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Language-based Measures of Mindfulness: Initial Validity and Clinical Utility

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Abstract

This study examined relationships among language use, mindfulness, and substance-use treatment outcomes in the context of an efficacy trial of mindfulness-based relapse prevention (MBRP) for adults with alcohol and other drug use (AOD) disorders (see Bowen, Chawla, Collins et al., in press). An expert panel generated two categories of mindfulness language (ML) describing the mindfulness state and the more encompassing “mindfulness journey,” which included words describing challenges of developing a mindfulness practice. MBRP participants ($n=48$) completed baseline sociodemographic and AOD measures, and participated in the 8-week MBRP program. AOD data were collected during the 4-month follow-up. A word count program assessed the frequency of ML and other linguistic markers in participants’ responses to open-ended questions about their postintervention impressions of mindfulness practice and MBRP. Findings supported concurrent validity of ML categories: ML words appeared more frequently in the MBRP manual compared to the 12-step *Big Book*. Further, ML categories correlated with other linguistic variables related to the mindfulness construct. Finally, predictive validity was supported: greater use of ML predicted fewer AOD use days during the 4-month follow-up. This study provided initial support for ML as a valid, clinically useful mindfulness measure. If future studies replicate these findings, ML could be used in conjunction with self-report to provide a more complete picture of the mindfulness experience.

Keywords

Relapse Prevention; Mindfulness; Validity; Substance use; Linguistic marker; Language

Mindfulness-based relapse prevention (MBRP; Witkiewitz et al., 2005) is an 8-week substance-use aftercare program that integrates mindfulness practice with cognitive-behavioral relapse prevention (Daley & Marlatt, 2006; Marlatt & Gordon, 1985). In a recent randomized trial comparing the efficacy of MBRP to treatment as usual (TAU), MBRP significantly reduced rates of substance use and craving during the 4-month follow-up (Bowen, Chawla, Collins et al., in press). Relative to TAU participants, MBRP participants exhibited significant increases in acceptance and ability to act with awareness. Additionally, high participant satisfaction and treatment compliance demonstrated the feasibility of the MBRP program.

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Thus, findings supported MBRP as an efficacious and feasible aftercare treatment for substance use disorders.

A logical next-step is to evaluate potential correlates of the observed MBRP treatment effects. According to Shapiro et al. (2006), self-report measures may help determine whether posttreatment increases in mindfulness are correlated with better health outcomes. However, the language individuals use to describe their experience of mindfulness may also serve as a behavioral indicator of the development of mindfulness. In fact, the ability to describe observed phenomena by applying words comprises one component of mindfulness as it is currently defined (Baer et al., 2004). This ability may also be indicative of a “de-centered” or “metacognitive” perspective, which has been proposed to be an important mechanism by which mindfulness affects outcomes (Teasdale et al., 2002). Additionally, facilitators of mindfulness-based interventions are trained to model qualities such as acceptance and being in the present moment, which is aided by the careful and intentional use of language.

On the other hand, the compatibility of literal language and mindfulness has been disputed. It has been asserted that verbal processing undermines acceptance and attention to the present moment because it activates a concrete and learned “relational network” of meanings and labels (Hayes & Shenk, 2004; Hayes & Wilson, 2003). Despite these differing assertions, no studies to date have empirically examined the relationship between language use and mindfulness, which indicates a gap in the literature that should be addressed.

One strategy for examining language and assessing its role in treatment outcomes is the use of word count programs, such as the Linguistic Inquiry and Word Count program (LIWC2007; Pennebaker, Booth et al., 2007). The LIWC locates and counts the occurrence of words contained in writing samples that represent linguistic and psychological categories. The LIWC issued from research exploring the impact of expressive writing on physical and psychological health (Pennebaker, 1997; Pennebaker et al., 1988), but it has been more recently expanded to other psychological research areas, including how linguistic markers reflect psychological states (Pennebaker & Chung, 2007), social behavior (Mehl & Pennebaker, 2003; Pennebaker & Graybeal, 2001), and psychopathology (e.g., depression, suicidality; Rude et al., 2004; Stirman & Pennebaker, 2001).

