while the PEAS-H is specific to HD populations, the CCM can be used in any diagnostic group. It is possible that results may differ to those seen in the present study if the CCM is studied in another diagnostic group. Therefore it is reccomended that the psychometric properties and clinical utility of the CCM be examined in a variety of diagnostic groups in future studies.

Third, participants were part of a clinical trial investigating the neural mechanisms of response to CBT for HD. While consistent with other treatment studies in HD (Frost, Pekareva-Kochergina, & Maxner, 2011; Steketee, Frost, Tolin, Rasmussen, & Brown, 2010), participants in this study were primarily White (91%) and female (83%), and this study also excluded individuals based on various fMRI considerations. Participants in this study were also treatment seeking and thus potentially had higher levels of motivation to reduce their symptoms than the wider HD population. For this reason the participants in this study may not be representative of the HD population more generally and future research would benefit from investigating the psychometric properties of these new measures in larger and more diverse samples.

Finally, the treatment was provided in a group setting and results may differ for individual treatment where the therapist is likely to have a greater understanding of the client's within-session and between-session compliance. Individuals participating in a group treatment

program may also have felt pressure to demonstrate higher levels of compliance due to social pressure from the other group members. Future research may wish to examine these measures in individual CBT treatments.

Overall, the results of this study indicate preliminary evidence to suggest that the CCM and PEAS-H have adequate psychometric properties. The current study provides preliminary support for the use of the CCM and PEAS-H to measure within-session and between-session compliance respectively in samples of HD patients. The results of this study have important implications for future treatment planning and personalization of treatment for individuals with HD.

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Table 1.

Demographic characteristics of the sample at baseline (N = 70).

	Mean (SD)	N (%)
Age	54.26 (8.52)	-
Gender (% female)	-	58 (83)
Ethnicity (% White)	-	64 (91)
Comorbid diagnoses		
Major depressive disorder (MDD)	-	28 (40)
Persistent depressive disorder (PDD)	-	18 (26)
Generalized anxiety disorder (GAD)	-	16 (23)
Attention deficit hyperactivity disorder (ADHD)	-	12 (17)
Social anxiety disorder (SAD)	-	12 (17)
Substance use disorder (SUD)	-	11 (16)
Obsessive-compulsive disorder (OCD)	-	9 (13)
Skin picking disorder (SPD)	-	8 (11)
Specific phobia (SP)	-	7 (10)
Binge eating disorder (BED)	-	5 (7)
Agoraphobia (AG)	-	4 (6)
Adjustment disorder (AD)	-	3 (4)
Posttraumatic stress disorder (PTSD)	-	3 (4)
Trichotillomania (TTM)	-	2 (3)
Premenstrual dysphoric disorder (PMDD)	-	2 (3)
Body dysmorphic disorder (BDD)	-	2 (3)

Panic disorder (PD)	-	1 (1)
Cyclothymic disorder (CD)	-	1 (1)
Anorexia nervosa (AN)	-	1 (1)
Pre-treatment scores		
SI-R total	60.96 (11.83)	-
Mean scores across treatment		
CCM	3.30 (0.54)	-
PEAS-H	4.77 (1.18)	-

Note. SI-R: Saving Inventory – Revised. CCM: CBT Compliance Measure. PEAS-H: The Patient Adherence Scale for Exposure and Response Prevention for Hoarding Disorder. Total scores on the SI-R range from 0-92; CCM 0-4; and PEAS-H 0-7.

Table 2.

CBT Compliance Measure (CCM): Means, Standard Deviations, and Factor Loadings

CCM Item	M	SD	Factor loading
1. To what extent did the patient espouse and understand the goals of treatment during the session?	3.22	0.78	.97
2. To what extent did the patient provide a report of progress?	3.48	0.82	.86
3. To what extent did the patient's words and actions in session adhere to the session agenda?	3.32	0.69	.98
4. To what extent were the patient's comments and statements appropriate to the topic?	3.35	0.59	.98
5. To what extent did the patient cooperate with attempts to challenge thoughts or beliefs?	3.18	0.85	.44
6. To what extent did the patient cooperate with attempts to change behaviors?	2.78	1.07	.69
7. To what extent did the patient make appropriate reports of thoughts and feelings in session?	3.31	0.65	.97
8. To what extent did the patient adhere to the time requirements of the session (arrive on time, remain in the room throughout the session, leave on time)?	3.78	0.51	.90

