

Loving-Kindness Meditation and the Broaden-and-Build Theory of Positive Emotions Among Veterans With Posttraumatic Stress Disorder

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Background: Loving-kindness meditation (LKM) is a practice intended to enhance feelings of kindness and compassion for self and others.

Objectives: To assess whether participation in a 12-week course of LKM for veterans with posttraumatic stress disorder (PTSD) is associated with improved positive emotions, decentering, and personal resources.

Research Design: In an open-pilot trial, veterans were assessed at baseline, after the course, and 3 months later. Effect sizes were calculated from baseline to each follow-up point for each construct of interest. Measures were chosen as an initial investigation of the broaden-and-build theory of positive emotions.

Subjects: A total of 42 veterans with active PTSD (40% female) participated.

Measures: Emotions, decentering, psychological wellbeing including autonomy, environmental mastery, personal growth, positive relations, purpose in life, self-acceptance, and sense of social support were measured at each time point.

Results: Significant increases in unactivated pleasant ($d=0.73$), but not activated pleasant, emotions were found over time. Activated and unactivated unpleasant emotions decreased over time ($d=-0.69$ and -0.53 , respectively). There were also increases in environmental mastery ($d=0.61$), personal growth ($d=0.54$), purpose in life ($d=0.71$), self-acceptance ($d=0.68$), and decentering ($d=0.96$) at 3-month follow-up.

Conclusions: Overall, positive emotions increased, and enhancement of personal resources occurred over time. Further investigation of LKM for PTSD is warranted.

Key Words: emotions, meditation, social support, post-traumatic stress disorder (PTSD), veterans

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Symptoms of posttraumatic stress disorder (PTSD) often persist for decades and result in reduced quality of life.¹ In the US general population, the lifetime risk of PTSD is estimated to be 8.7%,² whereas the rate of PTSD among returning combat veterans may be as high as 20%–30%.^{3,4} In a large analysis, 13% of returning Operations Iraqi Freedom and Enduring Freedom (OIF/OEF) veterans received a diagnosis of PTSD when they accessed VA health care.⁵ Clinical hallmarks of PTSD include recurrent, intrusive memories of a traumatic event, persistent avoidance of stimuli associated with the traumatic event, hyperarousal, and negative mood and cognitions associated with the traumatic event.⁶ The VA recommends medications (selective serotonin-reuptake inhibitors and prazosin), and psychotherapeutic approaches (cognitive processing therapy, exposure therapy, stress management skills training, and eye movement desensitization reprocessing) for PTSD.⁷ Despite the availability of these interventions, many people with PTSD continue to experience persistent PTSD symptoms, as well as anger, difficulties with interpersonal relationships, shame, and grief.⁸ To respond to the growing demand for mental health services, consensus recommendations have recommended the development of cost-effective nontraditional delivery systems, such as group interventions, to expand the availability of therapies.⁹

Emerging evidence indicates that veterans use complementary and alternative medicine (CAM) at high rates. A large multisite study found that 27% of VA outpatients utilized CAM within the past year.¹⁰ Another study found that nearly 50% of veterans reported use of CAM, with high stress, chronic medical illness, and a perceived negative impact of military service on health as significant predictors of CAM use.¹¹ In addition, dissatisfaction with reliance on prescription medication and the desire to address social and spiritual aspects of health have been shown to influence CAM use.¹²

Loving-kindness meditation (LKM) is a CAM approach intended to develop an enhanced ability to experience kindness, openheartedness, and compassion for self and others. LKM originated in the Buddhist tradition, but can be taught as a secular practice. An emerging literature suggests