Although the LIWC has been used with adult substance-use populations (Pennebaker & King, 1999; Vano, 2002), only one study to date has applied this method to predict substance-use outcomes following an intervention (Collins et al., 2005). Specifically, college drinkers receiving personalized normative feedback versus an alcohol education brochure used more first person singular and school-related words and fewer discrepancy, second person and body-related words when describing their responses to the intervention. Use of first- and second-person pronouns, which typically reflects level of personal “ownership” and self versus other focus, mediated the intervention effects. Personalized normative feedback recipients appeared to connect with and internalize the intervention, and in turn, decreased their drinking more than participants who received the alcohol education brochure. This study showed that word-count analyses can be used to learn more about relevant language correlates and corresponding cognitive processes potentially underlying substance-use intervention effects.

Current Study: Aims and Hypotheses

This study examined relationships among language use, mindfulness, and substance-use outcomes in the context of an efficacy trial of MBRP for adults with substance-use disorders. An expert panel of mindfulness and substance-use researchers generated 2 categories of mindfulness language (ML) words believed to reflect the mindfulness experience. The first category describes the actual state of mindfulness; whereas the second category describes the more encompassing “mindfulness journey,” which includes words describing the mindfulness

state as well as the challenges involved in developing a mindfulness practice. Next, the LIWC word count program assessed the frequency of ML encountered in participants' responses to open-ended questions about their postintervention impressions of mindfulness practice and the MBRP program. Finally, concurrent, discriminant and predictive validity of these ML categories was tested by assessing their relationship to other linguistic categories, related text-based sources, and alcohol and other drug (AOD) use days (i.e., frequency of AOD use) during the 4-month follow-up.

It was hypothesized that the ML categories would demonstrate convergent validity by corresponding to substantive high-frequency words in the MBRP treatment manual. ML categories would also demonstrate discriminant validity by showing little overlap with the twelve-step, self-help manual, the "*Big Book*" (Alcoholics Anonymous, 2006), which comes from a different theoretical and philosophical tradition. It was also hypothesized that ML would correlate with related linguistic variables. Specifically, the focus of mindfulness practice on experiences in the present moment (e.g., Baer et al., 2006; Kabat-Zinn, 1994; Marlatt & Kristeller, 1999) led us to hypothesize that ML would positively correlate with use of the present tense and would inversely correlate with past and future tense. Further, considering the focus of mindfulness on examining one's own internal states, we hypothesized that ML would positively and negatively correlate with use of personal versus impersonal pronouns, respectively. Given the focus of mindfulness practices on increasing awareness and perception of states and sensations in the body (Bowen, Chawla, & Marlatt, in press), we hypothesized a correlation with perception and body-related words. Because mindfulness teaches clients to accept negative emotions and engage in skillful rather than reactive behavior, we hypothesized relationships between ML, affect and anger words. It was also hypothesized that ML would evince clinical relevance and predictive validity by inversely predicting number of AOD use days during the 4-month follow-up.

Method

Participants

Participants ($n=48$) were drawn from the MBRP treatment group ($n=93$) that was part of a larger randomized treatment trial ($N=168$) conducted in a nonprofit public service treatment agency (for details, see Bowen, Chawla, Collins et al., in press). The final subsample was reduced to 48 participants because only 52% of MBRP participants attended the final treatment session during which ML was assessed. Participants' (27% female; $n=13$) average age was 40.89 years ($SD=10.61$). Most participants self-identified as White (69%); whereas 13% self-identified as Black, 8% as Hispanic/Latino/a, 8% as Multiracial, 6% as Native American, and 2% as Asian/Pacific Islander. Employment status varied: 33% were unemployed, 29% received public assistance or social security, 19% were employed part-time, and the remaining 17% were employed full-time. A high school degree or equivalent was the highest level of education for 31% of the sample; 4% did not complete high school, 42% completed community college/some 4-year college, and 21% obtained a 4-year college degree or higher.

Measures

A *Sociodemographics Questionnaire* assessed age, gender, race/ethnicity, employment status, and educational level. The *Timeline Followback* (TLFB; Sobell & Sobell, 1992) assessed daily AOD use and was used to create AOD use days (frequency) variables for the 2 months prior to baseline and during the 4-month follow-up. The TLFB has shown good reliability and validity for AOD use assessment (Carney et al., 1998; Fals-Stewart et al., 2000). The *Participant Feedback Form* included 4 open-ended questions that addressed participants' experiences in the MBRP program and was administered at the final treatment session (e.g.,

“What did you get out of coming [to the MBRP group], if anything?”). Responses to these items provided the writing samples used to assess ML use.

