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Patient constructive learning behavior in cognitive therapy: A pathway for improving patient memory for treatment?☆

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ABSTRACT

Patient memory for treatment is poor and associated with worse outcome. The Memory Support Intervention was designed to improve outcome by enhancing patient memory for treatment. Half of the strategies comprising the Memory Support Intervention (termed constructive memory support strategies) involve therapists inviting patients to construct new ideas, inferences, or connections related to treatment material that go beyond information already presented by therapists. This study investigated the relationship between patient responses to therapist use of constructive memory support strategies and patient recall of treatment contents. Therapist uses of constructive memory support strategies were coded from sessions recorded during a pilot trial of the Memory Support Intervention in the context of cognitive therapy for depression (n = 44 patients). Patients who successfully constructed new ideas, inferences, or connections (termed patient constructive learning behavior) in response to therapist use of constructive memory support strategies showed greater recall of treatment contents. Mediation analyses provided some evidence that patient constructive learning behavior may be a mechanism through which the Memory Support Intervention results in enhanced patient memory. Results highlight patient constructive learning behavior as a potential pathway for improving patient memory for treatment.

Patient memory for the contents of psychological treatment is poor. In cognitive behavioral therapy (CBT) for insomnia, patients forget up to 80% of treatment recommendations (Chambers, 1991; Lee & Harvey, 2015). In CBT for depression, when patients think about CBT skills and concepts in between sessions, less than half of these thoughts reflect accurate recall of content presented during sessions (Gumport, Williams, & Harvey, 2015). One decade after receiving behavioral couples counseling, up to 55% of patients cannot recall any skills presented (Hahlweg & Richter, 2010). Unsurprisingly, poor memory for treatment is associated with worse treatment adherence and worse treatment outcomes across both psychological and medical treatments (Bober, Hoke, Duda, & Tung, 2007; Dong, Lee, & Harvey, 2017a; Jansen et al., 2008; Lee & Harvey, 2015; Tosteson et al., 2003).

These findings prompted the development and evaluation of the Memory Support Intervention, an adjunctive intervention composed of eight memory support strategies derived from the educational and cognitive psychology literature that therapists deliver alongside treatment-as-usual (Table 1; Harvey et al., 2014). The goal of the Memory Support Intervention is to increase patient memory for *treatment points*, defined as insights, skills, or strategies that the therapist thinks are important for the patient to remember and/or implement as part of the treatment (Lee & Harvey, 2015). The intervention does not aim to enhance general memory functioning per se. It is important to note that several recommended practices within treatment-as-usual may function as memory support strategies (e.g., providing regular capsule summaries, discussing material covered in previous sessions, summarizing at the end of the session). However, the frequency of memory support in treatment-as-usual may be lower than optimal. In one study, therapists delivering cognitive therapy (CT)-as-usual used memory support strategies approximately eight times per session (Harvey et al., 2016), whereas preliminary analyses suggest that approximately double this amount is needed to maximize memory for treatment and clinical outcome (Lee, Dong, & Harvey, 2018). Accordingly, the Memory Support Intervention aims to increase the frequency of memory support beyond what is found in treatment-as-usual.

A pilot randomized controlled trial of the Memory Support Intervention in the context of CT for depression suggested that adding the intervention was associated with small to medium effect sizes in the expected direction on mood outcomes, although none were statistically significant (Harvey et al., 2016). While this initial signal of overall efficacy was encouraging, several questions remain unanswered. Specifically, it is unknown (1) which memory support strategies are the most

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Table 1
Memory support strategies.

Strategy	Definition
Attention Recruitment	Involves the therapist using expressive language that explicitly communicates to the patient that a treatment point is important to remember (e.g., "if there is one thing I would like you to remember in ten years time, it is this skill"), or multimedia/diverse presentation modes (e.g., using a white board) as a means to recruit the patient's attention.
Categorization	Involves explicit effort by the therapist to work with the patient to group treatment points discussed into common themes/principles (e.g., "Let's create a list of ways we can work on waking up at the same time each morning.").
Evaluation	Involves the therapist working with the patient to (a) discuss the pros/cons of a treatment point (e.g., "What would be some advantages/disadvantages of waking up at the same time each morning?"); or (b) use comparisons to compare a new treatment point to an existing or hypothetical alternative (e.g., "How would this new strategy of exercising more compare to your current habit of lying in bed when you are feeling depressed?").
Application	Involves the therapist working with the patient to apply a treatment point to past, present, or future (real or hypothesized) scenarios (e.g., "Can you think of an example in which you might try this new method of coping to deal with your stress at work?").
Repetition	Involves the therapist restating, rephrasing, or revisiting information discussed in treatment (e.g., "in other words," "as we talked about earlier," or "in sum").
Practice Remembering	Involves the therapist facilitating the patient to regenerate, restate, rephrase, and/or revisit a treatment point (e.g., "Can you tell me some of the main ideas you've taken away from today's session?).
Cue-Based Reminder	Involves the therapist helping the patient develop new or existing cues (e.g., text reminders) to facilitate memory for treatment points.
Praise Recall	Involves the therapist rewarding the patient for successfully recalling a treatment point (e.g., "It's really great that you remembered that point!") or remembering to implement a desired treatment point (e.g., "I'm so glad you remembered to step back and look at the evidence.").

effective for improving patient memory for treatment, (2) what the mechanisms of action are through which memory support strategies improve patient memory for treatment, and (3) how to optimally deliver memory support strategies to engage the mechanisms of action. Answering these questions reflect important steps in intervention development (Borkovec, Newman, Pincus, & Lytle, 2002; Kazdin, 2007). The current study seeks to apply recent advances in cognitive science towards this purpose in order to inform future iterations of the Memory Support Intervention.