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that self-compassion is associated with healthy psychological functioning (including life satisfaction and social connectedness), and negatively associated with self-criticism, rumination, thought suppression, anxiety, and depression.¹³ Self-criticism, shame,¹⁴ rumination, and thought suppression are frequently associated with PTSD.¹⁵ Therefore, an intervention that increases self-compassion might favorably influence clinical manifestations of PTSD, and a small body of literature supports this hypothesis. A study of PTSD symptoms among university students found a correlation between greater self-compassion and lower rates of avoidance symptoms.¹⁶ An intervention called “compassionate mind training” designed to teach self-compassion, was beneficial for individuals who had experienced trauma in a small pilot study.¹⁷

The phrase loving-kindness describes an emotional state of kindness or goodwill, rather than sentimental love. In LKM, a practitioner brings to mind a particular person (eg, a good friend) and silently repeats phrases of positive intention for that person. These phrases may express a desire for safety, happiness, health, and ease or peace for the person held in mind. Classically, 4 phrases are used, such as: “may you be safe,” “may you be happy,” “may you be healthy,” and “may your life unfold with ease.”¹⁸ As practitioners continue to practice LKM, they are then asked to bring to mind other individuals or categories of people, including themselves, neutral persons, and persons who have caused them difficulty or harm, while changing the phrases as needed (ie, “may you be safe” becomes “may I be safe”).¹⁸

When practicing LKM, a person is asked to notice and feel the positive emotion elicited by each of the phrases of positive intention, or to notice whether there is a sense of reluctance, hesitation, or even aversion for the self or another. The practitioner is encouraged to greet these responses with kindness, and to notice them without judgment. More generally, during LKM, when practitioners become distracted by thoughts that arise during the practice, they are instructed to notice what has distracted them with an attitude of nonjudgmental, mindful attention, and then return to the LKM phrases and the breath without self-criticism. Walking meditation may also be used as a method to teach LKM. Informal LKM practices are also encouraged—practitioners are asked to practice LKM toward themselves or others during everyday activities such as walking, eating, washing the dishes, or standing in line at the grocery store. This systematic development of kindness toward self and others is intended to change the orientation to oneself, others, one’s life experiences, and to result in a broadening of the range of emotional responses and choices available.

LKM AND THE BROADEN-AND-BUILD THEORY OF POSITIVE EMOTIONS

The broaden-and-build theory of positive emotions provides a framework for understanding how LKM practice may influence affect, behaviors, and clinical outcomes.^{19,20} The broaden-and-build theory proposes that positive emotions broaden a person’s perceptual and cognitive abilities, and with this broadened outlook one is able to build personal

resources.²¹ This broadened mindset is characterized by openness to new situations and ideas rather than the narrow focus typically associated with negative emotions and habitual responses (eg, fight or flight).¹⁹ Personal and social resources that are postulated to be enhanced by positive emotions can include the ability to mindfully attend to experience, a sense of environmental mastery, a sense of purpose in life, enhanced self-compassion, or improved ability to give and receive social support.¹⁹

There is accumulating evidence in support of the broaden-and-build theory. Studies of experimentally induced positive emotional states that show that positive emotions broaden the scope of visual attention,^{22–24} enhance openness to new experiences,²⁵ improve ability to accept feedback,^{26,27} and enhance a sense of connection with others.¹⁹ In a randomized controlled trial of LKM versus a waitlist control, findings supported both the “broaden” aspect (enhanced positive emotions), the “build” part of the theory (enhanced personal resources), as well as improved mood and quality of life.¹⁹

LKM, THE BROADEN-AND-BUILD THEORY, AND PTSD

The lives of many people with PTSD are marked by ongoing severe emotional (and often accompanying physical) pain, including the hallmark emotion of fear. According to the broaden-and-build theory, negative emotions arise in response to perceived threats and undesirable circumstances, whereas positive emotions arise through identification of perceived opportunities in the environment.²¹ One of the core features of PTSD is a phobic response to reminders of a traumatic event and to the memories associated with that event, which in conjunction with information-processing problems, leads to pervasive fear and poor functioning.²⁸ LKM practice may provide individuals with PTSD a means to identify additional opportunities/resources in their environment, and to temper the often habitual preoccupation with the past and the narrow focus on negative aspects of one’s situation. In addition, many survivors of trauma carry a strong sense of shame, such that their fundamental view of themselves is negative and is characterized by self-alienation.^{14,29} LKM’s emphasis on cultivation of goodwill toward oneself may help to repair the tendency toward shame that many individuals with PTSD suffer. This may prove particularly helpful when kindness and support are lacking in the environment.