Materials

Individual text files were analyzed using the LIWC (Pennebaker, Booth et al., 2007), a computer program that categorizes words into 80 hierarchical dimensions, including linguistic, psychological, relativity-related, and other content categories. The LIWC created proportions of the number of words in each writing sample representing *linguistic categories* hypothesized to be significantly correlated with mindfulness (i.e., verb tense, pronoun use, affect, anger, insight, body and perception). The linguistic categories are built into the default dictionary (i.e., LIWC 2007 English dictionary; Pennebaker, Booth et al., 2007) and have been researched and validated in various writing samples since the development of the program (Pennebaker, Chung et al., 2007). *ML dictionary words* were brainstormed and discussed by mindfulness experts, entered into 2 LIWC dictionaries, and counted by the LIWC program (see Table 1). *Word frequency counts* for the MBRP treatment manual (Bowen, Chawla, & Marlatt, in press), and the 12-step *Big Book* (Alcoholics Anonymous, 2006), were generated using custom software written in the Perl computer programming language. This program scanned the manuals and sorted words from most to least frequent. A separate table held “filtered” words (i.e., articles, pronouns, and prepositions) to be ignored when inspecting manual overlap.

Procedure

Near the end of their inpatient or intensive outpatient treatment, participants were recruited, screened and randomized into the larger treatment trial (see Bowen, Chawla, Collins et al., in press). Participants presented at their treatment site to complete the baseline data assessment, including assessment of AOD and sociodemographic variables. Surveys were self-administered using computers set up to access the web-based survey. Trained, undergraduate research assistants provided instruction and assistance during assessments as needed. Next, participants underwent either TAU or the 8-week, group-based MBRP treatment. The Participant Feedback Form was completed by MBRP participants who attended the final treatment week. Participants provided AOD use days data at the posttest, 2-month and 4-month follow-ups, which were completed at the treatment facility. If participants did not complete scheduled follow-ups, substance use data were obtained via telephone. Participants received gift cards for completion of assessments.

Data Preparation

Trained undergraduate research assistants double entered data from the Participant Feedback Form into separate text files for each participant. Text files were cleaned by the first author and were run through the LIWC program using the LIWC 2007 default dictionary and the 2 ML dictionaries created for the current study. The program yielded the proportion of participants’ writing samples reflecting words from the chosen linguistic and ML categories. These data were entered into STATA 10 (StataCorp, 2007) for the analyses.

Results

Preliminary analyses showed a significant association between race and use of mindfulness journey words ($U=68, p=.03$); thus, race was entered as a covariate in later AOD use analyses. There were no other associations between baseline demographic variables and AOD use or ML ($ps > .12$). As predicted, ML words largely correlated with hypothesized linguistic markers (see Table 2). Convergent validity was further supported in that a word count conducted on the MBRP manual ($n_{\text{words}}=28989$) indicated that all ML words appeared at least twice ($M=62.98, SD=74.40$), and collectively made up 13.5% of the total manual words. Word frequency analyses established the 100 most frequently occurring words in the MBRP manual

and 12-step *Big Book*. Aside from articles, pronouns and prepositions, there was only a 1-word overlap between ML and the 100 most frequent words in the *Big Book* (see Figure 1). A proportional z test indicated that overlap between ML and the MBRP treatment manual was significantly higher than the overlap between ML and the *Big Book* ($z = 4.70, p < .001$).

Separate zero-inflated negative binomial models¹ (ZINB; Cameron & Trivedi, 1998; Hardin & Hilbe, 2007) tested the association of ML and total number of AOD use days during the 4-month follow-up. The 2, separate mindfulness state, $\chi^2(3, N = 41) = 18.22, p = .0004$, and journey, $\chi^2(3, N = 41) = 8.15, p = .04$, models both predicted AOD use days. After controlling for race and baseline AOD use days, there were inverse effects for mindfulness state ($IRR = .03, SE = .05, p = .02$) and journey ($IRR = .55, SE = .13, p = .01$) language. Thus, for each one percent increase in the use of ML in a given writing sample, the rate of AOD use during the 4-month follow-up was reduced by 97% and 45%, respectively. Neither mindfulness state nor journey words predicted the zero-inflation process ($ps > .19$).

