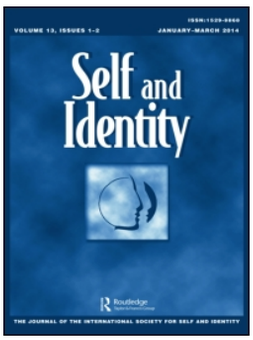

Routledge
Taylor & Francis Group

Self and Identity

ISSN: 1529-8868 (Print) 1529-8876 (Online) Journal homepage: http://www.tandfonline.com/loi/psai20

Who am I? Differential effects of three contemplative mental trainings on emotional word use in self-descriptions

Anna-Lena Lumma, Anne Böckler, Pascal Vrticka & Tania Singer

To cite this article: Anna-Lena Lumma, Anne Böckler, Pascal Vrticka & Tania Singer (2017) Who am I? Differential effects of three contemplative mental trainings on emotional word use in self-descriptions, Self and Identity, 16:5, 607-628, DOI: 10.1080/15298868.2017.1294107

To link to this article: https://doi.org/10.1080/15298868.2017.1294107

SELF AND IDENTITY, 2017
VOL. 16, NO. 5, 607–628
https://doi.org/10.1080/15298868.2017.1294107

Routledge
Taylor & Francis Group

Who am I? Differential effects of three contemplative mental trainings on emotional word use in self-descriptions

Anna-Lena Lumma[a§], Anne Böckler[a,b], Pascal Vrticka[a] and Tania Singer[a]

[a]Department of Social Neuroscience, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [b]Department of Psychology, University of Würzburg, Würzburg, Germany

ABSTRACT

In a large-scale longitudinal mental training study, we examined whether learning different contemplative practices can change the emotional content of people's self-concept as assessed through emotional word use in the Twenty Statement Test. During three 3-month training modules, participants learned distinct practices targeting attentional, socio-affective, or socio-cognitive capacities, or were re-tested. Emotional word use specifically increased after socio-cognitive training including perspective-taking on self and others, compared to attentional and socio-affective compassion-based trainings, and retest-controls. Overall, our findings demonstrate training-induced behavioral plasticity of the emotional self-concept content in healthy adults and could indicate greater emotional granularity. These findings can inform future interventions in mental health, given that alterations in self-referential processing are a common contributing factor in psychopathology.

ARTICLE HISTORY
Received 28 March 2016
Accepted 3 February 2017
Published online 24 March 2017

KEYWORDS
Self-concept content; emotional word use; mental training; meditation; trait affect

Introduction

The emergence of the "self" is both an interesting and complex topic that has been researched for several decades within multiple disciplines (Baumeister, 2011). Although the operationalization of the self is a challenging endeavor (Klein & Gangi, 2010), research has identified different subcomponents and mechanisms that give rise to the complex system of the self. To better understand the complexity of the self, it is therefore important to study its different subcomponents separately and investigate their unique and common features. One widely studied subcomponent of the self is the self-concept, which can be regarded as a cognitive structure that represents self-relevant information (Leary & Tangney, 2003; Markus, 1977; Oyserman, Elmore, & Smith, 2012).

The cognitive structure of the self-concept is believed to be dynamic, and its content to be representative of thoughts about the self that can be updated through the process of self-construal (Markus & Kunda, 1986; Peters & Gawronski, 2011). Consequently, the content

CONTACT Anna-Lena Lumma lumma@cbs.mpg.de
[§]Department of Social Neuroscience, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
Supplemental data for this article can be accessed at http://dx.doi.org/10.1080/15298868.2017.1294107.

of the self-concept can be regarded as a state-like aspect of personality, and considered to be an important mediator regarding the influence of environmental factors on personality traits (Roberts & Jackson, 2008). Repetitive activation of certain self-relevant thoughts and feelings could therefore become part of an individuals' self-concept and over time potentially develop into more stable, longer lasting personality traits. Direct measures of the self-concept, such as validated closed-format trait questionnaires, capture explicit aspects of the self-concept that represent thoughts and beliefs individuals consciously attribute to their self, and that can be voluntarily controlled and revised (Back, Schmukle, & Egloff, 2009; Peters & Gawronski, 2011). In contrast, the implicit self-concept is representative of involuntary associations of self-relevant information and best assessed with indirect measures that cannot be directly influenced by participants (Back et al., 2009). The aim of the current work was to specifically investigate whether and how the emotional content of the self-concept can be altered by means of an indirect measure.