Trauma can also shatter the sense of basic trust in others, oneself, and the world at large. Disruptions in basic trust, as well the tendency to avoid reminders of the trauma in social situations, often result in withdrawal from close relationships.³⁰ The repetition of LKM phrases can also be conceived of as a mechanism to recreate a safe “holding environment,” which in LKM is created by phrases of positive intention. Social support has been shown to be an important factor in recovery from PTSD.³¹ The incremental restoration of a sense of basic trust in self and others, as well as an increased ability to self-modulate pervasive feelings of shame, guilt, and inferiority may lead to an enhanced sense of self-efficacy. Over time, enhancement of these factors might be expected to play a role in restoration of a connection to the

sense of self that has been lost through traumatic experiences, and may lead to a sense of reconnection with the community as well.

The cultivation of positive emotions through LKM might be also particularly helpful for the numbing and constrictive symptoms characteristic of chronic PTSD, which can present as feelings of chronic alienation and deadness. Providing a technique through which positive emotions can repeatedly be enhanced, as in LKM practice, might provide an innovative pathway to address these numbing and constrictive symptoms. It is also possible that a meditation practice that encourages observation of one's thoughts and feelings as temporary mental events could help address the tendency for distressed individuals to identify personally with thoughts and feelings as reflections of their true nature. This can be particularly distressing if much of one's internal experience is characterized by painful, traumatic memories that may include beliefs that one failed in crucial ways that led to bad outcomes.

Although we know of no formal comparison of rates of adopting a regular LKM practice as compared with other meditation practices, in our experience it is not uncommon for people in severe distress to find it easier to practice LKM than mindfulness practices, such as the breathing and body scan meditations. LKM relies on the repetition of simple phrases intended to elicit feelings of kindness for self and others, and these phrases may serve as a readily accessible anchor to the present moment for people in severe distress. As part of LKM instructions, participants are also often asked to notice the thoughts and feelings that arise during the course of practice, and to regard passing thoughts and feelings as objects of attention, to be viewed with curiosity and openness. This capacity—to regard thoughts and feelings as temporary, objective events in the mind—is termed decentering. It has been hypothesized that in the setting of aversive emotional states, mindfulness interventions promote exposure-based learning and extinction through the combined effects of decentering (which allows a person to observe and label experience) and curiosity (which maintains attentional focus).^{32,33} LKM can be hypothesized to have similar effects.

We previously reported the results of an open-pilot trial of LKM for veterans with PTSD.³⁴ In that publication, we reported on the primary clinical outcomes (PTSD symptoms and depression) as well as changes in mindfulness and compassion for self and others. Briefly, we found that participation in the LKM intervention was associated with clinically significant improvements in PTSD and depression as well as increased compassion and mindfulness. As part of the pilot, we also collected preliminary data pertaining to the broaden-and-build theory of positive emotions; these are reported here. We hypothesized that enhanced positive emotions, attentional broadening, and built personal resources would occur following participation in a 12-week course of LKM.

METHODS

We conducted a before-and-after study of 42 veterans who participated in a 12-week LKM course as an adjunct to their usual care at a large, urban VA Hospital. The main study findings and procedures have previously been

reported.³⁴ The study was approved by the Institutional Review Board and all subjects gave written informed consent. The trial was registered with clinicaltrials.gov: NCT01607632.

Participants

The exclusion criteria were: (1) prior history of a psychotic disorder; (2) mania, or poorly controlled bipolar disorder; (3) known borderline or antisocial personality disorder; (4) current suicidal or homicidal ideation with intent; and (5) active substance use disorder.