Discussion

This study examined the relationships among mindfulness language, linguistic markers, and substance-use treatment outcomes. Findings largely supported the convergent validity of the ML categories by confirming the hypothesized associations between ML and linguistic variables. ML was inversely related to participants' use of past tense words, which reflects the focus of mindfulness practices on present moment experience (e.g., Baer et al., 2006; Kabat-Zinn, 1994; Marlatt & Kristeller, 1999). Greater use of ML was also associated with decreased use of impersonal pronouns, which may reflect the MBRP focus on examining one's own internal states and supports the notion that mindfulness practice fosters a greater sense of agency and personal choice (Kabat-Zinn, 1990; Segal et al., 2002). Mindfulness state words were positively associated with use of affect and body-related words, which is consistent with the focus of mindfulness practices on increasing awareness of affective states and associated bodily sensations (Bowen, Chawla, & Marlatt, in press), and with neurobiological research showing that mindfulness meditation is associated with changes in areas of the brain involved in interoceptive and visceral awareness (Critchley et al., 2004; Holzel et al., 2008). The association of mindfulness journey words with fewer anger and more insight words also fits the focus of mindfulness practice on interrupting automatic and reactive behavior and helping participants develop skillful responses when confronted by triggering situations (Segal et al., 2002).

Convergent validity was further supported in the text-based analyses: high-frequency words in the MBRP manual resembled the ML categories in that they comprised more active, present tense verbs as well as tactile and sensory experience words. Further, 38% of the ML words were contained within the 100 most frequent words in the MBRP manual. The percent of

¹Zero-inflated negative binomial (ZINB) regression is a subset of generalized linear models for count outcomes that are positively skewed, overdispersed (i.e., the variance is greater than the mean), and have a preponderance of zeroes (i.e., zero responses are more frequently observed than would be expected given the distribution). ZINB models two processes for each participant. The first process is a Bernoulli trial, which much like a logistic regression, determines the probability that an observation is consistently zero or is a feasible count response predicted by the negative binomial distribution. For example, if participants are abstinent from AOD use before treatment begin and remain so, they may never enter the count process because they are considered to be "always-zero" responses (Hardin & Hilbe, 2007). If the observation may be predicted by the negative binomial process, it enters this count estimation which proceeds as a typical negative binomial regression.

Negative binomial regression provides output much like a multiple (OLS) regression, but the interpretation of the regression coefficients is different. Instead of standardized regression coefficients or betas, exponentiated coefficients or incident rate ratios (IRR) may be interpreted as the rate of change in the outcome variable for each one point increase in the predictors. IRRs ranging from 0 to 1 indicate an inverse relationship between the predictor and outcome; whereas IRRs greater than 1 indicate a positive relationship between the predictor and outcome. There is no widely accepted statistic that provides a percentage of variance accounted for (R^2). There are various pseudo- R^2 statistics for generalized linear models more generally, but they may neither be interpreted as percent variance accounted for nor are they widely agreed upon (Hardin & Hilbe, 2007).

content overlap between ML and the MBRP manual was significantly higher than the overlap between ML and the *Big Book*.

In support of the ML categories' discriminant validity, only one word ("time") in the mindfulness journey category appeared in the 100 most frequent words in the *Big Book*. The words were also qualitatively different: the *Big Book* list comprised less experiential and more concrete words (e.g., "had," "not," "drink," "God," "alcoholic") than the ML and MBRP lists. This finding conformed to hypotheses and is not surprising given the philosophical differences between MBRP and 12-step approaches. Although there are several points of overlap between the two models, including emphasis on acceptance and the value of meditation (Hsu et al., 2008), the philosophical underpinnings of 12-step approaches are based largely on the disease and spiritual models of addiction (Spicer, 1993). Affected individuals are encouraged to accept the label of an "addict" or "alcoholic," and to enlist the support of a Higher Power to aid them in their recovery, which may explain the emphasis in the *Big Book* on words such as "alcoholic" and "God." In contrast, MBRP discourages use of and identification with labels and encourages ongoing observation and acceptance of all thoughts, sensations and emotional states (Bowen, Chawla, & Marlatt, in press; Marlatt et al., 2008). This may explain the greater emphasis of the MBRP manual on tactile, sensory and present tense verbs and its considerable overlap with ML.