Information stored in the self-concept can be classified among distinct factors including content and emotional evaluation (Oyserman et al., 2012). Prior research suggests that the way one thinks about oneself is related to emotional traits in several ways. First, the tendency to emotionally evaluate oneself can result in affectively biased attention to self-relevant information (Leary, 2007), a process tightly linked to personality traits and mental health (Browning, Holmes, & Harmer, 2010). For example, overly positive self-representations are usually associated with narcissistic traits, which in turn are related to poorer mental health and difficulties in interpersonal relationships (Konrath & Bonadonna, 2014). In contrast, the predisposition to evaluate oneself mainly negatively and preferentially identify with negative information is related to ruminative self-referential processing (Krans, de Bree, & Moulds, 2015; Nejad, Fossati, & Lemogne, 2013), which is known to be a major cause of mood disorders such as depression (Gotlib & Joormann, 2010). In addition, overly negative self-judgment is linked to lower self-esteem and self-compassion (Neff, 2009), which are important prerequisites for sustaining mental as well as physical health (MacBeth & Gumley, 2012; Neff, Kirkpatrick, & Rude, 2007). Support for the relatedness of processing self-relevant and emotional stimuli also comes from functional neuroimaging studies, which indicate that emotion regulation and self-referential processing share overlapping brain regions (Northoff, 2005). Another line of research indicates that the emotional content of the self-concept might fluctuate in response to contextual factors such as mood states (Sedikides, 1992). This research leads to the question whether, and if so, how the emotional content of the self-concept can be altered in systematic ways.

Previous research shows that change in the self-concept can, for instance, be triggered by developmental processes during the transition from infancy to adulthood, or during existential life circumstances such as illness or break-ups with a spouse (Oyserman et al., 2012). Change in the self-concept is often not intentional but occurs on an implicit and involuntary level, and seems to be multifaceted including social, developmental, biological, and cultural aspects that are still under investigation (Gore & Cross, 2011). Within the clinical domain, the intentional induction of change specifically regarding the emotional evaluation of the self-concept content is the goal of several therapeutic methods. Cognitive therapy, for instance, aims at changing the maladaptive emotional content of the self-concept towards more adaptive emotional content and its evaluation (Hofmann, Asmundson, & Beck, 2013; Vreeswijk, Spinhoven, Eurelings-Bontekoe, & Broersen, 2014). In addition, interventions such as mindfulness-based cognitive therapy (Kuyken et al., 2010; Williams & Kuyken, 2012) are targeted to overcome self-generated, habitual negative thinking patterns (Killingsworth

& Gilbert, 2010; Ruby, Smallwood, Engen, & Singer, 2013). Overall, these data suggest that the content of the self-concept is intentionally alterable through interventions in patients. However, much less is known about how change in the emotional content of the self-concept can be achieved through targeted interventions that are practiced by healthy adults, that is, outside of the clinical therapeutic setting. Given the importance of the emotional content of the self-concept in mental health and psychological well-being, our goal was to investigate (i) whether targeted contemplative mental trainings practiced by healthy adults on a daily basis could alter the emotional content of the self-concept, and if so, (ii) which type of practice would be most efficient in inducing self-concept related plasticity.