Measures

Demographics characteristics were recorded using a written questionnaire.

Measures Related to Attentional Broadening

Emotions: The Circumplex Measure of Emotion³⁵ assesses affect over the past 7 days by ratings of 20 emotional states on a 7-point Likert scale (Cronbach $\alpha=0.93$).³⁶ Emotions were categorized as unactivated positive (eg, calm, serene), activated positive (eg, happy, delighted), unactivated negative (eg, bored, sad), and activated negative (eg, frustrated, distressed).

Decentering: Decentering was measured using the 11-item version of the Experiences Questionnaire, which has adequate to good internal consistency.³⁷ Decentering is “the ability to observe one's thoughts and feelings as temporary, objective events in the mind, ... as opposed to reflections of the self that are necessarily true.”³⁷

Attention allocation: The computer-based Attention Network Test (ANT) assessed attentional network efficiency by measuring response to visual stimuli. The ANT assesses alerting, orienting, and executive control.^{38–40} Participants click the right or left arrows on the keyboard in response to congruent or incongruent arrowheads, which may or may not be preceded by cues. Scores of the ANT were calculated using mean response times as follows: alerting network score (no cue–double cue), orienting network score (central cue–spatial cue), and executive control network score (incongruent–congruent).^{38–40}

Measures Related to “Built” Personal Resources

Psychological wellbeing (PWB): The 42-item PWBScale⁴¹ assesses environmental mastery, personal growth, purpose in life, autonomy, positive relations with others, and self-acceptance (Cronbach $\alpha=0.91$).⁴¹ Environmental mastery can be defined as the ability of an individual to create an environment suitable to his/her needs and capacities, and to “participate in spheres of endeavor that go beyond the self.”⁴¹ A sense of purpose in life can be defined as “the ability of a person to find meaning in the face of suffering and difficulty.”⁴¹ Self-acceptance can be defined as “a kind of self-evaluation that is long term and involves awareness, and acceptance of both personal strengths and weaknesses.”⁴¹ Positive relations with others refers to interpersonal relationships that include friendship, love, and warm relating to others, whereas personal growth can be defined as a continual process of developing one's potential.⁴¹

Social support: The 21-item Sense of Support Scale⁴² assesses perceived quantity and quality of social support. The Sense of Support Scale has adequate internal consistency (Cronbach $\alpha = 0.84$).

Procedure

After baseline assessment, participants took part in a 12-week LKM course as previously described.³⁴ Each participant continued to receive usual care from their medical and mental health providers during the study period without intervention from the study team. Follow-up assessments were performed immediately after LKM and 3 months post-LKM (6 mo after baseline).

Data Analyses

Standardized mean differences (Cohen *d*, with 95% confidence intervals) from baseline to the follow-up time points were calculated for each measure.

RESULTS

Table 1 shows the demographic characteristics of the study population.³⁴ Approximately, 40% of study participants were female and the average age of participants was 54 years.

Broadening Facilitators

There were no changes in activated pleasant emotions over time, but unactivated pleasant emotions increased both at the post-LKM and 3-month follow-up time points (Table 2). Reductions were found in activated unpleasant emotions at post-LKM and at 3-month follow-up. Unactivated unpleasant emotions were unchanged at post-LKM, but declined at 3-month follow-up.

Decentering increased, with a large effect size, at both the post-LKM and 3-month follow-up time points.

Executive control network score (calculated by subtracting the mean response time for congruent flanker trials from incongruent flanker trials using the ANT) decreased with a medium to large effect size post-LKM and at 3-month follow-up. There was also an increase in alerting effect (calculated by subtracting the mean response time for double cue trials from no cue trials using the ANT) at 3-month follow-up, with a medium effect size.