Table 3

Patient Adherence Scale for Exposure and Response Prevention for Hoarding Disorder (PEAS-H): Means, Standard Deviations, and Factor Loadings

PEAS-H Item	*M*	*SD*	*Factor loading*
1. Sorting/Discarding Assignments: what % of sorting/discarding assignments did the patient attempt since the last visit?	5.09	1.74	.93
2. Sorting/Discarding Assignments: how well did the patient do the assigned sorting/discarding tasks that were attempted?	4.32	1.24	.93
3. Acquiring: what % of urges to acquire did patient successfully resist since the last visit?	4.91	1.28	.59

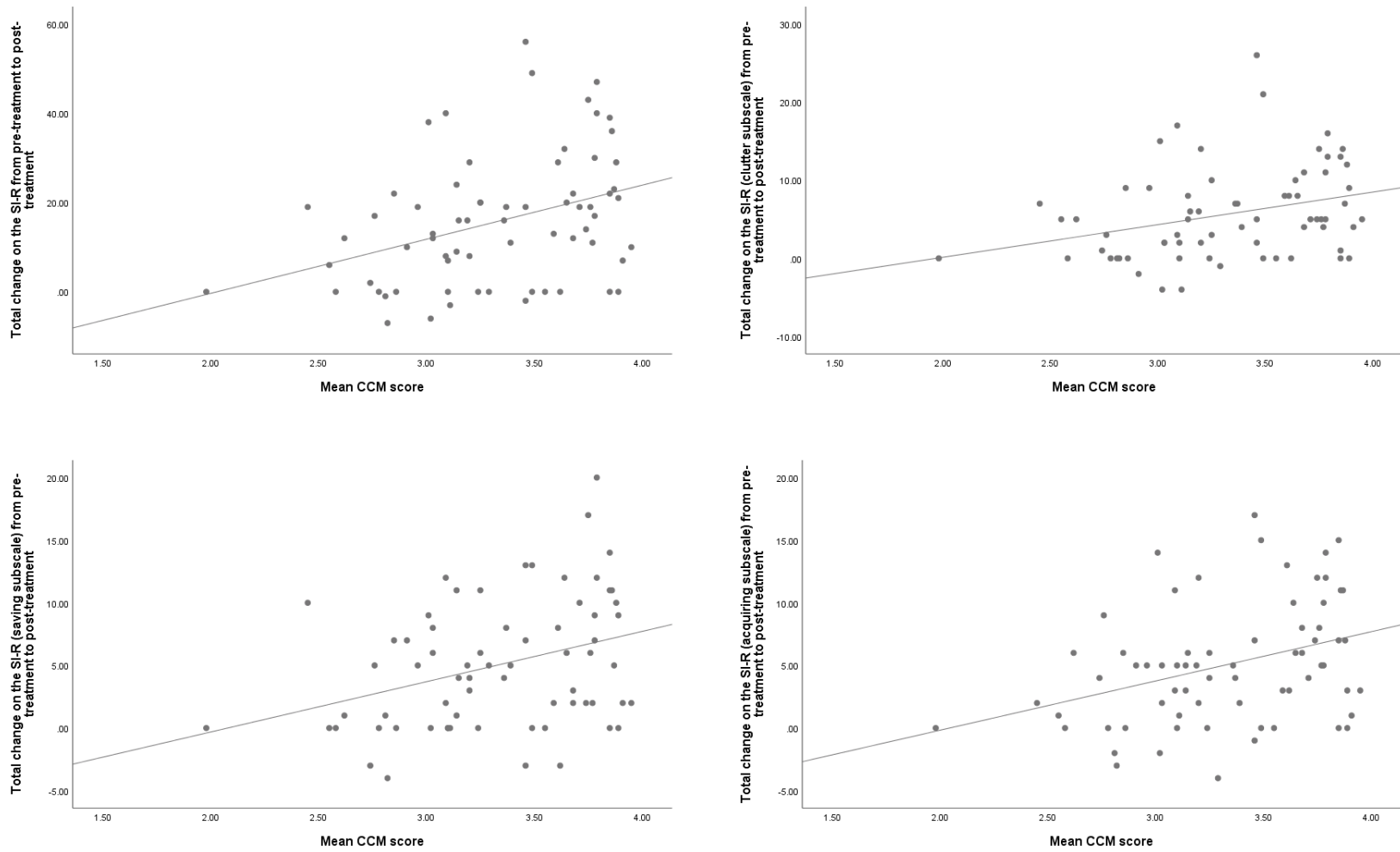*Between-Session Compliance and Relationship with Hoarding Severity*

Figure 1.