Convergent evidence suggests that constructive educational activities, which involve learners generating new ideas, inferences, or connections that go beyond what is explicitly presented, result in better memory outcomes than activities that involve passively absorbing information (e.g., listening to a lecture) or interacting with learning material without generating new content (e.g., rehearsing previously learned information) (Chi & Wylie, 2014; Menekse, Stump, Krause, & Chi, 2013). The definition of constructive educational activities highlights the central role of learner behavior (e.g., learners generating new ideas, inferences, connections) in memory for learning material.

The concept of constructive educational activities is highly relevant to the line of research evaluating the Memory Support Intervention because (1) patients' responses (i.e., learner behaviors) to therapist use of memory support strategies have not been examined, and (2) not all memory support strategies offer patients the opportunity to be constructive in their learning of treatment material. Notably, only half of the memory support strategies (application, evaluation, categorization, cue-based reminder) currently comprising the Memory Support Intervention involve therapists inviting patients to elaborate on treatment information in ways that can be considered constructive. In the current study, we termed these four strategies *constructive memory* support *strategies*, because they involve patients constructing new ideas, inferences, or connections, even though therapists sometimes use these strategies in ways that do not encourage constructive learning behaviors or patients may fail to actually generate any new ideas, inferences, or connections. The other half of strategies comprising the Memory Support Intervention (attention recruitment, repetition, practice remembering, praise recall) do not involve prompting patients to construct new ideas, inferences, or connections. We termed these *non-constructive memory* support *strategies*. Previous findings in the cognitive science literature indicating the superiority of constructive educational activities suggest that constructive memory support strategies may have a larger effect on patient memory for treatment than the non-constructive strategies (Chi & Wylie, 2014; Menekse et al., 2013).

Constructive memory support strategies may result in better patient memory relative to non-constructive strategies by facilitating *patient constructive learning behaviors*. Patient constructive learning behaviors are defined as occurring when patients generate new ideas, inferences, or connections about treatment contents presented by the therapist (e.g., identifying a new situation in which to apply a therapy skill). As patient constructive learning behaviors in theory represent a more proximal predictor of memory (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001; Chi & Wylie, 2014), these behaviors are expected to show a stronger relationship to patient memory for treatment than therapist use of constructive memory support strategies. Increasing patient constructive learning behaviors may also be one mechanism through which the Memory Support Intervention results in enhanced memory for treatment. Importantly, all these relationships may be observed both within a single session (e.g., constructive learning behaviors in a single session predicting past session memory), and across treatment (e.g., average constructive learning behaviors across treatment predicting cumulative memory for treatment).

The way that therapists deliver constructive memory support strategies may influence the likelihood that patients will display constructive learning behaviors in response. For example, patient constructive learning behavior may be more likely if the therapist *invites a response* from the patient instead of the therapist providing new ideas, inferences, or connections directly to the patient. Additionally, when patients initially struggle to respond to the therapist's use of a constructive memory support strategy, therapists who use *scaffolding* may be more successful at eliciting patient constructive learning behavior than therapists who do not. Scaffolding for this context is defined as guided prompting that attempts to elicit further responses from the patient instead of directly providing a correct answer or changing the topic of the conversation (Chi et al., 2001).

The current study includes five specific aims. The first aim is to describe the frequency of patient constructive learning behavior in the context of therapist use of constructive memory support strategies. We hypothesized that some patient constructive learning behavior would be observed. The second aim is to examine the effect of therapist invitation to respond and therapist scaffolding on the likelihood of patient constructive learning behavior. We hypothesized that patient constructive learning behaviors would be more likely when the therapist invited a response from the patient or used scaffolding versus not. The third aim is to examine the relationship between patient constructive learning behavior and patient memory for treatment. We hypothesized that more occurrences of constructive learning behaviors would be associated with greater memory for treatment. The fourth aim is to compare the strength of the relationships between patient constructive learning behavior, therapist use memory support strategies, and patient memory for treatment. We hypothesized that patient constructive learning would show a stronger relationship to patient memory than therapist use of constructive memory support strategies, and that therapist use of constructive memory support strategies would show a stronger relationship to patient memory than therapist use of non-constructive memory support strategies. The fifth and final aim is to test patient constructive learning behavior as a mediator through which the Memory Support Intervention results in enhanced memory for treatment. We hypothesized that there would be a significant indirect effect of the Memory Support Intervention on patient memory for treatment, such that receiving the Memory Support Intervention would increase patient constructive learning behaviors, which would in turn result in enhanced memory for treatment. Additionally, we investigated aims three, four, and five in the context of two single sessions (mid-treatment, and final session), as well as across treatment.