Built Personal Resources

For “built resources,” there were improvements in personal growth, purpose in life, and self-acceptance at both the post-LKM and 3-month follow-up time points, with medium effect sizes. An improvement in environmental mastery was found only at the 3-month follow-up time point. Sense of social support increased post-LKM, with a medium effect size, but at the 3-month follow-up time point, the 95% confidence interval included zero. There were no reliable effects on autonomy or positive relations with others.

DISCUSSION

In this pilot study, we found that veterans with PTSD experienced increased unactivated positive emotions, enhanced decentering, and increased personal resources following participation in a 12-week LKM course, as compared with base-

TABLE 1. Participant Characteristics (N = 42)

Characteristics	N (%)
Sex	
Female	17 (40.5)
Age (mean ± SD)	53.6 (8.6)
Ethnicity	
White	35 (83.3)
Black	3 (7.1)
Hispanic	1 (2.4)
Asian/Pacific Islander/Native American	1 (2.4)
Other	1 (2.4)
Religion	
Christian	25 (59.5)
None	14 (33.3)
Other	2 (4.8)
Buddhist	1 (2.4)
Living situation	
Own/rent	36 (85.7)
Homeless	3 (7.1)
Other	3 (7.1)
Marital status	
Married or committed partnership	16 (38.1)
Highest level of education	
12th grade (high school graduate)	6 (14.3)
Some college	10 (23.8)
College graduate	18 (42.9)
Postgraduate studies	8 (19.0)
Income	
Full time employment	1 (2.4)
Part time employment	5 (11.9)
VA service connection pension	20 (47.6)
Unemployed	8 (19.0)
Use of psychotropic medications at baseline	
Antidepressants	27 (64.3)
Benzodiazepines	16 (38.1)
Antipsychotics	8 (19.0)
Prazosin	17 (40.5)
Categories of mental health services utilized: n (%) who utilized each modality during the study period	
Supportive individual therapy	21 (50)
Supportive group	17 (40.5)
Individual cognitive-behavioral therapy	6 (14.3)
Acceptance and commitment therapy	1 (2.4)
Cognitive processing therapy (1 group, 1 individual)	2 (4.8)
Prolonged exposure	1 (2.4)
Addiction treatment	2 (4.8)
Medication management visit	30 (71.4)
Any mental health treatment	37 (88.1)

line. Of note, the categories of emotions that increased over time in our study were consistent with the conceptualization and practice of LKM, which would be expected to induce unactivated pleasant emotions (eg, calm, serene, relaxed), but not necessarily activated pleasant emotions (eg, enthusiastic, delighted). We also found reductions in both activated and unactivated unpleasant emotions over time. Overall, these findings, in combination with our prior findings of increases in mindfulness and self-compassion along with reductions in PTSD symptoms and depression following participation in LKM,³⁴ provide support for further investigation of LKM as an intervention designed to enhance positive emotions and self-compassion in the treatment of PTSD. Our results raise the possibility that LKM might serve as an adjunct to established cognitive behavioral interventions for PTSD, given that the emotional numbing symptom cluster of PTSD may be less

TABLE 2. Descriptive Statistics and Effect Sizes From Baseline to Post-LKM, and Baseline to 3-Month Follow-up

