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A Semantic Corpus Comparison Analysis of Couple-Focused Interventions for Problematic Alcohol Use

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Abstract

Incorporating spouses into interventions for problematic alcohol use is associated with increased efficacy; yet, little is known about the therapeutic processes that may explain these effects. In a study of partner language use during couple-focused alcohol interventions, we utilized a linguistic corpus comparison tool, Wmatrix, to identify semantic themes that differentiated couples with successful and unsuccessful treatment outcomes, and may therefore also reflect potential change processes. Thirty-three couples participated in a randomized control trial of Family Systems Therapy (FST) or Cognitive Behavioral Therapy (CBT). Linguistic comparisons of partners' speech during the therapy sessions suggested that *drinks and alcohol* was a significant differentiating semantic theme. Specifically, patients and spouses in FST with successful outcomes used *more* language related to *drinks and alcohol* than patients and spouses in FST with unsuccessful outcomes. Post-hoc analyses of context suggested that, in FST, successful spouses spoke less about the patient's drinking and more about alcohol in general (without reference to an individual) than unsuccessful spouses. Conversely, spouses in CBT with successful outcomes used *less* language related to *drinks and alcohol* than spouses in CBT with unsuccessful outcomes. In CBT, successful spouses spoke more about the patient's and couple's drinking, and less about the spouse's and other people's drinking than unsuccessful spouses. Results emphasize the role of spouse behavior—in this case indexed via language use—in alcohol treatment outcomes. Findings also suggest potentially distinct therapeutic processes in FST and CBT, and highlight the utility of linguistic corpus comparison methods in couple-focused intervention research.

Keywords

couples therapy; alcohol use; text analysis; language use; close relationships

Incorporating spouses in interventions for problematic alcohol use is associated with increased efficacy. Although couple relationship functioning has been found to predict successful alcohol treatment outcomes, the specific therapeutic change processes that may help to explain these effects remain largely unknown (McCrary, Stout, Noel, Abrams, &

Nelson, 1991; McCrady, Hayaki, Epstein, & Hirsch, 2002; McKay, Longabaugh, Beattie, Maisto, & Noel, 1992; O'Farrell, Choquette, Cutter, Brown, & McCourt, 1993; O'Farrell, Choquette, & Cutter, 1998). The majority of extant research adopts a theory-driven approach to studying therapeutic processes of change that relies largely on patient self-reports and observational measures that require specification of the behaviors or processes one wants to measure, and are therefore bound by the theoretical orientation of interest (Kerig & Baucom, 2004; Moos, 2007). Exploratory, data-driven methods have emerged in recent research as alternative, yet complementary, approaches to studying therapeutic change processes that have the potential advantage of revealing variables that may exist outside the "theoretical spotlight." The present study investigated partners' language use during two couple-focused alcohol interventions using a linguistic corpus comparison tool, Wmatrix. Specifically, we used this exploratory, data-driven method to identify semantic themes that emerged from partners' speech during a pretreatment alcohol discussion and subsequent therapy sessions and differentiated couples with successful and unsuccessful treatment outcomes. From the emergent semantic themes, we then focused on one theoretically relevant theme that may reflect important potential therapeutic processes during the couple-focused alcohol interventions.

Automatic text analysis (ATA) is a data-driven tool that has recently gained traction in clinical science, as it allows researchers to unobtrusively investigate psychological and interpersonal processes by extracting quantitative information about thematic and stylistic features from individuals' naturally occurring speech (Shapiro & Markoff, 1997). By assessing language use as it naturally unfolds, most often with little intention or conscious control, ATA helps to bypass some of the limitations of traditional self-report and observational methods to reveal information about psychological states, cognitive style, perspective and focus, and social and communal processes (Pennebaker, Mehl, & Niederhoffer, 2003). For example, self-reports can be susceptible to response biases such as social desirability (i.e., impression management and self-deceptive enhancement; Paulhus, 2002), or demand characteristics, and therefore, may have questionable accuracy with substance use populations (Del Boca & Noll, 2000). Although observational coding systems circumvent some of these concerns, they are time and labor intensive, and can be subject to poor reliability (Heyman, 2001). Linguistic Inquiry and Word Count (LIWC; Pennebaker, Booth, & Francis, 2007) is the most widely used and best validated ATA tool in psychological research. It employs a word count-based approach to describe texts based on relative frequencies of grammatical (e.g., pronouns, articles, prepositions) and psychological (e.g., emotion words, cognitive processing words) categories.

A growing body of research has used LIWC to investigate couples' relational and psychotherapeutic processes that are predictive of positive relationship functioning and treatment outcomes. One consistent finding in this area involves partners' use of personal pronouns—especially first-person plural pronouns (*we-talk*)—as markers of shared couple identity and a communal orientation to coping with health problems. For example, partners' use of *we-talk* during couple interactions has been associated with relationship satisfaction (Williams-Baucom, Atkins, Sevier, Eldridge, & Christensen, 2010), positive problem solving (Simmons, Gordon, & Chambless, 2005), and lower cardiovascular arousal during conflict (Seider, Hirschberger, Nelson, & Levenson, 2009). In the health arena, spouse *we-*

talk during a coping-focused interview predicted a favorable symptom course for heart failure patients over a six-month period (Rohrbaugh, Mehl, Shoham, Reilly, & Ewy, 2008) and better dyadic adjustment for breast cancer patients and their spouses (Robbins, Mehl, Smith, & Weihs, 2013). In the first study of pronoun use during couple-focused intervention, greater use of *we*-talk by health-compromised smokers and their spouses over the course of therapy predicted smoking cessation one year later (Rohrbaugh, Shoham, Skoyen, Jensen, & Mehl, 2012). In addition, recent studies of partner pronoun use during couple-focused alcohol interventions for alcohol use found that spouse *we*-talk during the interventions predicted successful treatment outcomes (Rentscher, Soriano, Shoham, Rohrbaugh, & Mehl, 2015) and patient abstinence six months post-treatment (Halgren & McCrady, 2015). Together, these findings suggest that partner language use during therapy may reflect relational processes, such as a communal orientation to coping with the health problem, that are important predictors of alcohol treatment outcome.