1. Method

1.1. Study overview

Data for the current study were drawn from a pilot randomized controlled trial (NCT01790919) comparing cognitive therapy-as-usual (CT-as-usual) to cognitive therapy integrated with the Memory Support Intervention (CT + Memory Support) for adults with Major Depressive Disorder ($N = 48$). Patients in both conditions received 14 weekly, 50-min, individual sessions with a therapist holding a master's or doctoral degree in psychology. All sessions were video recorded. Therapists in both conditions delivered CT according to an identical protocol, using handouts of the same quality and quantity. Providers in the CT + Memory Support condition were additionally trained to use the strategies in the Memory Support Intervention and were instructed to incorporate these strategies as much as possible during sessions. As described above, because several recommended practices within CT-as-usual may function as memory support strategies (e.g., providing regular capsule summaries may function as repetition), there was also some level of memory support used in the CT-as-usual condition. The mean number of memory support strategies used per session was 18.32 (SD = 8.83) in the CT + Memory Support condition, and 8.83 ($SD = 3.87$) in the CT-as-usual condition. Thus, the two conditions differed in the overall frequency or *dose* or memory support, rather than the presence or absence of memory support. Additional details about the procedures for the trial are described elsewhere (Harvey et al., 2016). Four participants from the trial dropped out before starting treatment or after a small number of sessions, and did not provide sufficient data to be included in the present analysis. Demographic characteristics for patients included in the present study ($N = 44$) are displayed in Table 2. The University of California, Berkeley, Committee for the Protection of Human Subjects approved all study procedures.

Table 2
Participant demographic characteristics (N = 44).

Characteristic	*n* or *M*	% or *SD*
Age	43.41	10.27
Gender		
Female	25	56.82%
Male	19	43.18%
Race		
Caucasian	33	75.00%
Asian	4	9.09%
African American	1	2.27%
American Indian/Alaska Native	1	2.27%
Multi-racial	1	2.27%
Ethnicity		
Hispanic	7	15.91%
Non-Hispanic	37	84.09%
Years of Education	15.93	1.91

1.2. Measures

1.2.1. Therapist use of memory support strategies

Therapist use of memory support strategies was measured with the Memory Support Rating Scale (MSRS; Lee, Worrell, & Harvey, 2016). The MSRS is an observer-rated measure that indexes the total number of times therapists use each of the eight different types of memory support included in the Memory Support Intervention within a session. The MSRS also provides timestamps for each therapist use of memory support. The MSRS has demonstrated acceptable inter-rater reliability, convergent validity with patient recall of treatment contents, and discriminate validity with unrelated observer-rated measures of therapy sessions (Lee et al., 2016). During the pilot trial, for each patient sessions were randomly selected for MSRS coding during the first third of treatment (sessions 1–5), second third of treatment (sessions 6–10), and final third of treatment (sessions 11–14). This selection process was chosen to limit MSRS coding for each patient to a feasible number of sessions while maintaining an adequate sampling of sessions across treatment. Additionally, sessions 7 and 14 were typically coded if not randomly selected because the mid-treatment and post-treatment assessments (which included measures of recall) occurred immediately after these sessions. An average of 3.15 sessions were coded per patient ($SD = 1.15$). Two summary variables were derived from the MSRS coding: (1) the total number of constructive memory support strategies used by therapists per session, and (2) the total number of non-constructive memory support strategies used by therapists per session. The total number of constructive memory support strategies used by therapists in an individual session was obtained by summing the total number of times therapists used application, evaluation, categorization, and cue-based reminders. The total number of non-constructive memory support strategies used by therapists in an individual session was obtained by summing the total number of times therapists used repetition, attention recruitment, practice remembering, and praise recall. Across all sessions coded with the MSRS ($n = 154$), 468 instances of constructive memory support strategies and 1828 instances of non-constructive memory support strategies were coded.

1.2.2. Patient memory for treatment

Patient memory for treatment was measured using the Patient Recall Task (PRT; Lee & Harvey, 2015). The PRT is a free recall measure of patient memory, during which patients are given a sheet of paper and asked to take 10 min to recall as many treatment points as they can remember from all of the sessions they have had so far ("cumulative recall") as well as their most recent session ("past session recall"). Treatment points are defined for patients as "insights, skills, or strategies that you [the patient] think are important to remember and/or implement as a part of treatment." The overall number of treatment points recalled was determined using a scoring rubric developed in a previous study (Lee & Harvey, 2015). According to the rubric, recall responses must be consistent with CT to count towards the overall total. For example, "thoughts contribute to feelings" would count as one, but "keep my emotions positive" would not. If a patient writes the same idea more than once, one point is awarded to the group of responses. One expert coder evaluated all the PRT responses in the present sample (Harvey et al., 2016). The expert coder established excellent inter-rater reliability between two independent coders ($n = 32$, $r = 0.92$, $p < 0.001$) and predictive validity of clinical outcome ($n = 30$, r's = 0.34–0.69, p's < 0.001–0.154) in a previous study (Lee & Harvey, 2015). In the present sample, the PRT total scores demonstrated predictive validity with the amount of memory support received (r's = 0.29–0.36, p's = 0.022–0.073) (Harvey et al., 2016). Because the PRT was evaluated by one expert coder, inter-rater reliability could not be calculated in this sample. Patients completed the PRT at a mid-treatment assessment (immediately after session 7), post-treatment assessment (immediately after session 14), and 6-month follow-up assessment.