Outcomes	Pretreatment		Post-LKM		3-Month Follow-up		
	<i>M (SD)</i>	<i>M (SD)</i>	SMD	95% CI	<i>M (SD)</i>	SMD	95% CI
Measures of broadening							
Circumplex emotions							
Activated pleasant	9.6 (5.5)	11.4 (5.8)	0.30	−0.15, 0.76	11.8 (6.1)	0.34	−0.12, 0.80
Unactivated pleasant	6.6 (3.1)	9.4 (4.3)	0.76	0.29, 1.23	9.5 (4.4)	0.73	0.26, 1.20
Activated unpleasant	19.2 (6.0)	15.1 (6.0)	−0.66	−1.13, −0.19	14.6 (6.6)	−0.69	−1.16, −0.22
Unactivated unpleasant	18.6 (6.4)	15.8 (5.8)	−0.46	−0.92, 0.00	15.3 (5.5)	−0.53	−0.99, −0.06
Attention allocation							
EQ-Decentering	27.7 (7.6)	34.4 (7.5)	0.86	0.39, 1.33	35.3 (7.6)	0.96	0.49, 1.43
ANT							
Alerting	18.0 (36.7)	32.7 (34.0)	0.44	−0.02, 0.90	36.7 (28.2)	0.58	0.10, 1.06
Orienting	47.4 (37.0)	56.3 (34.3)	0.25	−0.21, 0.71	56.3 (27.7)	0.27	−0.20, 0.74
Executive function	167.4 (68.4)	131.9 (43.9)	−0.59	−1.05, −0.12	110.3 (59.8)	−0.89	−1.38, −0.40
Measures of “built” personal resources							
PWB							
Autonomy	28.0 (7.8)	30.8 (6.8)	0.37	−0.08, 0.83	31.0 (7.2)	0.39	−0.07, 0.85
Environmental mastery	19.4 (6.8)	22.1 (6.8)	0.37	−0.09, 0.83	23.8 (7.0)	0.61	0.15, 1.07
Personal growth	26.7 (5.7)	29.7 (6.7)	0.48	0.02, 0.94	30.1 (6.9)	0.54	0.08, 1.00
Positive relations	21.8 (5.8)	24.4 (5.6)	0.45	−0.01, 0.91	24.4 (6.9)	0.39	−0.06, 0.85
Purpose in life	21.6 (7.4)	26.3 (7.5)	0.62	0.16, 1.08	27.0 (7.7)	0.71	0.25, 1.18
Self acceptance	18.2 (6.9)	23.0 (7.9)	0.62	0.15, 1.08	23.3 (7.5)	0.68	0.22, 1.15
SSS	26.5 (10.4)	32.7 (12.2)	0.54	0.08, 0.99	30.9 (13.2)	0.34	−0.11, 0.80

N = 42.

Bold indicates 95% CI does not include zero.

ANT indicates Attention Network Test; CI, confidence interval; circumplex, circumplex measure of emotion; EQ-decentering, experiences questionnaire-decentering items; LKM, loving-kindness meditation; PWB, psychological wellbeing; SMD, standardized mean difference; SSS, Sense of Support Scale.

responsive to cognitive-behavioral interventions than other symptom clusters.^{43,44}

The findings are generally compatible with the broaden-and-build theory of positive emotions, which posits that induction of subtle, pleasant emotional states leads to changes in attention and thinking, which in turn leads to “built” personal resources.²⁰ However, it is important to note that we did not assess the temporal sequence of change or conduct analyses of mediation in this small initial study. Therefore, our comments regarding the broaden-and-build theory of positive emotions in this context remain speculative. We chose to report the results within the broaden-and-build framework to add to the small body of literature suggesting that this theory may explain the effects of LKM.^{19,45} The broaden-and-build theory is well suited for LKM in that it focuses specifically on positive emotions; this is also the emphasis of LKM, which seeks to cultivate compassion and kindness toward self and others. An alternative model that could be examined to explain the effects of LKM is the motivational dimensional model of affect, which factors in the degree of motivation for approaching or acquiring something associated with a particular positive emotional state.⁴⁶ Evaluating the role of motivation in the context of increased positive emotions could be a useful refinement that might aid the field’s understanding of LKM’s mechanisms of change in future research. Future research that evaluates both key tenets of the broaden-and-build theory and of the motivational dimension model of affect in the context of LKM for PTSD would significantly move this nascent literature forward.⁴⁶