In general, contemplative training such as mindfulness- and meditation-based practices are suggested to lead to states of non-judgmental present-moment awareness and increased compassion (related both to oneself and others) (Dahl, Lutz, & Davidson, 2015; Hofmann, Grossman, & Hinton, 2011; Neff & Dahm, 2015; Vago & Silbersweig, 2012). Accordingly, contemplative mental training could be well suited as a type of targeted intervention that induces change in the emotional content of the self-concept. Although much attention has recently been given to the effects of mindfulness-based interventions on change related to attention, cognition, social emotions, and stress (Hölzel et al., 2011; Kok, Waugh, & Fredrickson, 2013; Lutz, Slagter, Dunne, & Davidson, 2008), little is known about how these interventions could affect the emotional content of the self-concept; empirical evidence regarding the specific effects of mindfulness meditation on self-concept change in healthy individuals has only started emerging recently (Crescentini & Capurso, 2015). In a previous study, Campanella and colleagues found that participants who underwent an 8-week mindfulness meditation training showed increased scores post-training on different facets of the Temperament and Character Inventory, a personality measure assessing how individuals evaluate different facets of their self-concept such as self-directedness, cooperativeness, and self-transcendence (Campanella, Crescentini, Urgesi, & Fabbro, 2014). Another pertinent study showed that experienced Vipassana meditators, compared to meditation-naïve participants, were emotionally less reactive towards negative self-relevant stimuli (Lutz et al., 2016). These studies provide preliminary evidence that meditation expertise and mindfulness-meditation-based interventions can influence different aspects of self-referential processing, including emotional evaluation of self-concept content. Importantly, however, mindfulness-based intervention programs, such as the 8-week mindfulness-based stress reduction program (MBSR; Kabat-Zinn, 2003) or mindfulness-based cognitive therapy (MBCT; Williams & Kuyken, 2012), are composed of a multitude of different mental training techniques including attention-based, meta-cognitive, and socio-affective aspects. It therefore remains unclear which components of these mindfulness-based interventions contribute to change of the self-concept, and whether different types of contemplative training practices could differentially influence the self-concept, particularly its emotional content.

To close this gap, we investigated differential effects of three targeted interventions that were designed to specifically train (a) attention and interoception, (b) socio-affective skills such as loving-kindness and compassion, or (c) socio-cognitive capacities such as meta-cognition and perspective-taking on self and others. In order to investigate change in the emotional content of the self-concept through different types of contemplative practice, meditation-naïve participants underwent a 9-month mental training composed of three distinct 3-month training modules in a study called the *ReSource Project* (Singer et al., 2016). The training modules included core exercises targeting attentional and interoceptive as well

as socio-affective and socio-cognitive capacities (see Figure 1, panel A). A detailed description of the three modules is provided in the Methods (see Section Procedure and design). Summarized briefly, during the Presence Module, participants trained attention and interoceptive awareness with the help of breathing meditation and body scan techniques as core exercises. These core exercises practiced within the Presence Module are often incorporated within MBSR programs (Kabat-Zinn, 2005). Conversely, the Affect Module aimed at training emotions such as care, compassion, and gratitude, as well as prosocial motivation and dealing with difficult emotions through practicing loving-kindness meditation and a partner-based contemplative dyad called the Affect Dyad. Specifically, the loving-kindness meditation (Salzberg, 1995) is often integrated in other compassion-based interventions like the Compassion Cultivation Training (Jazaieri et al., 2013). Finally, the Perspective Module was designed to improve socio-cognitive abilities such as meta-cognition on one's own thoughts and perspective-taking on self and others. Core exercises such as the observing-thoughts meditation (Ricard, 2008) are often also implemented within the context of MBSR programs (Kabat-Zinn, 2005).

All training modules were taught by qualified meditation teachers who were specifically recruited for the study. Participants were asked to practice the respective core exercises five times per week at home for 30 minutes using guided audio-files via an online platform,