1.2.3. Covariates

Patient IQ and educational attainment (years of education completed) were tested as covariates in study analyses to control for the effect of patient baseline cognitive ability on the likelihood of patient constructive learning behaviors and recall of treatment contents. IQ was measured using the National Adult Reading Test (Nelson & Willison, 1991). Absolute depressive symptoms was tested as a covariate to control for the effect of depressive symptoms on memory (Burt, Zembar, & Niederehe, 1995). Depressive symptoms were measured using the self-report version of the Inventory of Depressive Symptomatology (Rush, Gullion, Basco, Jarrett, & Trivedi, 1996). Therapist was tested as a covariate to control for therapist effects (e.g., therapist competency). Finally, as aims two through four sought to investigate the relationships between therapist use of memory support, patient constructive learning behavior, and patient recall regardless of treatment condition, treatment condition was added as a covariate for these analyses. Because the two study conditions differed only in the dose of memory support, the relationships between therapist use of memory support, patient constructive learning behavior, and patient recall were not expected to differ between treatment groups. Indeed, neither treatment condition nor any other covariate described above showed statistically significant relationships with any outcomes evaluated in this study. Thus, the covariates were not included in the final analyses reported below.

1.3. Coding procedures

Therapist invitation to respond, therapist scaffolding, and patient constructive learning behaviors in the context of therapist use of constructive memory support strategies were measured using an observational coding system developed for this study. Using the timestamps provided by the MSRS, coders identified segments of session recordings when therapists used constructive memory support strategies. The development of coding system was an iterative process involving coding approximately 10% of all instances of constructive memory support strategies identified by the MSRS. Coders were one licensed clinical psychologist and one graduate student who were experienced delivering the Memory Support Intervention alongside cognitive therapy, a masters-level research assistant who was experienced with MSRS coding, and three undergraduate research assistants who received training about cognitive therapy for depression and the coding of memory support strategies.

1.3.1. Therapist invitation to respond

Therapists were coded as inviting patients to respond if the instance of constructive memory support involved the therapist either asking the patient a question or otherwise indicating that they expected a response from the patient (e.g., the therapist stops speaking and looks expectantly at the patient).

1.3.2. Therapist scaffolding

Therapist scaffolding was coded when, after the patient had provided an initial (usually unsatisfactory) response, the therapist attempts to elicit additional responses from the patient. Scaffolding was not coded if the therapist simply gave patients an answer or raised a new question or issue unrelated to the instance of constructive memory support. For example, scaffolding was coded when the therapist rephrased an initial question or elicited additional detail about the patient's initial response (e.g., “tell me more about that”).

1.3.3. Patient constructive learning behavior

Stemming from the definition of constructive educational activities provided by Chi and Wylie (2014), patient constructive learning behavior was coded when patients expressed ideas about the concepts and skills involved in cognitive therapy that went beyond information that was already stated by the therapist. Examples of constructive learning behaviors coded included patients providing an example of an abstract concept (e.g., an example of black-and-white thinking), giving a rationale for why a skill would be helpful, identifying themes among skills (e.g., behavioral experiments and thought records both improve mood by modifying thoughts), and generating ideas for cue-based reminders (e.g., placing paper thought records around the house).

1.3.4. Inter-coder agreement

Coders determined the presence/absence (coded 1/0) of therapist invitation to respond, therapist scaffolding, and patient constructive learning behavior separately for each instance of constructive memory support identified on the MSRS. Appendix 1 includes example transcripts with coding decisions. A total of 468 instances of constructive memory support use across 44 patients and 154 sessions were coded. Two coders rated each instance of constructive memory support and resolved discrepancies by consensus. Percent agreement for each coding variable was acceptable: 87.61% agreement for therapist invitation to respond, 80.13% for therapist scaffolding, and 83.11% for patient constructive behavior. Cohen's kappa's, which account for the possibility of chance agreement between raters (Cohen, 1960), indicated adequate agreement for therapist invitation to respond ($\kappa = 0.74$) and patient constructive behavior ($\kappa = 0.65$), but weak agreement for therapist scaffolding ($\kappa = 0.51$) according to established cutoffs. Inter-coder agreement for therapist scaffolding was high according to percent agreement but low according to Cohen's kappa due to the relatively low base rate of therapist use of scaffolding (see Results below), which inflated the probability that coders would agree by chance alone (Cohen, 1960).

1.4. Data Analysis

Multi-level logistic regression was used to examine the effect of therapist invitation to respond and therapist scaffolding on patient constructive learning behavior for Aim 2 (Raudenbush & Bryk, 2002). Multi-level logistic regression was selected instead of ordinary logistic regression in order to account for the nesting structure in the data (instances of therapist uses of memory support nested in patients). The fixed parts of the models included therapist invitation to respond or therapist scaffolding. The random parts of the models included random intercepts for the baseline odds of patient constructive learning behavior, and well as random slopes for the focal predictors (invitation to respond or therapist scaffolding).

Linear regression was used to examine the effect of patient constructive learning behavior on patient recall of treatment contents for Aim 3. We performed two sets of linear regressions.

First, we examined the effect of the average number of patient constructive learning behaviors per session across treatment on patient cumulative recall at post-treatment and 6-month follow-up. Second, we examined the effect of patient constructive learning behavior in the sessions immediately preceding the mid-treatment and post-treatment assessments on patient past session recall from those sessions. Only patients with MSRS coding completed for the sessions immediately preceding the mid-treatment assessment ($n = 36$) and post-treatment assessment ($n = 33$) were included in this second set of linear regressions. Participants who completed the mid- and post-treatment assessments but did not have MSRS data available for the sessions immediately preceding these assessments were not included in the analyses to avoid excessive error due to extensive missing data. Additionally, analyses of missing data indicated that mid-treatment and final session MSRS data were missing completely at random, indicating that excluding cases with missing MSRS data at these time points would not bias our findings (Rubin, 1976).