Although LIWC is a valuable data-driven tool that has been applied to the study of change processes during couple-focused interventions for substance use problems, it is based on a simple, decontextualized word-count technique that is subject to clear limitations. Given that LIWC was developed by psychologists for psychologists, its dictionary and pre-defined categories are not as extensive and refined as ATA tools developed by researchers with a more comprehensive interest in language. Notably, LIWC does not have the ability to disambiguate multiple meanings of words or account for the context or temporal sequence of words in a sentence. For example, the LIWC software is unable to capture *how* a given word is used or the true meaning of words used in a sarcastic or ironic sense (Mehl & Gill, 2010).

Wmatrix is a relatively new ATA tool developed within the field of computational linguistics (Rayson, 2008) that addresses many of LIWC's limitations, but to date has been seldom used in psychological research. As a corpus comparison tool, Wmatrix compares two bodies of text corpora and detects linguistic features (e.g., semantic themes) that reliably differentiate one corpus from the other. By aggregating individuals' language use into two texts that differ in a meaningful way, semantic themes can be linked to psychological constructs of interest. Wmatrix has been applied to the study of personality traits (Oberlander & Gill, 2006), psychopathology (Hancock, Woodworth, & Porter, 2013), and deception (McQuaid, Woodworth, Hutton, Porter, & ten Brinke, 2015). Because the unit of analysis in Wmatrix is the frequency of the individual word rather than the aggregated word category frequency at the level of the participant, it lends itself particularly well to analyses with relatively small samples (but substantial text volume) that would suffer from limited statistical power with typical, person-oriented ATA approaches. In addition, Wmatrix draws from a more comprehensive dictionary and categorizes the semantic themes of words after taking into account the surrounding context and frequency of usage in the current text and in frequency-based dictionaries (Rayson et al., 2004).

The Present Study

The present study extends the current literature on partners' language use during couple-focused interventions for problematic alcohol use by exploring the utility of Wmatrix for identifying semantic themes that emerged from couples' speech during two couple-focused

interventions for problematic alcohol use: Family Systems Therapy (FST; Shoham, Rohrbaugh, Stickle, & Jacob, 1998) and Cognitive Behavioral Therapy (CBT; Beutler et al., 1993). Specifically, the present study aimed to identify theoretically relevant semantic themes in partners' speech during therapy sessions that differentiated successful and unsuccessful treatment outcomes, and may reflect the potential therapeutic processes that facilitated positive change. Identification of semantic themes that uniquely characterize the discourse of couples with successful and unsuccessful outcomes may shed light on therapeutic processes to be investigated in future research, such as increased cognitive awareness and understanding of the problem, or spousal engagement in the patient's problem drinking. As Wmatrix is comprised of 21 high-order categories that organize 232 semantic themes, it affords the opportunity to explore theoretically meaningful categories and themes such as Emotional actions, states and processes (e.g., Liking, Worry/concern), Social actions, states, and processes (e.g., Reciprocity, Participation), and Psychological actions, states and processes (Understand, Planning). Although researchers have been increasingly interested in studying couples' language use during psychotherapy (e.g., Atkins, Rubin, Steyvers, Doeden, & Baucom, 2012), to our knowledge this is the first study to utilize a corpus comparison approach.

The first research question guiding the present study was whether semantic themes in the patients' and spouses' speech during the therapy sessions differentiated successful and unsuccessful treatment outcomes in the two interventions. Although we did not have specific *a priori* hypotheses, we expected that theoretically relevant semantic themes might be related to the patients' symptoms (i.e., alcohol use) or to key relationship processes (e.g., reciprocity, control). The second research question guiding this study was whether semantic themes that differentiated successful and unsuccessful outcomes differed by intervention type and may therefore reflect therapeutic processes that are unique to FST and CBT. Although previous research found the two interventions to be equally efficacious in the larger clinical trial (Shoham et al., 1998), there are several important differences between them that suggest similar outcomes may be achieved through distinct processes (Longabaugh, 2007). Although both interventions viewed alcohol use as the primary target for change and addressed relationship issues, FST focused on the system of relationships in which the drinking was embedded whereas CBT focused primarily on the thoughts and behavior of the individual alcohol user. The interventions also differed in the nature of the spouse's involvement in treatment. In FST, alcohol was referred to as an external "invader" in the couple's relationship, and alcohol use was framed as the *couple's* problem rather than the *patient's* problem. As such, the spouse was encouraged to reduce blame and unite with the patient to remove alcohol from their lives. In contrast, CBT aimed to redirect the spouse's attention from the patient's drinking to her own psychotherapeutic process, which involved abstaining from a chosen target behavior (e.g., eating junk food). Throughout CBT, both the patient and spouse underwent parallel processes as they received treatment for their respective problem behaviors.

The final research question guiding the present study was whether the semantic themes that differentiated successful and unsuccessful outcomes were unique to the intervention context, or whether they reflected more stable couple processes that existed prior to and outside of the context of the intervention. To address this question, we analyzed couples' language use

during a pretreatment marital interaction task and compared the results with analyses of language use during the therapy sessions. If the semantic themes that differentiated treatment outcomes emerged from speech during the therapy sessions but not during the pretreatment interaction, the themes might reflect therapeutic processes that are induced by the interventions rather than more stable couple processes.

In addition, to further identify theoretically relevant semantic themes that were unique to treatment outcome (successful vs. unsuccessful) and intervention type (FST vs. CBT), we conducted an exploratory analysis of the context of the emerging themes related to the second research question. Specifically, we focused on semantic themes that were theoretically meaningful for the two interventions and hand-coded the context in which the themes occurred in the therapy session transcripts. This contextual analysis informed our interpretation of the Wmatrix results, which identified differences in the *frequency* of semantic themes, as it provided information about differences in the *function* of those themes in the therapy session. For example, we expected that although semantic themes related to the patients' symptoms (i.e., alcohol use) or to key relationship processes (e.g., reciprocity, control) might emerge in both interventions, the *function* of the semantic themes in the therapy sessions might differentiate the two interventions in theoretically meaningful ways.