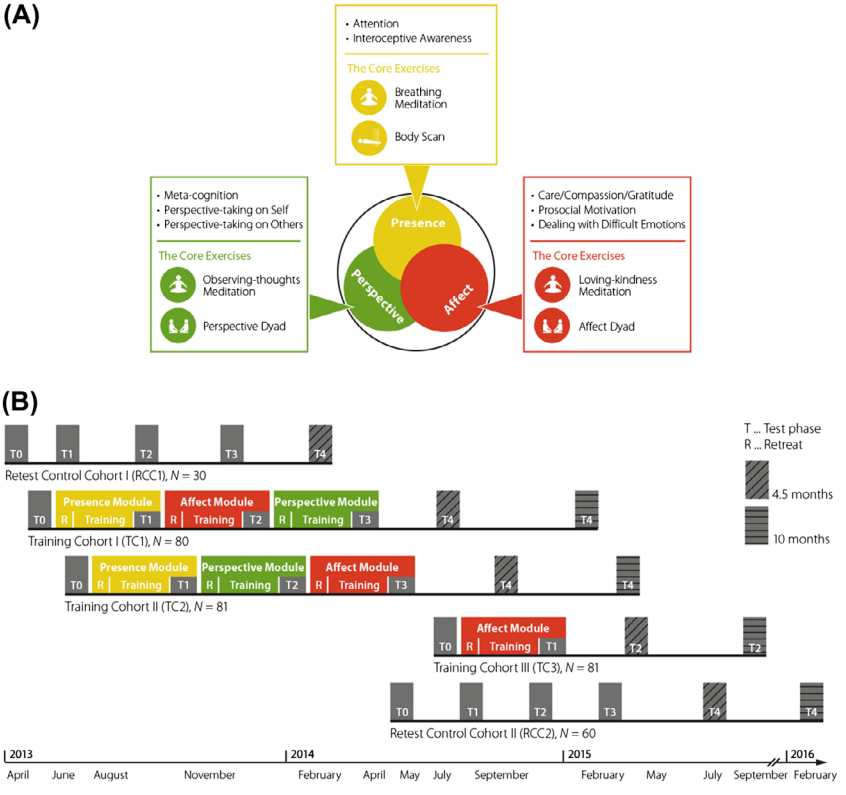

Figure 1. Panel A shows the *ReSource* protocol including all three training modules as well as the respective core processes and exercises. Panel B depicts the study design and sequence of training modules for all training cohorts (TC1, TC2, and TC3), and both retest control cohorts (RCC1 and RCC2). Source: Figure courtesy of (Singer et al., 2016).

which was developed for the study. In addition, participants attended a weekly 2-hours meditation session with the meditation teachers. Change in the emotional content of the self-concept was assessed before training onset and at the end of each training module by means of emotional word use extracted from the Twenty Statement Test (TST) (Kuhn & McPartland, 1954). The open-ended response format of the TST allows to measure different structural features of the self-concept, including the emotional content of the self-concept (Isbell, McCabe, Burns, & Lair, 2013; Krans et al., 2015). The emotional content of the self-concept was operationalized with emotional words used in the self-descriptions of the TST. Emotional word use was extracted with an emotion word dictionary included in the Linguistic Inquiry and Word Count (LIWC) software, which is a widely validated and frequently used word counting software (Chung & Pennebaker, 2008; Pennebaker, Francis, & Booth, 2001; Tausczik & Pennebaker, 2010). Our first goal was to identify whether the use of emotional words in self-descriptions would be related to individual differences in affective predisposition assessed in personality measures of trait affect, and therefore represents a valid measure of the emotional content of the self-concept. This was specifically tested by relating emotional word use with more general a priori derived factors of trait positive and negative affect, which include several questionnaires sharing underlying concepts (for further details see Methods and Chapter 10.4 in Singer et al., 2016).

Beyond validation of emotional word use as a measure of the emotional content of the self-concept, the main goal of the present study was to investigate whether the emotional content of the self-concept can be altered through contemplative mental training, and if so, which type of practice as implemented in the three modules would be most efficient. For instance, the Presence Module could alter the emotional content of the self-concept through increased awareness of internal bodily states (Bornemann, Herbert, Mehling, & Singer, 2015; Fox et al., 2012). In turn, the Affect Module could induce change in the emotional content of the self-concept through engagement with one's own feelings, as well as the generation of positive prosocial emotions and compassion to oneself and others (Neff & Germer, 2013; Singer & Klimecki, 2014). Finally, the Perspective Module could alter the emotional content of the self-concept through improved meta-cognition and training on perspective-taking on aspects of the self and the beliefs and intentions of others (Hayes & Wilson, 2003). The latter socio-cognitive skill is also referred to as mentalizing or the ability to take on the perspective of others by cognitively understating their beliefs, intentions, and feelings (Kanske, Böckler, Trautwein, & Singer, 2015; Singer, 2006, 2012).