Five to ten percent of treatment recall data was missing for participants included in the different linear regression analyses. These missing data were handled using multiple imputation, which involves generating multiple datasets that fill in missing values with a variety of plausible values given other observed responses (Enders, 2017). Statistical tests are then conducted in each imputed dataset and pooled into a final result. Multiple imputation was selected instead of complete case analysis to increase the sample size of the analyses and increase power (Enders, 2017).

Additional linear regressions were conducted according to the procedure specified for Aim 3 to obtain regression coefficients for the effects of therapist use of constructive and non-constructive memory support strategies on patient recall of treatment contents (Aim 4). These coefficients were then compared to each other and those for the effects of patient constructive learning behavior on recall by dividing the difference between coefficients by the standard error of the difference, which yields a *z* test statistic (Clogg, Petkova, & Haritou, 1995). Due to the directional hypotheses specified for Aim 4, one-tailed *p*-values were obtained for each *z*-value.

For Aim 5, linear regression was used to obtain estimates for all individual path coefficients (Hayes & Rockwood, 2017), including: (path *a*) the effect of treatment condition (*x* variable) on patient constructive learning behaviors (*m* variable); (path *b*) the effect of patient constructive learning behaviors on patient recall (*y* variable), controlling for treatment condition; (path *c*) the direct effect of treatment condition on patient recall, not controlling for patient constructive learning behaviors; and (path *c'*) the direct effect of treatment condition on patient recall, controlling for patient constructive learning behaviors. The indirect effect of treatment condition on patient recall through patient constructive learning behaviors was formally tested by dividing the product term *ab* by the standard error of the product, which yields a z-test statistic (also known as the Sobel test) (Hayes & Scharkow, 2013). While the Sobel test has been demonstrated to produce a more conservative evaluation of mediation in comparison alternative approaches (e.g., boot-strap confidence intervals), there is no established method to implement alternative approaches in the context of missing data handling with multiple imputation (Hayes & Scharkow, 2013).

All analyses were completed in R (R Core Team, 2016). Multi-level logistic regression was conducted using the lme4 package (Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2018). Multiple imputation was conducted using the mice package (van Buuren & Groothuis-Oudshoorn, 2011). Two-sided alpha level of 0.05 was used throughout except for Aim 4.

2. Results

2.1. Aim 1: describe the frequency of patient constructive learning behavior in the context of therapist use of constructive memory support strategies

Among the 468 instances of therapist use of constructive memory support strategies, patient constructive learning behavior was observed in 177 (37.82%). Across all sessions ($N = 154$), the average number of patient constructive learning behaviors was 1.15 per session ($SD = 1.48$).

2.2. Aim 2: examine the effect of therapist invitation to respond and therapist scaffolding on the likelihood of patient constructive learning behavior

Among the 468 instances of therapist use of constructive memory support, 273 instances (58.33%) involved the therapist inviting a response from the patient, and 131 instances (28.00%) involved the therapist using scaffolding. Fixed effects results from multi-level logistic regression indicated that when the therapists' use of constructive memory support involved inviting a response from the patient versus not, this was associated with increased odds of patient constructive learning behaviors ($b = 2.01$, $SE = 0.35$, $p < 0.001$). Similarly, when the therapists' use of constructive memory support involved scaffolding the patient versus not, this was also associated with increased odds of patient constructive learning behaviors ($b = 1.78$, $SE = 0.24$, $p < 0.001$). These effects correspond to a 7.98-fold and 5.93-fold increase in the odds of patient constructive learning behavior when the therapist invited a response from the patient or used scaffolding, respectively.

Table 3
Observed (pre-imputation) descriptive statistics for linear regression variables.

Variable	*n*	*M*	*SD*
Therapist Use of MS Strategies			
Number of Constructive MS Strategies			
Mid-Treatment Session	36	2.08	2.14
Final Session	33	3.79	3.57
Average Per Session Across Treatment	44	2.75	1.92
Number of Non-Constructive MS Strategies			
Mid-Treatment Session	36	11.00	8.95
Final Session	33	12.58	10.25
Average Per Session Across Treatment	44	10.50	6.97
Number of Patient Constructive Learning Behaviors			
Mid-Treatment Session	36	0.81	1.04
Final Session	33	1.42	1.77
Average Per Session Across Treatment	44	1.02	0.97
Patient Recall of Treatment Contents[a]			
Past Session Recall			
Mid-Treatment	34	4.26	2.55
Post-Treatment	31	4.71	4.32
Cumulative Recall			
Post-Treatment	40	9.00	5.11
6-Month Follow-Up	40	8.13	4.84

Note. MS = Memory support.
[a] Metric is number of treatment points recalled during the Patient Recall Task.

2.3. Aim 3: examine the relationship between patient constructive learning behavior and patient recall of treatment contents

Table 3 presents descriptive statistics for observed (pre-imputation) values for all variables used in the linear regression analyses reported below. A first set of linear regressions examined the effect of the average number of patient constructive learning behaviors per session across treatment on patient cumulative recall at post-treatment and 6-month follow-up. The average number of patient constructive learning behaviors per session significantly predicted cumulative recall of session contents at post-treatment, such that each additional occurrence of constructive learning behavior per session was associated with an additional 2.26 cumulative treatment points recalled ($b = 2.26$, $p = 0.003$) at post-treatment. The average number of patient constructive learning behaviors per session was not associated with cumulative recall at the 6-month follow-up assessment ($b = 0.78$, $p = 0.313$).