Scatterplots outlining relationship between Mean CCM scores and change on the SI-R and its subscales at post-treatment .
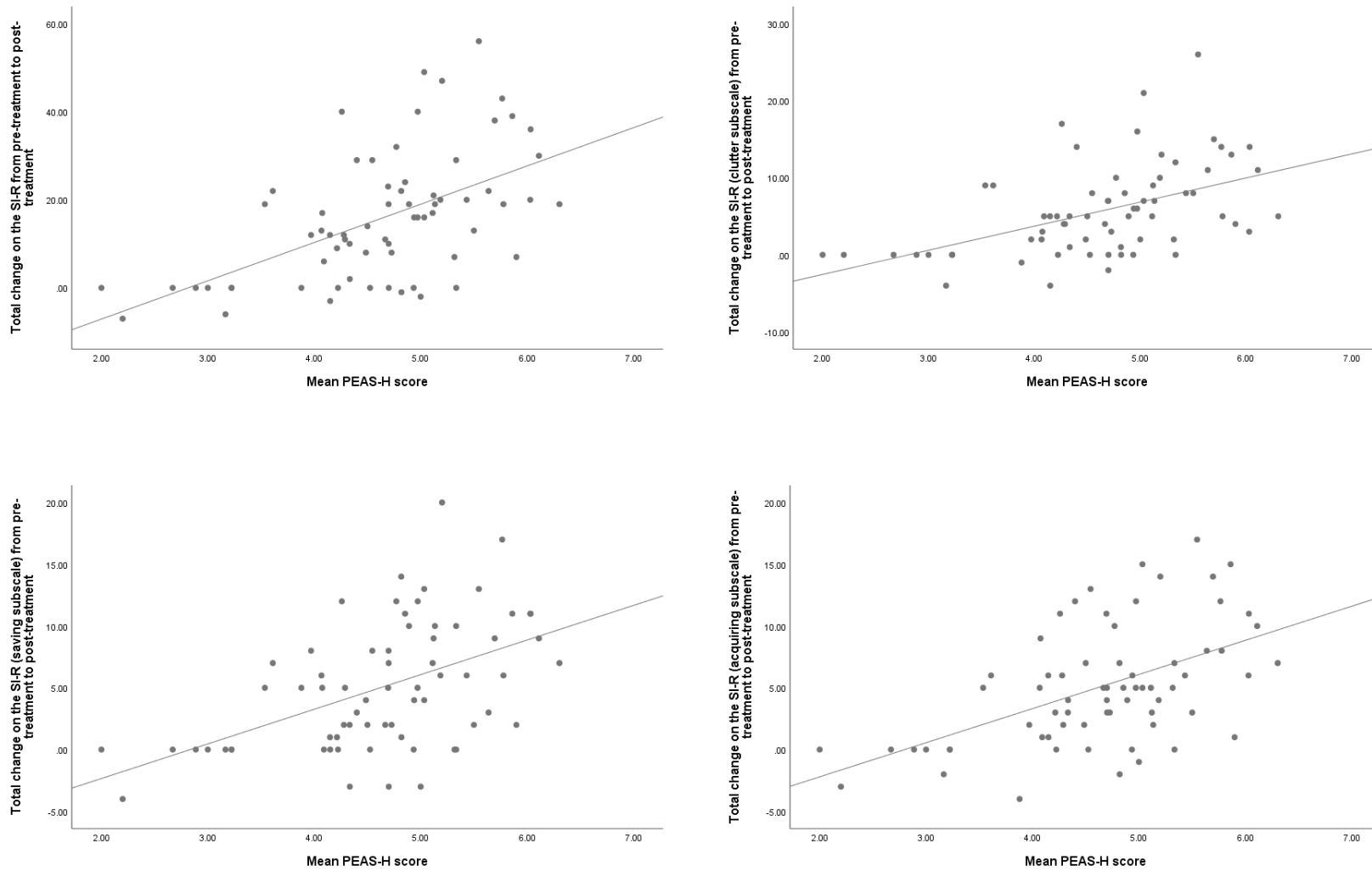
Figure 2.