Method

Participants

Thirty-three males with problematic alcohol use and their female partners ($N = 66$) were recruited. Couples were assessed for eligibility at the University of California, Santa Barbara. Male partners were required to qualify for (a) a primary diagnosis of alcohol abuse or dependence according to the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; American Psychiatric Association, 1987) and (b) a score of at least a seven on the Michigan Alcohol Screening Test (MAST; Selzer, 1971), indicating hazardous drinking or alcohol dependence. The male patients were required to be in a committed romantic relationship of at least one year in length with a partner who was also willing to participate in the study. Patients' mean MAST score was 31.5 ($SD = 8.9$). The average age of patients (males) was 39.2 years old ($SD = 10.2$, $range = 21 - 68$) and 91% were Caucasian. Thirty-six percent of patients were college graduates and 94% graduated from high school. The average length of couple relationship was 9.8 years ($SD = 10.2$, $range = 1 - 45$).

Participants were drawn from a larger randomized control trial ($N = 63$ couples) that investigated the efficacy of couple-focused Family Systems Therapy (FST; $n = 17$) and couple-focused Cognitive Behavioral Therapy (CBT; $n = 16$) for problematic alcohol use (Beutler et al., 1993; Beutler, Shoham, Jacob, & Rohrbaugh, 1997). Couples were included in the present study if they had unambiguously successful ($n = 18$) or unsuccessful ($n = 15$) patient-reported drinking outcomes at treatment termination (i.e., the patient maintained alcohol abstinence for 30 days prior to termination or had more than one heavy drinking day in the same period, respectively). Unfortunately, study follow-up data were incomplete, and even at termination nearly half of the couples in the larger trial had ambiguous outcomes with respect to abstinence. For this reason we used therapist case notes to supplement

abstinence reports in identifying successful and unsuccessful cases, and only considered cases for which there was convergence between the two sources. For a detailed description of the case selection process, see Rentscher, Soriano, Shoham, Rohrbaugh, and Mehl (2015).

Couples in the present study completed an average of 17.7 sessions ($SD = 3.3$; *range*: 8–20 sessions), and the number of completed sessions did not differ as a function of intervention type (FST vs. CBT) or treatment outcome (successful vs. unsuccessful), $F(3, 29) = 1.05$, $p = .39$. In addition, couples in the two intervention types and couples with successful versus unsuccessful outcomes did not differ in their mean age, $F(3, 28) = 1.10$, $p = .37$, relationship length, $F(3, 27) = 1.0$, $p = .41$, or alcohol problem severity $F(3, 29) = .17$, $p = .91$.

Interventions

Detailed descriptions of the couple-focused Family Systems and Cognitive Behavioral interventions can be found in Rohrbaugh, Shoham, Spungen, and Steinglass (1995) and Wakefield, Williams, Yost, and Patterson (1996), respectively. There are several important differences between the two interventions. FST focused on altering couple interactions that may maintain problematic alcohol use. From this perspective, problematic alcohol use was treated as a function of marital and family relationships, and therefore, improving interpersonal problems was a principal concern. FST therapists assessed problematic and effective interaction patterns, identified the severity and consequences of drinking, and shaped the intervention according to the couples' attitudes and beliefs about drinking within the relational system. In contrast, CBT focused on changing the drinking-maintaining thoughts and behaviors of the patients by exploring reoccurring behavioral and cognitive drinking patterns, and teaching cognitive, behavioral, and coping skills. The primary goal was to teach the patient the skills necessary to maintain abstinence and prevent relapse. Improving relational and life problems in order to maintain alcohol abstinence was a secondary concern.

The interventions also differed in how the spouse was involved in treatment. In FST, alcohol was often referred to as an “external invader” in the couple's relationship and home. By externalizing alcohol and framing it as the *couple's* problem rather than the *patient's* problem, spouses were encouraged to reduce blaming and unite with patients in order to remove alcohol from their lives. CBT aimed to redirect spouses' attention from the patients' drinking to their own psychotherapeutic process. In the first session, spouses chose a target behavior from which they too wished to abstain (e.g., eating junk food), and the patient and spouse underwent parallel processes as they received treatment for their respective behaviors.

Measures

Alcohol problem severity—The Michigan Alcohol Screening Test (MAST; Selzer, 1971) provided an index of alcohol problem severity at baseline. The MAST is a 25-item self-report questionnaire that requires participants to indicate drinking behaviors and negative consequences related to drinking.

Treatment outcome—As noted above, identification of successful and unsuccessful drinking outcomes at treatment termination was based on patients' reports of daily alcohol use, as operationalized by the Timeline Follow-back Interview (TLFB; Sobell & Sobell, 1992). Patients recalled the frequency and quantity of daily alcohol use over the 30 days prior to treatment termination with the help of a calendar and interviewer prompts focusing on anchor points such as weekends, paydays, birthdays, or holidays. The TLFB has good reliability in terms of both test-retest and interobserver (e.g., patient-spouse) agreement and comes well recommended for treatment outcome research (Carey & Teitelbaum, 1996; Sobell & Sobell, 1992). Outcomes were defined as successful when the patient reported alcohol abstinence for the 30 days prior to termination with no contradictory or qualifying information from other sources. An outcome was unsuccessful when the patient had more than one heavy-drinking day in the 30 days prior to treatment termination.

Procedure

Prior to beginning treatment, participants completed a series of questionnaires to assess alcohol problem severity and other dimensions of functioning. During the pre-intervention assessment session, couples also engaged in a videotaped marital interaction task (MIT) administered by research assistants, who instructed the couples discuss the patient's problematic alcohol use for ten minutes. Couples were randomly assigned to FST or CBT (Beutler et al., 1993; Shoham et al., 1998). Both interventions consisted of 20 sessions. Typically sessions one to 12 (active treatment phase) occurred within a span of six to 12 weeks, and sessions 13 to 20 (relapse prevention phase) occurred within a span of four to eight months. FST progressed based on the couples' readiness to change problematic drinking behaviors, and this less structured approach was generally associated with a longer duration of treatment. CBT was more structured, specifically requiring that couples abstain from alcohol by session 12. These differences in therapy structure and expectations placed on clients resulted in a faster-paced progression of CBT than FST. Patients completed the TLFB at therapy termination to assess alcohol use outcomes.