The second set of linear regressions examined the effect of patient constructive learning behavior in the sessions immediately preceding the mid-treatment and final session assessments on patient past session recall from those sessions. The number of patient constructive learning behaviors in the session immediately preceding the mid-treatment assessment significantly predicted patient recall of treatment contents from that session, such that each additional occurrence of constructive learning behavior in the previous session was associated with an additional 0.96 treatment points recalled ($b = 0.96$, $p = 0.019$) about that session. The number of patient constructive learning behaviors in the session immediately preceding the post-treatment assessment was not associated with recall of treatment contents from that session ($b = 0.41$, $p = 0.350$).

Table 4
Linear regression parameters for the effects of therapist use of memory support strategies and patient constructive learning behaviors on patient recall of treatment contents.

Outcome	*n*	Patient constructive learning behaviors			Therapist use of constructive MS strategies			Therapist use of non–constructive MS strategies		
		b	*SE*	*P*	*b*	*SE*	*p*	*b*	*SE*	*p*
Cumulative Recall: Post-Treatment[a]	44	2.26	0.72	0.003	0.92	0.38	0.020	0.20	0.11	0.066
Cumulative Recall: 6-Month Follow-Up[a]	44	0.78	0.77	0.313	0.37	0.39	0.353	0.09	0.11	0.340
Past Session Recall: Mid-Treatment Session[b]	36	0.96	0.39	0.019	0.32	0.20	0.117	0.05	0.05	0.265
Past Session Recall: Final Session[b]	33	0.41	0.43	0.350	0.11	0.22	0.626	0.01	0.07	0.896

Note. MS = memory support.
[a] Analyses evaluated the effect of average therapist use of memory support strategies and patient constructive learning behaviors across treatment on cumulative patient recall of treatment contents.
[b] Analyses evaluated the effect of therapist use of memory support strategies and patient constructive learning behaviors within one session on patient recall of treatment contents from that session. Only those with Memory Support Rating Scale coding available for the mid-treatment session and post-treatment session were included (see Data Analysis section).

Table 5
Comparisons between linear regression coefficients for effects of patient constructive learning behaviors and therapist use of memory support strategies on patient recall of treatment contents.

Outcome	Patient constructive learning behaviors vs. therapist use of constructive MS strategies		Patient constructive learning behaviors vs. therapist use of non-constructive MS strategies		Therapist use of constructive MS strategies vs. therapist use of non-constructive MS strategies	
	z	*p*	*z*	*p*	*z*	*p*
Cumulative Recall: Post-Treatment[a]	1.65	0.050	2.84	0.002	1.82	0.035
Cumulative Recall: 6-Month Follow-Up[a]	0.48	0.314	0.89	0.186	0.68	0.249
Past Session Recall: Mid-Treatment Session[b]	1.47	0.070	2.31	0.010	1.29	0.098
Past Session Recall: Final Session[b]	0.62	0.267	0.91	0.180	0.42	0.336

Note. MS = memory support; *p*-values are one-tailed due to directional hypotheses.
[a] Linear regression analyses evaluated the effect of average therapist use of memory support strategies and patient constructive learning behaviors across treatment on cumulative patient recall of treatment contents.
[b] Linear regression analyses evaluated the effect of therapist use of memory support strategies and patient constructive learning behaviors within one session on patient recall of treatment contents from that session.

2.4. Aim 4: compare the strength of the relationships between patient constructive learning behavior, therapist use memory support strategies, and patient recall of treatment contents

Table 4 presents linear regression parameters for the effects of therapist use of memory support strategies and patient constructive learning behaviors on patient recall of treatment contents. Table 5 presents comparisons between the linear regression coefficients. The hypothesized relationships between regression coefficients was only found in the analyses predicting patient cumulative recall at post-treatment from the average number of patient constructive learning behaviors and therapist use of memory support strategies per session across treatment. For these analyses, the effect of patient constructive learning behaviors was larger than the effects of therapist use of constructive and non-constructive memory support strategies on recall ($zs = 1.65–2.84$, $ps = 0.002–0.050$). These results indicate that one additional patient constructive learning behavior per session across treatment was associated with greater cumulative recall than one additional therapist use of constructive or non-constructive memory support strategies. The effect of therapist use of constructive memory support strategies was also larger than the effect of therapist use of non-constructive memory support strategies ($z = 1.82$, $p = 0.035$), indicating that one additional therapist use of constructive memory support strategies per session across treatment was associated with greater cumulative recall than one additional therapist use of non-constructive memory support strategies.

2.5. Aim 5: test patient constructive learning behavior as a mediator through which the Memory Support Intervention results in enhanced memory for treatment

Linear regression path coefficients and Sobel tests for the indirect effect of treatment condition on patient recall through patient constructive learning behaviors are presented in Table 6. Regarding path *a*, treatment condition was associated with the average number of patient constructive learning behaviors per session across treatment, such that those receiving the Memory Support Intervention displayed more constructive learning behaviors ($b = 0.67$, $p = 0.022$). No other regression coefficients for path *a* reached statistical significance. Regarding path *b*, the average number of patient constructive learning behaviors per session across treatment predicted cumulative recall at post-treatment, and the number of patient constructive behaviors in the mid-treatment session predicted past session recall from the mid-treatment session. These relationships were already evaluated under aim three above. No other regression coefficients for path *b* reached statistical significance. For the mediation model testing the indirect effect of treatment condition on cumulative recall at post-treatment through the average number of constructive learning behaviors per session across treatment, while both paths *a* and *b* were statistically significant individually, the Sobel test did not reach statistical significance ($z = 1.82$, $p = 0.069$). No other Sobel tests approached statistical significance.