Scatterplots outlining relationship between Mean PEAS-H scores and change on the SI-R and its subscales at post-treatment (ITT).
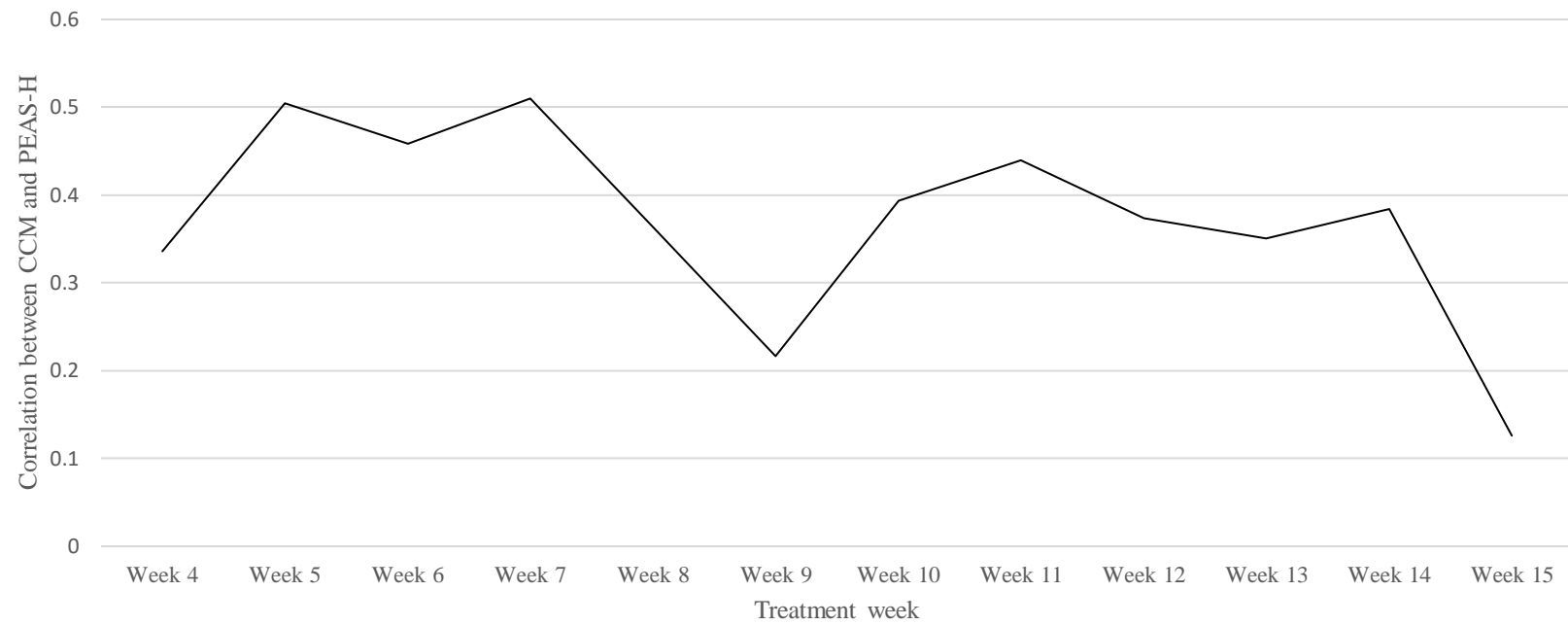
Figure 3.

Correlations between the CCM and PEAS by treatment week.

APPENDIX

CBT Compliance Measure (CCM)1	To what extent did the patient understand the goals of treatment during the session?	**0** Not at all (Seemed to have no grasp of the goals of CBT or had completely inaccurate ideas)	**1** A bit	**2** Moderately (Could identify the goals of CBT if prompted, or was generally accurate with some minor errors)	**3** Much	**4** Very much (Accurately and/or spontaneously identified the goals of CBT)	
2	To what extent did the patient provide a report of treatment progress?	**0** Not at all (Did not provide any report, written or verbal, on progress)	**1** A bit	**2** Moderately (Provides a report on progress when prompted, some missing information or minor inaccuracies)	**3** Much	**4** Very Much (Provides a report on progress that was accurate, timely, and complete)	**-99** First session
3	To what extent did the patient's words and actions in session adhere to the session agenda?	**0** Not at all (Statements and actions had nothing to do with the session agenda; patient is consistently off-task)	**1** A bit	**2** Moderately (Statements and actions generally consistent with the aims of the session; occasionally off-task)	**3** Much	**4** Very Much (Every statement and action was consistent with the aims of the session)	
4	To what extent were the patient's comments and statements appropriate to the topic?	**0** Not at all (Completely rambling or tangential; no ability to remain on topic)	**1** A bit	**2** Moderately (Occasional rambling or getting off topic but generally follows conversation)	**3** Much	**4** Very Much (Very focused discussion; consistently on topic)	
5	To what extent did the patient cooperate with *attempts* to challenge thoughts or beliefs?	**0** Not at all (Completely unwilling or unable to identify or challenge thoughts; actively resists efforts)	**1** A bit	**2** Moderately (Cooperative but seems at times to be going through the motions; some resistance to exercise)	**3** Much	**4** Very Much (Active and willing participant; eager to challenge thoughts and consider alternatives)	**-99** Cognitive change not on agenda