Corpus collection and preparation—To obtain speech samples for corpus comparison and analysis, research assistants transcribed each partner's verbatim speech from (a) the 10-minute baseline MIT and (b) three 5-minute segments sampled from the seventh, twelfth, and second-to-last therapy sessions. The early-therapy session (session seven) marked the beginning of the active treatment phase in FST and followed the final session of the assessment phase. The same session was selected for CBT, which was not characterized by equally distinct phases, to maintain congruency among interventions. The mid-therapy session (session 12) was the last session before the relapse prevention phase of FST and CBT and about halfway between the selected early- and late-therapy sessions. The late-therapy session was the second-to-last session; the final session was not used because it was likely atypical, composed of wrap-up topics including client feedback and review of treatment. If videotapes were missing or damaged, session eight (1 case), session 11 (6 cases) or 13 (1 case), and the third-to-last session (3 cases) were used as replacements.

The three 5-minute speech segments were sampled from each therapy session at time points centered at approximately 10, 25, and 40 minutes into each session. Our rationale for

choosing these segments was based on several points. First, the average duration of a CBT session was approximately 50 minutes, whereas the length of the FST sessions was longer and more variable (*range*: 25 – 97 minutes). In order to ensure that speech was sampled consistently across both interventions, segment time points were selected to avoid sampling the beginning and end of sessions, which were typically devoted to catch-up and wrap-up topics. Second, segment selection was based on Rohrbaugh et al.'s (2012) study, in which partner speech was sampled 25%, 50%, and 75% of the way through sessions. The 5-minute segments for the present study began 10, 25, and 40 minutes into each session (approximately 25%, 50%, and 75% of the way through an average CBT session). If necessary, segment time points were adjusted forward or backward (all within six minutes of the target) to ensure that each partner contributed at least 20% of the speech in each segment.

Corpus comparison and analysis—Verbatim transcripts of partner speech during the pretreatment interaction task and therapy sessions were submitted to WMatrix for corpus comparison and analysis (Rayson, 2008). Wmatrix consists of two tools that analyze two major linguistic features: CLAWS analyzes the part-of-speech of words (Garside & Smith, 1997) and UCREL analyzes the semantic function of words (Rayson, Archer, Piao, & McEnery, 2004). Based on the Longman Lexicon of Contemporary English (McArthur, 1981), UCREL contains over 37,000 words and 16,000 multi-word units that fall into 232 semantic categories, which is more comprehensive than LIWC's dictionary (containing ~4,500 words and 82 categories). Wmatrix uses several resources to categorize the semantic meanings of words. First, Wmatrix tags every word with several potential semantic themes, which are ranked by the frequency of their usage (the source of rankings includes frequency-based dictionaries and previous tags; Rayson et al., 2004). Second, Wmatrix identifies the contextually appropriate semantic theme for each word. CLAWS's categorization of the part-of-speech of each word helps to reject certain semantic interpretations. For example, if CLAWS tags the word *suits* as a verb (e.g. *the job suits me well*), the semantic theme “clothes and personal belongings” can be ruled out. Wmatrix further disambiguates multiple semantic themes by using proximal words to determine the current topic of discourse and a template for identifying typical contexts in which words are used. For example, the word *bank* is more likely to be tagged as “money” rather than “geographical terms” (i.e. *bank* of a river) if its surrounding words are as well. Together, Wmatrix yields a fine-grained analysis of semantic themes in language use.

Exploratory contextual analysis—Following the Wmatrix corpus comparison analyses, we focused on the most theoretically relevant and consistent semantic theme that differentiated couples with successful and unsuccessful treatment outcomes and further explored the context of the emerging semantic theme within the therapy session transcripts. Although Wmatrix analyses indicate differences in the frequency of semantic themes between corpora, they do not distinguish differences in the *function* of semantic themes. Wmatrix does, however, provide tools that allow users to view details about the semantic themes in the corpus comparison output. For each semantic theme, Wmatrix provides a separate list of tagged words and their frequencies for each corpus. It is also possible to view the context of each word as it appears in the original text. To conduct a more in-depth

analysis of differences in the *function* of semantic themes between couples with successful and unsuccessful treatment outcomes, we used these tools to hand-code the context of the emerging semantic theme of interest. We created a set of context categories for the analysis after exploring the ways in which partners used the target words in the original transcripts, including whether the speaker referred to the patient, spouse, couple, or another person or entity as the subject when using the target words (see Results section for more detailed description of context categories).

Data Analysis Plan

We performed four corpus comparison analyses to investigate the first research question of whether semantic themes during the therapy sessions would differentiate treatment outcomes, and the second research question of whether semantic themes would also differ by treatment type. To do this, we aggregated transcripts of the therapy sessions and then separated them by partner role (patient vs. spouse), treatment outcome (successful vs. unsuccessful), and intervention type (FST vs. CBT), resulting in a set of eight corpora (e.g., patients in FST with successful outcomes). For example, to investigate language use among (1) *patients in FST*, the corpus of aggregated transcripts of patients in FST with *successful* treatment outcomes (9 patients; 20,204 total words) was compared to the corpus of aggregated transcripts of patients in FST with *unsuccessful* treatment outcomes (8 patients; 17,615 total words). The other corpus comparisons were prepared and conducted in the same fashion: (2) *spouses in FST* with successful (9 spouses; 21,786 total words) versus unsuccessful (8 spouses; 16,531 total words) treatment outcomes, (3) *patients in CBT with successful* (9 patients; 23,924 total words) versus unsuccessful (7 patients; 16,958 total words) treatment outcomes, and (4) *spouses in CBT* with successful (9 spouses; 17,780 total words) versus unsuccessful (7 spouses; 15,922 total words) treatment outcomes.

We performed four additional corpus comparison analyses to investigate the third research question of whether the semantic themes that differentiated successful and unsuccessful outcomes were unique to the intervention context, or whether they reflected more stable couple processes that existed prior to and outside of the intervention context. To do this, we aggregated transcripts of the pretreatment marital interaction tasks and then separated them into eight corpora in the same fashion as the therapy session transcripts. The corpus comparisons were prepared and conducted in the same fashion: (1) *patients in FST* with successful (9 patients; 4,920 total words) versus unsuccessful (8 patients; 4,853 total words) treatment outcomes, (2) *spouses in FST* with successful (9 spouses; 7,556 total words) versus unsuccessful (eight spouses; 4,473 total words) treatment outcomes, (3) *patients in CBT* with successful (9 patients; 6,836 total words) versus unsuccessful (7 patients; 4,884 total words) treatment outcomes, and (4) *spouses in CBT* with successful (9 spouses; 8,515 total words) versus unsuccessful (7 spouses; 4,652 total words) treatment outcomes.