3. Discussion

This study sought to inform future iterations of the Memory Support Intervention (Harvey et al., 2014) by applying novel theories from cognitive psychology to identify effective intervention components, potential mechanisms of action, and methods to optimally engage mechanisms of action. Specifically, the construct of constructive educational activities (Chi & Wylie, 2014) was used to distinguish constructive memory support strategies from non-constructive memory support strategies, and to conceptualize patient constructive learning behavior in response to constructive memory support strategies as a potential mechanism of patient memory for treatment.

The first two aims of the current study were to describe the frequency of patient constructive learning behavior in the context of

Table 6
Linear regression path coefficients and Sobel tests for the indirect effect of treatment condition on patient recall through patient constructive learning behaviors.

Mediation Model																	
x	*m*	*y*	*n*	*a*			*b*			*c*			*c'*			Sobel Test	
				b	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*z*	*p*
Condition	Mean # constructive behaviors per session	Cumulative recall at post	44	0.67	0.28	0.022	2.15	0.77	0.008	1.98	1.52	0.201	0.64	1.49	0.671	1.82	0.069
Condition	Mean # constructive behaviors per session	Cumulative recall at FU6	44	0.67	0.28	0.022	0.73	0.83	0.386	0.58	1.56	0.711	0.10	1.65	0.953	0.82	0.410
Condition	# constructive behaviors in mid–treatment session	Past session recall after mid–treatment session	36	0.52	0.34	0.133	1.03	0.41	0.016	−0.06	0.87	0.944	−0.60	0.84	0.478	1.32	0.188
Condition	# constructive behaviors in final session	Past session recall at final session	33	1.11	0.60	0.075	0.26	0.46	0.576	1.66	1.59	0.308	1.37	1.67	0.421	0.54	0.588

Note. FU6 = 6-month follow-up assessment.

therapist use of constructive memory support strategies, and to examine if the way therapists delivered constructive memory support strategies influenced the likelihood of patient constructive learning behavior. Approximately 38% of therapist uses of constructive memory support strategies were associated with constructive learning behavior from patients. The odds of patient constructive learning behavior increased approximately eight-fold if the therapist's use of a constructive memory support strategy involved inviting a response from the patient, and increased approximately six-fold if the therapist used scaffolding. These results are consistent with studies of tutoring effectiveness, which show that increasing tutor use of open-ended questions (e.g., inviting a response) and scaffolding, and decreasing use of didactic explanations results in more student constructive learning behaviors and better learning outcomes (Chi et al., 2001).

While a minority of patients may engage in constructive learning behavior with minimal prompting or support from the therapist, these findings suggest that most will benefit from the therapist inviting a response and providing scaffolding. Indeed, among the 177 instances of patient constructive learning behavior observed in the present study, only 17 (9.60%) occurred without the presence of therapist invitation to respond or scaffolding. Therapists in the current study were not explicitly trained to deliver constructive memory support strategies with these guidelines. This is reflected in the observed frequencies of therapists inviting a response from patients and using scaffolding (in 58% and 28% of constructive memory support instances, respectively), which leave considerable room for improvement. Additionally, when therapists used scaffolding, they typically relied on a small number of scaffolding strategies including refocusing the patient by asking a question a second time, or prompting patients to be more specific after an initial vague answer. Therapists' ability to scaffold patients effectively may be increased by training in a variety of scaffolding strategies, such as presenting an example response from which patients can model their own response (Collins, Brown, & Holum, 1991), providing hints (Quintana et al., 2004), and "problematizing" patients' responses, which involves asking questions that highlight unresolved aspects of an initial response to invoke curiosity and motivation to generate additional responses (Reiser, 2004). Effective scaffolding ability may be essential to make constructive learning behavior accessible to patients from a variety of educational backgrounds and cognitive abilities (Chi, De Leeuw, Chiu, & Lavancher, 1994).

The third aim was to examine the relationship between patient constructive learning behavior and patient recall of treatment contents. In two of four analyses, patients who engaged in more constructive learning behaviors evidenced greater recall of treatment contents. Patient constructive learning behavior in the final session did not predict past session recall from that session. This null finding may reflect the structure of the final session, which was typically to review treatment points discussed over the course of treatment. Thus, in the context of the final session, the constructs of "past session recall" and "cumulative recall" overlap. Accordingly, past session recall at the final session may depend more on learning behaviors across the course of treatment than in the final session itself. Our finding that the average number of patient constructive learning behaviors across treatment predicted cumulative recall at post-treatment supports this hypothesis.

The average number of patient constructive learning behaviors across treatment did not predict cumulative recall at the 6-month follow-up assessment. This null finding cannot be explained by a general trend towards forgetting between post-treatment and follow-up, as the average number of treatment points recalled did not differ significantly between these two timepoints. One explanation of these results may be that the mechanisms of patient memory for treatment *after treatment has ended* differ from the mechanisms of patient memory *during treatment*. For example, in-session mechanisms (e.g., patient constructive learning behaviors) may contribute to patient memory for treatment during treatment, while mechanisms that occur outside the session (e.g., patient adherence to treatment) may occupy a more central role in patient memory after treatment has ended. Future research is needed to investigate these possibilities.