#	Question	0	1	2	3	4	-99
6	To what extent did the patient cooperate with *attempts* to change behaviors?	**0** Not at all (Completely unwilling or unable to identify problem behaviors; actively resists efforts)	**1** A bit	**2** Moderately (Cooperative but seems at times to be going through the motions; some resistance to exercise)	**3** Much	**4** Very Much (Active and willing participant; eager to identify problem behaviors and work on new ones)	**-99** Behavior change not on agenda
7	To what extent did the patient make appropriate reports of thoughts and feelings in session?	**0** Not at all (Completely unwilling or unable to report thoughts and feelings; or report is completely inaccurate or inappropriate)	**1** A bit	**2** Moderately (Can identify thoughts and feelings when prompted; or occasionally report seems inaccurate or inappropriate)	**3** Much	**4** Very Much (Reports thoughts and feelings in an accurate, spontaneous, and appropriate manner consistently)	
8	To what extent did the patient adhere to the time requirements of the session (e.g., arrive on time, remain in the room throughout the session, leave on time)?	**0** Not at all (Barely attended or did not attend at all)	**1** A bit	**2** Moderately (Out of room for some of the session, but generally present enough to benefit)	**3** Much	**4** Very Much (Perfect adherence to time requirements)	

PEAS-H

A) Sorting/Discarding Assignments: what % of sorting/discarding assignments did the patient attempt since the last visit?

99   Not assigned
1   None (0%)
2   Minimal (<10%)
3   Very few (~25%)
4   About half (~50%)
5   Many (~75%)
6   Most (>90%)
7   All that were assigned (100%)

B) Sorting/Discarding Assignments: how well did the patient do the assigned sorting/discarding tasks that were attempted?

99   Sorting/discarding tasks not assigned
1   Refused– did none of the assigned sorting/discarding tasks
2   Attempted sorting/discarding tasks with <u>no</u> intent or attempt to refrain from compulsions (e.g., few or minimal sorting/discarding tasks conducted with full intent to ritualize after)
3   Attempted sorting/discarding tasks with intention of refraining from compulsions but with obvious reluctance (e.g., spent little time on sorting/discarding tasks, did some compulsions during the sorting/discarding tasks without making real effort to refrain)
4   Made a good effort to conduct the sorting/discarding tasks as assigned by the therapist but gave into compulsions during or after the sorting/discarding tasks
5   Good—completed the sorting/discarding tasks as assigned by the therapist (e.g., appropriate tasks, correct amount of time) with minimal compulsions or safety aids during or afterwards
6   Very good— sorting/discarding tasks performed as assigned by the therapist (e.g., appropriate tasks, correct amount of time, no compulsions during or afterwards, no safety aids)
7   Excellent—all of the sorting/discarding tasks attempted were performed as assigned by the therapist (e.g., appropriate tasks, correct amount of time, no compulsions during or afterwards, no safety aids), the patient facilitated the process (e.g., made modifications to the assignment that increased the difficulty), and the patient looked for opportunities to extend the sorting/discarding homework into their lifestyle

C) Acquiring: what % of urges to acquire did patient successfully resist since the last visit? (If instructions to refrain from acquiring are not yet in effect, rate based on compliance with therapist's instructions for refraining from acquiring).

99   Not assigned
1   None (0%)
2   Minimal (<10%)
3   Sporadically (~25%)
4   About half (~50%)
5   Many (~75%)
6   Most (>90%)
7   Most (> 90%) and discarded the item if they slipped and acquired something OR no urges because symptoms are so minimal or 100% refraining from acquiring.