The output of a corpus comparison in Wmatrix includes the absolute and relative frequency of each semantic theme for both corpora. The absolute frequency is the raw word count and the relative frequency is the percentage of all words that fall into a given semantic category. The semantic themes are sorted by their accompanying log-likelihood value, which estimates the reliability of between-corpora differences in word frequencies. To guard

against alpha-inflation due to multiple testing, we adopted a threshold of 15.13 ($p < .0001$) for log-likelihood values (Rayson, 2003). Log-likelihood values of 10.83 ($p < .001$) and above were also considered with care. Finally, we performed a set of chi-square tests based on the exploratory context codings to investigate differences in the context of the semantic themes as a function of partner role, treatment outcome and intervention type.

Results

Corpus Comparison and Analysis

Semantic themes that emerged from the four corpus comparisons of partner language use during the therapy sessions, and yielded differences with a log-likelihood value of 15.13 or greater, appear in Table 1. With regard to the first research question, results suggested that the semantic themes that differentiated successful and unsuccessful outcomes included, for example, *pronouns* for patients, *anatomy and physiology* for spouses, and *food and drinks and alcohol* for both partners. With regard to the second research question, results suggested that the semantic themes that differentiated successful and unsuccessful treatment outcomes also differed by treatment type. Of these, the semantic theme *drinks and alcohol* was the most theoretically relevant theme as it related to the patient's symptoms. The absolute and relative frequencies of language use related to *drinks and alcohol* in the eight corpora derived from the therapy sessions appear in Table 2. Interestingly, the comparison involving patients in CBT did not yield any differences that reached the log-likelihood threshold; however, *drinks and alcohol* reached the log-likelihood threshold for patients in FST and spouses in CBT and fell just below the threshold for spouses in FST (LL = 10.43, $p < .01$; Figure 1), although the two interventions showed an inverse pattern of partner language use as it related to treatment outcome. The comparison involving patients in FST suggested that patients with successful treatment outcomes used significantly *more* language related to *drinks and alcohol* than patients with unsuccessful treatment outcomes. The comparison involving spouses in FST suggested that spouses with successful treatment outcomes also used *more* language related to *drinks and alcohol* than spouses with unsuccessful treatment outcomes. In contrast, the comparison involving spouses in CBT suggested that spouses with successful treatment outcomes used significantly *less* language related to *drinks and alcohol* than spouses with unsuccessful treatment outcomes.

With regard to the third research question, the corpus comparison analyses of language use during the pretreatment marital interaction did not result in any significant differences in language related to *drinks and alcohol* (all LL values < 3.84 , $p > .05$), suggesting that associations between alcohol-related language and treatment outcome are specific to the therapy context rather than more broadly reflective of “dispositional” characteristics of the couples. The absolute and relative frequencies of language use related to *drinks and alcohol* within the eight corpora derived from the pretreatment marital interactions appear in Table 3.

Exploratory Contextual Analysis

For the more in-depth, exploratory context analysis, we focused exclusively on the semantic theme *drinks and alcohol* because of its theoretical relevance and consistency in differentiating treatment outcomes across the two interventions. To further interpret the

differences in language use related to *drinks and alcohol*, we examined the words that Wmatrix tagged for this semantic theme in their original context within each of the eight therapy session corpora. Specifically, we manually coded each word according to the following mutually exclusive context categories: (1) *patient drinking*, (2) *spouse drinking*, (3) *others drinking* (e.g., friends or family members), or (4) *couple drinking* (i.e., the couple as a unit). These categories frequently included comments about the act of drinking or not drinking (e.g., “*I haven't had a drink in two weeks*”) and thoughts about drinking or not drinking (e.g., “*I thought a beer would taste good with this food*”), as well as comments that referenced a specific person(s) as the subject (e.g., “*I walked by the liquor store after a bus ride*”). We created a fifth contextual category for language related to *drinks and alcohol* that partners used during *role-play* activities for the purpose of drink refusal training (a frequently-used technique in CBT that likely involves more deliberate, conscious language use). For contexts that did not fall into these categories (e.g., “*Alcohol is a funny creature*”, “*Society revolves around alcohol*”), we created a residual sixth category, *other*. Two research assistants independently coded all of the data to estimate inter-coder reliability. Intraclass correlation coefficients based on a two-way random effects model (average measure, ICC[2,2]) were .90 for *patient drinking*, .91 for *spouse drinking*, .88 for *others drinking*, .82 for *couple drinking*, .84 for *role-play*, and .81 for *other*.

To mirror the four corpus comparisons, we performed four post-hoc chi-square tests to investigate differences in the six context categories related to *drinks and alcohol* between (1) *patients in FST* with successful and unsuccessful treatment outcomes, (2) *spouses in FST* with successful and unsuccessful treatment outcomes, (3) *patients in CBT* with successful and unsuccessful treatment outcomes, and (4) *spouses in CBT* with successful and unsuccessful treatment outcomes. The contingency tables for the four chi-square tests appear in Table 4. Among patients in FST, there was no difference in the context of language use related to *drinks and alcohol* between couples with successful and unsuccessful treatment outcomes (see Figure 2, Panel a). Among spouses in FST, however, the context of language use related to *drinks and alcohol* did differ significantly between treatment outcomes (see Figure 2, Panel b), such that spouses with successful treatment outcomes spoke less about *patient drinking* than spouses with unsuccessful treatment outcomes, $\chi^2(1) = 5.03, p < .05$. In addition, spouses with successful treatment outcomes used more language related to *drinks and alcohol* that fell into the residual *other* category than spouses with unsuccessful treatment outcomes, $\chi^2(1) = 14.99, p = .0001$. Spouses in FST did not differ in their use of language related to *spouse drinking*, $\chi^2(1) = 0.22, p > .10$, *others drinking*, $\chi^2(1) = 0.08, p > .10$, or *couple drinking*, $\chi^2(1) = 0, p > .10$.