Methods

Participants

A total of $N = 332$ healthy adult participants were recruited for the *ReSource Project*, a longitudinal mental training study conducted in the cities of Leipzig and Berlin from April 2013 to February 2016. Participants undergoing mental training were split into three cohorts. Eighty participants were assigned to training cohort 1 (TC1), 81 participants were assigned to training cohort 2 (TC2), and another 81 participants were assigned to training cohort 3 (TC3). In addition, an independent sample of 30 (RCC1) and 60 (RCC2) participants were part of two retest control cohorts not undergoing any training. RCC1 and RCC2 were later on combined and treated as a single retest control cohort (denoted hereafter as RCC). The first

Table 1. Sample size per time point.

	T0	T1	T2	T3
Missing data	9 (5 D)	24 (12 D)	21 (16 D)	26 (23 D)
Excluded data	5	9	7	9
Final sample size	318	299	223	216

Notes: Description of the final sample size per time point, including the number of missing data as well as excluded data from the TST. The initial sample size at T0 was $N = 332$. Missing data were either due to participants not completing the TST at the respective time point, or due to study dropouts (D; denoted in brackets). Dropouts were due to participants developing new medical problems, discomfort with study or experiments, time constraints, or other reasons (such as moving to another city etc., and no disclosure). For a detailed description of the *ReSource* study sample, please refer to Chapter 7 in (Singer et al., 2016).

measurements were taken at baseline before training onset (denoted hereafter as time point T0). All further measurements were taken during the testing phase (weeks 9–13) of each training module (denoted hereafter as time points T1, T2, and T3). The follow-up testing phases (T4 for TC1, TC2, and RCC; T2 for TC3) took place either 4.5 or 10 months after the last training session and are not included in the present analysis. For an illustration of the study design and sequence of training modules, see Figure 1, panel B.

For the current study, we focused on data from all three training cohorts and the RCC from T0 to T3. This sample included $N = 332$ participants (196 females; mean age 40.71 ± 9.25 years). $N = 26$ participants dropped out over the course of the study duration (see Table 1). Data from those participants were used for analyses until the time of dropout. The final sample size per measurement time point for the present study further deviated from the initial numbers mentioned above due to missing data and TST answer exclusion (for more information on the TST, please see Section TST data analyses below). A complete list of available data per time point is provided in Table 1.

Participants underwent a screening assessment including mental health questionnaires (Major Depression Inventory (Bech, Rasmussen, Olsen, Noerholm, & Abildgaard, 2001), DIA-X for axis I disorders for DSM-IV (Wittchen & Pfister, 1997)), and a clinical diagnostic interview (Structured Clinical Interview for DSM-IV, SKID-I (Wittchen, Zaudig, & Fydrich, 1997)), to ensure that they were psychologically healthy. For more details about the selection criteria see Singer et al. (2016). All participants gave informed consent prior to participation. The study was approved by the Research Ethics Committee of the University of Leipzig, number 376/12-ff, and the Research Ethics Committee of the Humboldt University in Berlin, numbers 2013-02, 2013-29, and 2014-10. The study was registered with the Protocol Registration System of ClinicalTrials.gov under the title "Plasticity of the Compassionate Brain" with the ClinicalTrials.gov Identifier: NCT01833104.