The fourth aim was to compare the effects of patient constructive learning behavior, therapist use of constructive memory support strategies, and therapist use of non-constructive memory support strategies on patient recall. In the analyses regressing cumulative recall at post-treatment on the average number of patient constructive learning behaviors and therapist uses of memory support strategies across treatment, the effects of patient constructive learning behavior on recall were larger than the effects of therapist use of constructive memory support strategies on recall, which were in turn larger than the effects of therapist use of non-constructive memory support strategies on recall. The remaining non-significant comparisons for other analyses (e.g., cumulative recall at follow-up) likely resulted from the null results discussed above.

The results from aim four provide initial support for the hypothesis, derived from the cognitive science literature (Chi & Wylie, 2014), that constructive memory support strategies are more effective at promoting patient memory for treatment than non-constructive memory support strategies. However, therapists trained in the Memory Support Intervention use non-constructive memory support strategies approximately four times as often as constructive memory support strategies (Dong, Lee, & Harvey, 2017b). This disparity in usage may reflect the greater effort and time required to use constructive memory support strategies relative to non-constructive strategies (e.g., engaging the patient in a discussion concerning how to apply a treatment point in a new situation vs. repeating a treatment point to the patient). Indeed, therapists not trained in the Memory Support Intervention only use non-constructive memory support strategies approximately three times as frequently as constructive strategies (Dong, Lee, et al., 2017b), suggesting that training in memory support may result in larger gains in non-constructive memory support strategy use relative to constructive memory support strategy use. Future research should investigate whether the Memory Support Intervention may be simplified by retaining only the constructive memory support strategies. Such a simplification might promote the successful dissemination of the intervention (Damschroder et al., 2009) as well as focus therapists' attention on the most effective memory support strategies. On the other hand, an exclusive focus on the more effortful constructive memory support strategies may be less tolerable to therapists and patients.

The fifth aim was to test patient constructive learning behavior as a mediator through which the Memory Support Intervention results in enhanced memory for treatment. There was some support for individual paths in the mediation models: that the Memory Support Intervention resulted in more patient constructive learning behaviors, and in turn that more frequent constructive learning behaviors predicted better patient recall of treatment contents. However, none of the formal tests for mediation reached statistical significance. These null results should be interpreted with caution and may reflect the increased probability of Type II error in this small, underpowered, pilot sample (Fritz & Mackinnon, 2007).

The findings from aim five provide some evidence that increasing patient constructive learning behavior may be a mechanism through which the Memory Support Intervention results in enhanced patient memory. Recognizing this mechanism may allow therapists to deliver the Memory Support Intervention in a more targeted manner. For example, patient constructive learning behavior could therefore provide a criterion by which therapists could judge whether to move on from an instance of constructive memory support or continue with scaffolding. Moreover, identifying patient constructive learning behavior as a pathway to enhanced memory for treatment also suggests additional strategies not currently included in the Memory Support Intervention. For example, using discovery-based learning methods to guide patients to construct their own treatment points as opposed to using memory support strategies to support recall of treatment points provided by the therapist (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011).

This study has several limitations. First, we only investigated patient constructive learning behaviors that occur in the context of therapist use of constructive memory support strategies. Future research should examine if patients also engage in spontaneous constructive learning behaviors. Second, the inter-rater reliability of coding variables (i.e., patient constructive learning behaviors, therapist invitation to respond, therapist scaffolding), especially as assessed by Cohen's kappa, were adequate though relatively low. These low values partially represent the low base rate of the coded variables, but also indicate the difficulty of adapting concepts from cognitive psychology for evaluation in the context of therapy. Third, the range of some study variables (e.g., number of patient constructive learning behaviors, therapist use of constructive memory support strategies), was somewhat restricted, which typically results in underestimating the strength of the relationship between variables (Bland & Altman, 2011). Relatedly, the frequency of patient constructive learning behavior was low, raising the possibility that these learning behaviors were not a central mechanism of recall in this study. However, the results suggest a promising potential for patient constructive learning as a mechanism of recall if targeted by effective interventions. Fourth, the scoring rubric for the Patient Recall Task (one point for each treatment point recalled), assumes that all treatment points are equally significant. While this counting method of measuring patient recall shows evidence of reliability and validity (Harvey et al., 2016; Lee & Harvey, 2015), there may be important differences in the quality, importance, or impact of recalled treatment points (Dong, Zhao, Ong, & Harvey, 2017). Fifth, this study used data from a small pilot trial not designed to investigate the statistical significance of the effects of interest. These results should be replicated in an adequately powered, confirmatory study. Finally, the analyses for aims two through four were correlational in nature, allowing for the possibility of alternative casual relationships. For example, it's possible that more patient constructive learning behaviors result in more therapist use of memory support strategies. However, experimental results from aim five suggesting that participants randomized to the Memory Support Intervention engaged in more constructive learning behaviors provides support for the causal relationships proposed by this study.

4. Conclusion

In summary, based on a small, pilot sample, this study provides initial evidence that patient constructive learning behaviors may represent an important pathway to enhanced patient memory for treatment. These constructive learning behaviors can be elicited by strategies comprising the Memory Support Intervention, and may be more likely to occur if therapists are trained to invite patients to express ideas, inferences, and connections about treatment contents and provide scaffolding to patients who experience difficulty going beyond what the therapist has presented.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.brat.2019.02.006.

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