Among patients in CBT, the context of language use related to *drinks and alcohol* differed significantly between treatment outcomes (see Figure 3, Panel a), such that patients with successful treatment outcomes spoke more about *spouse drinking*, $\chi^2(1) = 5.42, p < .05$, and less about *other*, $\chi^2(1) = 10.90, p < .001$, than patients with unsuccessful treatment outcomes. Patients in CBT did not differ in their language use related to the *patient drinking*, $\chi^2(1) = 1.57, p > .10$, *others drinking*, $\chi^2(1) = 0.10, p > .10$, *couple drinking*, $\chi^2(1) = 1.72, p > .10$, or *role-play*, $\chi^2(1) = 1.64, p > .10$. Among spouses in CBT, the context of language use related to *drinks and alcohol* also differed significantly between treatment outcomes (see Figure 3, Panel b), such that spouses with successful treatment outcomes spoke more about

patient drinking, $\chi^2(1) = 5.40$, $p < .05$, and *couple drinking*, $\chi^2(1) = 7.71$, $p < .01$, and less about *spouse drinking*, $\chi^2(1) = 4.91$, $p < .05$, than spouses with unsuccessful treatment outcomes. There was also a marginal effect for *others drinking*, $\chi^2(1) = 3.07$, $p < .10$, such that spouses with successful treatment outcomes spoke less about *others drinking* than spouses with unsuccessful treatment outcomes. Spouses in CBT did not differ by treatment outcome in their use of the context categories *role-play*, $\chi^2(1) = 1.67$, $p > .10$, or *other*, $\chi^2(1) = 0.003$, $p > .10$.

Discussion

The present study investigated partners' language use during two couple-focused alcohol interventions (Family Systems and Cognitive Behavioral Therapy) using a linguistic corpus comparison tool, Wmatrix. Specifically, we used this exploratory, data-driven method to identify semantic themes that emerged from partners' speech during a pretreatment marital interaction and subsequent therapy sessions and differentiated couples with successful and unsuccessful treatment outcomes (i.e., patient alcohol abstinence or non-abstinence). The research questions guiding the present study included: (1) whether semantic themes in patients' and spouses' speech during therapy sessions differentiated couples with successful and unsuccessful treatment outcomes, (2) whether semantic themes that differentiated treatment outcomes differed by intervention type and may therefore reflect therapeutic processes that are unique to FST and CBT, and (3) whether the semantic themes that differentiated treatment outcomes were unique to the intervention context, or reflected more stable couple processes that existed prior to and outside of the context of the intervention. From the emerging semantic themes, we then focused on one theoretically relevant theme and conducted exploratory analyses investigating the context of the semantic theme within the therapy session transcripts.

With regard to our first research question, results of the corpus comparison analyses, with the exception of the analysis of patients in CBT, suggested that several semantic themes statistically differentiated couples with successful and unsuccessful outcomes. Of these, the semantic theme *drinks and alcohol* was the most theoretically relevant and consistent in differentiating treatment outcomes across the two interventions. With regard to the second research question, results suggested that the semantic themes that differentiated treatment outcomes also differed by intervention type (FST vs. CBT), and the specific pattern of language use related to *drinks and alcohol* differed substantially between the two interventions. Both patients and spouses in FST with successful treatment outcomes used *more* language related to *drinks and alcohol* during therapy sessions than patients and spouses in FST with unsuccessful treatment outcomes. Conversely, spouses in CBT with successful treatment outcomes used *less* language related to *drinks and alcohol* than spouses in CBT with unsuccessful treatment outcomes. For patients in CBT, language use related to *drinks and alcohol* did not differentiate successful and unsuccessful outcomes. Discussions of alcohol were clearly required in therapy sessions to accomplish the goals of treatment; however, these findings reveal that the extent to which partners talk about drinking may reflect potentially unique therapeutic processes related to treatment outcome in FST and CBT. With regard to the third research question, results from corpus comparisons of language use related to *drinks and alcohol* during the pretreatment marital interaction

revealed no significant differences between couples with successful and unsuccessful treatment outcomes. This finding suggests that the semantic theme reflects processes that are unique to the intervention context rather than more stable couple processes that existed prior to and outside of the context of the intervention.

Following these corpus comparisons, exploratory context analyses that aimed to examine the *function* of the semantic theme suggested that the context of partner language use related to *drinks and alcohol* also differed by treatment outcome and intervention type. Although patients in FST with successful outcomes used *more* language related to *drinks and alcohol* than patients with unsuccessful outcomes, the specific context of the semantic theme did not differ by treatment outcome. One potential interpretation of these findings is that the extent of patients' alcohol-related language use during therapy (regardless of context) reflects disclosure of alcohol-related thoughts and behaviors during therapy, rather than denial of the problem. For example, one patient who had a successful treatment outcome reflected, "I find that I probably drank a lot more when I was depressed and then, you know, it compounds it; you get more depressed drinking and then it's like a vicious cycle." Whereas denial is often associated with problem drinking and is a common barrier to treatment (Morse & Flavin, 1992), disclosure has been found to increase self-understanding and treatment engagement, as well as abstinence and recovery (Pennebaker, 1993, 1997; Stiles, McDaniel, & McGaughey, 1979; Stiles, Shuster, & Harrigan, 1992).

Similarly, spouses in FST with successful outcomes used *more* language related to *drinks and alcohol* than spouses with unsuccessful outcomes. It is possible that spouses' alcohol-related language use indicates their active engagement in the treatment process, which is essential to the goals of FST (Rohrbaugh et al., 1995). Interestingly, exploratory analyses further revealed that spouses in FST with successful outcomes spoke less about patient drinking and more about *drinks and alcohol* in a broader sense without referring to a specific person (e.g., "Alcohol is alcohol. You can get drunk on champagne, you can get drunk on wine..."). A primary objective of FST is to encourage the couple to unite together against alcohol as an external "invader" of their relationship. For example, when discussing the consequences of her partner's drinking, a spouse in FST with a successful outcome spoke about alcohol as an entity separate from the patient ("Yeah, when there is alcohol involved..."), whereas a spouse with an unsuccessful outcome spoke about the patient and alcohol problem as intertwined ("When he's drunk..."). Greater spousal reference to alcohol in a general way, rather than to the patient's drinking, may reflect externalization of the alcohol problem, which is a therapeutic process unique to FST.