We found promising changes in built personal resources over time, including environmental mastery, per-

sonal growth, purpose in life, and self-acceptance. We have also previously reported on changes in self-compassion, and mindfulness following LKM.³⁴ This increase in personal resources could potentially buffer feelings of grief, shame, and guilt, which are pervasive in chronic PTSD. In terms of specific personal resources, active participation in and mastery of the environment is considered an important component of PWB.⁴¹ For people with PTSD, an enhanced sense that one is capable of creating safe, functional environments is predicted to be an important factor in reduced PTSD symptoms, particularly decreased avoidance. For personal growth, it is now recognized that traumatic events may result in personal growth, which may include finding purpose and meaning in life.⁴⁷

Sense of social support has been defined as a person’s perception of “how approachable and forthcoming people within the social environment are likely to be.”⁴² Perceived social support seems to be more important than actual available support.⁴² In the setting of PTSD, greater social support and positive social interactions have been found to be associated with reductions of PTSD symptoms over time.⁴⁸ Enhanced perception of support has been also associated with reduced depressive symptoms,⁴⁹ and reduced appraisal of environmental threat. We found that perceived social support increased at the post-LKM time point, but waned at 3-month follow-up, suggesting that further engagement in a group may be needed to maintain this capacity. Taken as a whole, these findings might signal a decrease in the broad-ranging sense of alienation (ie, social, spiritual, and self) and loss of meaning and life purpose that PTSD researchers Fontana and Rosenheck⁵⁰ have observed to be at the core of chronic PTSD.

We assessed measures reflective of attention allocation, and found effects on decentering as well as components of the ANT. Decentering has been defined as “the ability to observe one’s thoughts and feelings as temporary, objective events in the mind, as opposed to reflections of the self that are necessarily true.”³⁷ Decentering allows a person to view thoughts as not synonymous with oneself. Thus, we considered decentering to be a reflection of attentional broadening. Impaired ability to adopt a decentered perspective can be considered a general vulnerability factor for psychological and social dysfunction, and improvement in decentering is associated with clinical improvement in depression.³⁷ Decentering increased after LKM with a large effect size.

Executive function can be defined as “a collection of high-order neurocognitive abilities, including selective attention, behavioral planning, response inhibition, set shifting, and the manipulation of information in problem-solving tasks.”³⁹ One facet of executive functioning thought to be of particular importance in PTSD is the ability to inhibit habitual responses; impairment of this ability is thought to contribute to reexperiencing, hyperarousal, and numbing.³⁹ For people with PTSD, inability to differentiate threat-related from nonthreat stimuli may result in suppression of trauma-related stimuli and neutral stimuli, which can result in emotional numbing or risk avoidance. The ANT⁴⁰ evaluates executive functioning by measuring inhibition of response to conflicting contextual stimuli⁴⁰; this has previously been shown to be impaired among individuals with PTSD.³⁹ In our study we found that the ANT executive control index score decreased following LKM. However, a decrease in the executive control network index score at follow-up could be due to either a decrease in response time to incongruent stimuli (which would be compatible with improved executive functioning) or an increase in response time to congruent stimuli. Similarly, the increase in the alerting score of the ANT at 3-month follow-up could be due to an increase in the response time to no cue trials (which might reflect a lessening of hypervigilance), or a decrease in the response time to double cue trials. We suggest that future trials in which the ANT is utilized as an assessment for PTSD interventions include response times for the subcomponents of the scores (which were not recorded using the Web-based version of the ANT in our trial) to better discern the effects of the intervention; see Leskin and White³⁹ for an example of this methodology.

This study has a number of additional limitations, which preclude conclusions regarding a causal association between LKM practice and the changes in positive affect or personal resources seen over time. The most significant limitation is the lack of a control arm; the changes seen could occur due to regression to the mean or to the natural history of illness. The changes could also be due to nonspecific effects, such as participation in a group, rather than to specific effects of LKM practice. In addition, the veterans who participated in this study continued to receive usual care, which included a range of other treatments (summarized in Table 1), which could have accounted for some or all of the clinical improvement observed. Despite these limitations, we think that the findings warrant further investigation of LKM and the broaden-and-build theory of positive emotions, as applied to PTSD.

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