ML use predicted AOD frequency during the 4-month follow-up period, which supported the predictive validity of ML. This finding also provided support for the hypothesized underlying process: that MBRP should increase mindfulness, which should in turn help participants decrease their AOD use. Unfortunately, because there was no baseline assessment of ML and because the writing samples were not available for participants in the control condition, it is impossible to ascribe causality to the relationship between mindfulness and later substance use. This finding did, however, provide evidence that level of mindfulness language is a valid and clinically relevant construct. Future experimental studies may explore whether change in ML over the course of the MBRP treatment mediates substance use behavior change.

Limitations of this study deserve mention. First, there was a relatively low rate of attendance at the final session, during which participants completed the writing samples used to assess ML. It is also important to note that the mindfulness state words are a subset of the mindfulness journey category; thus, the two categories are overlapping and highly correlated. Although it was deemed important to capture the subtle distinctions between the actual state of mindfulness versus the challenges inherent in mindfulness practice, the predictive models of AOD should not be interpreted independently without acknowledgment of this overlap. Finally, follow-up attrition was relatively high over the 4-month follow-up period. The resulting data missingness may have introduced bias into the dataset and reduced power to find significant differences (Kazdin, 1998). These flaws limit the conclusions that can be drawn; however, the robustness of the findings that ML is a valid and clinically relevant behavioral measure of mindfulness is encouraging.

Despite the limitations, ML showed potential as a valid and clinically relevant representation of mindfulness. ML was associated with other linguistic variables believed to represent key aspects of mindfulness, showed appropriate content overlap with relevant text-based sources, and predicted subsequent substance use outcomes. Future studies may employ larger samples and experimental designs to further investigate ML as a valid and clinically useful way to assess mindfulness and as a potential mechanism underlying mindfulness-based treatment effects on substance use outcomes.