In contrast to FST, spouses in CBT with successful outcomes used *less* language related to *drinks and alcohol* than spouses with unsuccessful outcomes. A primary objective of CBT was to reduce the spouse's focus on the patient's drinking by encouraging the spouse to focus on her own productive process throughout therapy, which involved abstaining from a chosen target behavior (e.g., eating junk food). Thus, one potential explanation for this finding is that, less spousal language related to *drinks and alcohol* may reflect adherence to this objective as a therapeutic process unique to CBT. In addition, exploratory context analysis revealed that spouses in CBT with unsuccessful outcomes spoke more about their own drinking and less about the patient's and *couple* drinking. For example, one spouse with an

unsuccessful outcome reflected on her own struggle with abstinence (“I always have a beer with this kind of food”), and another spoke of her drinking as problematic (“Drinking, I think, can sabotage parts of me that I don't need to”). Interestingly, spouses with successful outcomes also spoke more about *couple* drinking. Although relationship processes were not a primary objective in CBT, it appears that spouses who addressed couple drinking (i.e., drinking together) relative to their own drinking were more likely to experience successful treatment outcomes. For example, one spouse with a successful outcome stated, “I feel very confident that we can still have fun without drinking”, and another conveyed a communal orientation by saying, “I think with my sister, I'm going to tell her that we're not drinking.”

Finally, although language use related to *drinks and alcohol* did not differentiate successful and unsuccessful outcomes for patients in CBT, exploratory context analyses suggested that patients with successful outcomes spoke less about their spouse's drinking than patients with unsuccessful outcomes. Several patients with unsuccessful outcomes conveyed concern about their spouse's drinking (e.g., “It sounds like you're becoming more aware of when you are drinking and why you're drinking;” “I'm just glad you didn't get drunk”), which was not observed in the *drinks and alcohol* language use of patients with successful outcomes. Consistent with the finding that spouses in CBT with unsuccessful outcomes spoke more about spouse drinking, this suggests that couples in which both partners used alcohol were less likely to experience successful CBT treatment outcomes (Leonard & Eiden, 2007; McAweeney et al., 2005).

The present study has several important limitations. First, our sample size was small ($N=66$), and thus the eight subgroups created for corpus comparison were relatively small as well (*range*: 7 – 9). Wmatrix's corpus comparison method of analyzing language at the word level (rather than the participant level) can somewhat alleviate statistical power problems, but ultimately, it cannot improve generalizability. Future research should aim to replicate and further explore the current findings in a larger sample. Second, all patients in this sample were male, and therefore gender and role effects are indistinguishable. Future research should utilize more representative samples and include both male and female patients. Third, although Wmatrix is linguistically more refined than LIWC and other word-count based text analysis tools, the relative trade-off is the ease of interpretation. Semantic categories within Wmatrix were not designed to be theoretically or psychologically meaningful, and therefore, emerging themes (e.g., *general actions/making*) are not always readily interpretable. For this reason, we focused on drinks and alcohol as the most theoretically relevant themes and supplemented Wmatrix analyses with hand-coded, exploratory context analyses. It is important to note, however, that there may be alternative interpretations for the patterns of alcohol-related language use during the therapy sessions, and the therapeutic processes we have proposed warrant further conceptual and empirical exploration.

Despite these limitations, this study is the first to explore semantic themes during couple-focused interventions that distinguish successful from unsuccessful treatment outcomes using a data-driven, corpus comparison tool. Language patterns that emerged from the data can be interpreted as a function of the format and structure of the interventions themselves, and as manifestations of unique patient and spouse processes. On the broadest level, the language patterns may suggest the existence of at least some differential therapeutic

processes in FST and CBT for problematic alcohol use. This interpretation is consistent with the notion that treatment modalities with diverse theoretical bases induce differential processes to achieve similar amounts of change (Longabaugh, 2007). Findings also highlight the importance of incorporating patient's spouses in alcohol treatment. In this study, couples in FST had successful outcomes when spouses used *more* alcohol-related language, and spoke about alcohol in a general way rather than in reference to the patient, and couples in CBT has successful outcomes when spouses used *less* alcohol-related language, referring less to their own drinking and more to the patient's or couple's drinking. Spousal participation in treatment is an important avenue for future research, as many spouses do not passively support patients, but can play an active and pivotal role in their recovery (e.g., Bodenmann et al., 2008; McCrady et al., 2002; Rohrbaugh et al., 2012). Although most couple and family researchers would agree with this notion, there is a paucity of empirical evidence to explain *how* spouses affect patients' recovery. To maximize the efficacy of alcohol treatments, future research on spousal and interpersonal therapeutic processes is necessary. Conducting attribute-treatment interaction studies with a focus on relationship and spouse characteristics in addition to patient attributes may also be a fruitful path for couple-focused intervention research (Shoham et al., 1998).

Finally, exploratory data-driven approaches such as Wmatrix depart from theoretical considerations, and in doing so have the potential of revealing relational and therapeutic processes that may not have been otherwise considered (Hill, 1990). In this study, several semantic themes emerged from partner speech during the conjoint therapy sessions that differentiated treatment outcomes (e.g., Drinks and alcohol, Food, Pronouns). Although the relative frequency of the *drinks and alcohol* theme was lower than some of the other semantic themes that emerged (e.g., Pronouns, General actions/making), we focused on this theme because it was the most theoretically relevant and consistent across the two interventions in differentiating treatment outcome. Future studies would benefit from exploring other semantic themes related to emotional (e.g., liking, worry/concern), social (e.g., reciprocity, respect), and psychological (e.g., attention, expect) processes among couples in treatment for health problems. Beyond couple-based interventions, Wmatrix has potential applications for clinical and psychosocial intervention research in which researchers are interested in comparing the language use of two distinguishable groups that may differ, for example, by level of functioning or a clinical outcome of interest. Although, to our knowledge, this was the first study to explore semantic themes in psychosocial interventions using Wmatrix, other recent developments in automatic text analysis are gaining momentum in psychology. Topic models (or Latent Dirichlet Allocation, LDA; Griffiths & Steyvers, 2004) have recently gained popularity as a data-driven method for quantifying the semantic dimensions in texts and have recently been used to investigate, among other things, language patterns on Facebook and Twitter (e.g., Dehghani, Sagae, Sachdeva, & Gratch, 2014; Eichstaedt et al., 2015; Kern et al., 2014; Schwartz et al., 2013). In the clinical context, Atkins, Rubin, Steyvers, Doeden, and Baucom (2012) used topic models to empirically characterize common themes brought up in couple therapies for relationship distress, such as family, finances, and sex, as well as topics specific to different treatment modalities. Atkins and colleagues then used the results of the topic models to predict human behavioral codings; for example, blaming behaviors during therapy were

associated with negative emotion and swear words, but also topics involving children and money. While advanced text analytical techniques such as WMatrix or LDA are unlikely to fully replace word-counting methods like LIWC, more computationally intensive data-driven text analysis can reveal important insights that cannot be readily captured by tools with limited pre-determined categories and can further guide future theory development (Sagi & Dehghani, 2014; Schwartz & Ungar, 2015).