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Big Book (Frequency)		LIWC Mindfulness	MBRP manual (Frequency)	
The (1011)	By (89)	Accept*	The (1315)	Noticing (83)
To (971)	God (89)	Allow*	To (956)	Meditation (81)
We (887)	Been (88)	Attention	And (823)	Experience (80)
Of (785)	When (86)	Automatic/Autopilot	Of (748)	Might (80)
A (647)	About (84)	Aware*	You (657)	Them (80)
And (626)	Could (82)	Balanc*	Your (618)	Use (79)
He (477)	These (80)	Being	In (542)	Each (78)
That (415)	Drinking (79)	Body	A (455)	Into (77)
In (376)	One (79)	Breath*	Or (388)	Our (75)
I (339)	From (78)	Calm*	That (321)	Not (75)
Is (339)	Some (75)	Center*	What (299)	Focus (74)
It (325)	Me (74)	Choice*	This (282)	Back (73)
Have (304)	Them (74)	Commit*	Is (259)	Relapse (71)
Our (294)	More (73)	Compassion*	As (255)	Out (71)
Be (273)	People (70)	Curiosity	It (255)	Daily (69)
For (255)	Out (68)	Discomfort*	Are (251)	By (68)
Not (247)	Ourselves (64)	Space	With (227)	They (68)
Had (239)	Your (64)	Emotion*	Practice (219)	These (68)
Are (236)	Spiritual (63)	Energy*	We (215)	Aware (67)
Was (234)	How (62)	Experienc*	Can (210)	Mind (67)
You (227)	Time (61)	Expand*	Body (199)	Space (66)
This (207)	Drink (60)	Feel*	On (197)	Will (65)
His (203)	Way (60)	Fight*	Sensations (195)	Bringing (64)
With (196)	Their (60)	Fix*	Now (177)	Best (64)
If (191)	Man (58)	Free*	For (173)	All (62)
As (181)	Many (57)	Friend*	Awareness (160)	Then (62)
But (173)	Should (56)	Sens*	If (156)	Sitting (61)
Us (171)	Other (56)	Grateful	Thoughts (155)	Up (61)
Or (167)	Such (55)	Gratitude	How (151)	Situations (60)
Him (154)	Power (54)	Judg*	Be (140)	Moment (59)
Will (147)	Than (54)	Thought*	Just (139)	May (59)
On (138)	Life (52)	Let*	Pause (130)	About (58)
All (134)	Like (50)	Meditat*	Minutes (120)	Did (56)
At (128)	Only (49)	Mindful*	Attention (109)	Right (55)
My (127)	Then (49)	Moment*	Breath (107)	Day (55)
Would (124)	Go (47)	Nonjudg*	Notice (103)	Allowing (54)
Were (123)	Think (46)	Notic*	From (103)	More (54)
There (122)	Any (46)	Now*	Do (97)	Yourself (53)
Which (114)	Day (46)	O.k.	Session (95)	Feel (88)
An (112)	Up (45)	Observ*	Have (94)	Mindfulness (83)
May (112)	Never (44)	Open*	Way (94)	Here (51)
They (105)	Much (44)	Paus*	When (93)	Emotions (46)
Who (105)	Alcoholics (44)	Practice	Times (93)	Situation (49)
Do (104)	Good (43)	Time*	Any (91)	Using (49)
No (103)	Must (43)	Present	Breathing (90)	Automatic (49)
What (96)	Most (42)	Sit*	At (90)	Activities (47)
So (96)	Why (42)	React*	An (52)	Taking (47)
Alcoholic (95)	Himself (42)	Relax*	Gently (85)	So (46)
Can (94)	See (42)	Resist*	There (83)	Like (50)
Has (90)	Own (41)	Respon*	Bring (51)	Many (45)
		Scan*		
		Gentle*		
		Push*		
		Slow*		
		Sober		
		Soften*		
		Ease		
		Stop*		
		Struggl*		
		Kind*		
		Peace		
		Willing*		

Figure 1. Mindfulness language (ML) words are in the center column. Words shaded in black represent overlap between ML and the 100 most frequent words in the MBRP manual (Bowen, Chawla, & Marlatt, in press), which account for 55.60% (n=16119) of the total words in the MBRP manual. Words shaded in gray represent overlap between ML and the 100 most frequent words in the *Big Book* (Alcoholics Anonymous, 2006), which account for 56.76% (n=16428) of the total words in the *Big Book*.

Table 1

Mindfulness language categories

Linguistic category	Operationalization	Examples
Mindfulness: State	Describes the actual mindfulness experience	<ul style="list-style-type: none"> • Accept* • Balanc* • Calm* • Ease • Let* • Meditat* • Observ* • Present • Scan* • Soften* • Space • Willing
Mindfulness : journey	Includes all words from the mindfulness state category plus challenges surrounding the practice of mindfulness	<ul style="list-style-type: none"> • Automat* • Autopilot • Judg* • Sober • React* • Struggl* • Fight* • Fix* • Time • Discomfort • OK

* Notes. = is a symbol for wild card in the Linguistic Inquiry and Word Count program. It implies that all forms of the word will be counted.

Table 2
 Bivariate Spearman's Rho Correlations Between Mindfulness and Other Linguistic Categories

Measure	1	2	3	4	5	6	7	8	9	10	11
1. Mindfulness: Core	--										
2. Mindfulness: journey	.70**	--									
3. Impersonal pronouns	-.36*	-.29*	--								
4. Past	-.31*	-.36*	.27	--							
5. Present	-.15	.04	.12	-.33*	--						
6. Future	-.01	-.02	.11	-.07	-.03	--					
7. Affect	.28*	-.05	-.15	.03	-.14	-.18	--				
8. Anger	-.11	-.31*	.04	.08	.02	.05	.11	--			
9. Insight	.16	.37**	-.03	-.32*	.13	.02	-.23	-.29*	--		
10. Perception	-.05	-.19	-.10	-.18	.24	.16	-.17	.18	-.07	--	
11. Body	.33*	.18	-.04	-.25	.12	-.01	-.10	.18	-.10	.15	--

**
 $p \leq .01$

*
 $p \leq .05$