In conclusion, findings from the present study suggest that semantic themes unique to the therapy context differentiate successful and unsuccessful treatment outcomes, and that the context of partners' alcohol-related language may reflect differential therapeutic processes in couple-focused Family Systems and Cognitive Behavioral Therapy for problematic alcohol use. Findings emphasize the role of spouse behavior in alcohol treatment outcomes and highlight the potential utility of linguistic corpus comparison methods in the investigation of therapeutic processes in couple-focused interventions for health problems.

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Key Practitioner Message

- Incorporating spouses into interventions for problematic alcohol use is associated with increased efficacy; yet, little is known about the specific therapeutic processes that may explain these effects.
- Findings from this study suggest that semantic themes such as *drinks and alcohol* in partner speech during therapy sessions differentiate successful and unsuccessful treatment outcomes among couples participating in two couple-focused interventions for problematic alcohol use.
- In addition, the context in which partners used alcohol-related language differed by intervention type and treatment outcome, which suggests potential therapeutic processes that are unique to the two interventions (Family Systems vs. Cognitive Behavioral Therapy).

Figure 1. Frequency of *Drinks and Alcohol* Language Use

Relative frequency of words related to *drinks and alcohol* used by patients and spouses during FST and CBT. Corpus comparisons indicated that the frequency significantly differed by treatment outcome for patients in FST, spouses in FST, and spouses in CBT.

Figure 2. Context of Drinks and Alcohol Language Use of Couples in FST

Percentage of all words related to *drinks and alcohol* that, were used in five different contexts by patients and spouses in FST. The context category *role-play* is not shown as there were zero words coded for this context for couples in FST.

Figure 3. Context of *Drinks and Alcohol* Language Use of Couples in CBT
Percentage of all words related to *drinks and alcohol* that were used in six different contexts by patients and spouses in CBT.

Table 1

Relative Frequency of Semantic Themes in Four Corpus Comparisons

Intervention	Role	Semantic Theme	Relative Frequency		Log-likelihood
			Successful Treatment Outcome	Unsuccessful Treatment Outcome	
FST	Patient	Food	0.42	0.06	52.29
		Pronouns	18.68	21.53	35.45
		Drinks and Alcohol	0.91	0.40	34.58
		Business; Selling	0.23	0.07	16.36
		Exclusivizers/particularizers	1.33	0.88	16.20
	Spouse	Discourse Bin	6.36	4.70	43.83
		Food	0.41	0.08	40.92
		Drinks and Alcohol	0.80	0.52	10.43 [†]
CBT	Spouse	Anatomy and Physiology	0.37	0.77	22.18
		General Actions/Making	1.95	1.29	21.09
		Drinks and Alcohol	0.47	0.89	20.87
		Degree; Boosters	1.34	0.87	15.99

Note. Critical log-likelihood values: LLR = 15.13, $p < .0001$; LLR = 10.83, $p < .001$;

Relative frequency represents the percentage of all words that fall into each semantic theme (absolute frequency of words in the semantic theme divided by the total word count for each corpus). No significant semantic themes emerged for patients in CBT.

[†]LLR = 6.63, $p < .01$.

Table 2

Absolute and Relative Frequency of Language Use Related to Drinks and Alcohol During the Interventions

Intervention Type	Partner Role	Treatment Outcome	Absolute Frequency	Relative Frequency
FST	Patient *	Successful	171	0.91
		Unsuccessful	67	0.40
	Spouse †	Successful	164	0.80
		Unsuccessful	82	0.52
CBT	Patient	Successful	227	1.02
		Unsuccessful	143	0.91
	Spouse *	Successful	78	0.47
		Unsuccessful	133	0.89

Note. The absolute frequency is the raw word count and the relative frequency is the percentage of all words that fall into the semantic category “Drinks and Alcohol” (absolute frequency of words divided by the total word count for each corpus).

* $p < .0001$,

† $p < .01$.

Table 3

Absolute and Relative Frequency of Language Use Related to Drinks and Alcohol During the Baseline Marital Interaction Task

Intervention Type	Partner Role	Treatment Outcome	Absolute Frequency	Relative Frequency
FST	Patient	Successful	95	1.94
		Unsuccessful	83	1.72
	Spouse	Successful	125	1.68
		Unsuccessful	85	1.91
CBT	Patient	Successful	135	2.06
		Unsuccessful	97	2.06
	Spouse	Successful	132	1.62
		Unsuccessful	86	1.91

Note. The absolute frequency is the raw word count and the relative frequency is the percentage of all words that fall into the semantic category “Drinks and Alcohol” (absolute frequency of words divided by the total word count for each corpus). All log likelihood values < 3.84, $p > .05$.

Table 4

Contingency Table of Frequency of Word Use Related to Drinks and Alcohol in Six Mutually Exclusive Context Categories

Intervention Type	Partner Role	Treatment Outcome	Context Category						Total	χ^2
			Patient Drinking	Spouse Drinking	Others Drinking	Couple Drinking	Role-Play	Other		
FST	Patient	Successful	103	3	57	5	0	10	178	3.43
		Unsuccessful	43	3	16	1	0	3	66	
	Spouse	Successful	78	20	32	9	0	32	171	20.33*
		Unsuccessful	62	9	16	5	0	1	93	
CBT	Patient	Successful	190	2	29	5	8	2	236	21.35***
		Unsuccessful	108	7	21	7	2	11	156	
	Spouse	Successful	36	16	9	11	5	3	80	21.25***
		Unsuccessful	33	48	28	4	10	5	128	

Note. Context categories that differ significantly by treatment outcome ($p < .05$) are displayed in boldface.* $p < .05$,** $p < .001$.