Procedure and design

At the beginning of each training module, participants attended a three-day retreat under the supervision of qualified meditation teachers who introduced participants to the core exercises of the respective trainings. These core exercises were then individually practiced at home on a daily basis for 30 minutes. In addition, participants attended a weekly session with the meditation teachers, which allowed them to ask questions about the exercises and practice together in a group. Information about training adherence for each core exercise of the respective training module is provided in Supplemental Data S1. During the retreats and the weekly sessions, meditation teachers were instructed not to address any of the

specific capacities that should be trained by the individual modules. Each of the three training modules lasted for thirteen weeks and were designed to train either attentional, socio-affective, or socio-cognitive capacities as briefly outlined below (see Figure 1, panel A). Within the first 8 weeks of each training module, participants were familiarized with the respective core exercises and learned different aspects about them during the weekly meditation sessions with the teachers. For the remaining five weeks of each training module, participants continued with and deepened their practice of the core exercises and also started to undergo the experimental measurement phase. TC1 started with the Presence Module, continued with the Affect Module, and finished with the Perspective Module. TC2 also started the training with the Presence Module, but continued with the Perspective Module, and finished with the Affect Module. TC3 only underwent training in the Affect Module. The RCC did not undergo any training and was tested at four time-points like TC1 and TC2. For an overview of the experimental design, see Figure 1, panel B.

Presence module

The Presence Module was designed to train attention and interoception (i.e., body awareness). The daily core exercises included a breathing meditation (Hanh, 2011) and a body scan practice (Kabat-Zinn, 2005). Both practices are often embedded in mindfulness-based meditation programs such as MBSR (Kabat-Zinn, 2005), but are often also combined with additional meditation exercises.

Affect module

The goal of the Affect Module was to cultivate loving-kindness, care, gratitude, and prosocial motivation as well as to practice dealing with difficult emotions. The core exercises of the Affect Module comprised a loving-kindness meditation (Salzberg, 1995) and the Affect Dyad, which can be regarded as a partner-based contemplative dialogue helping to cultivate empathic listening, dealing with difficult emotions as well as cultivating gratitude.

Perspective module

The Perspective Module aimed at training the ability to take perspective of one's own inner self-aspects and the self-aspects of others as well as to improve meta-cognition about one's thought processes. The core exercises of the Perspective Module included an observing-thoughts meditation (Krishnamurti, 1993; Ricard, 2008) and another partner-based contemplative dialogue called the Perspective Dyad, which includes working on the self and is based on the Internal Family System approach (Schwartz, 1997) and Inner Parts Work (Holmes, Holmes, & Eckstein, 2007). Essential for the Perspective Dyad is the identification of inner parts or self schemas that make up the personality structure as a whole. Examples of such inner parts are the "inner critic," the "inner child," or the "inner optimist" (Holmes et al., 2007). Initially, participants were asked to identify a set of six inner parts, which they were allowed to change once per week throughout the Perspective Module. The Perspective Dyad consisted of two rounds throughout which each participant was randomly assigned to either be in the speaker or listener role. The speaker was asked to first briefly describe a situation that happened within the last 24 hours and was then instructed to re-tell the situation from the perspective of one of his/her inner parts that was randomly assigned to him/her. The listener was instructed to mindfully pay attention to the speaker and utilize perspective-taking in order to infer which of the inner parts was used by the speaker to

re-tell the situation. Overall, the Perspective Dyad should train participants to flexibly enact these different inner parts and improve perspective-taking on their own inner parts and those of their training partner.

Measures

Twenty Statement Test

The Twenty Statement Test (TST) was used to assess participants' self-concept (Kuhn & McPartland, 1954). In this measure, participants were asked to answer the question "Who am I?" by filling in 20 statements beginning with "I am …" Participants were allowed to answer freely, using as many words as they preferred. Participants completed this task between weeks 9 and 13 at all four measurement time points (T0–T3) via an online-platform, which was specifically designed for the study and could be accessed online from the participants' home (see Chapter 8 in the *ReSource Project* documentation (Singer et al., 2016)). Instructions for the TST were taken from Kuhn et al. (Kuhn & McPartland, 1954):

> There are twenty numbered blanks on the page below. Please write twenty answers to the simple question "Who am I?" in the blanks. Just give twenty different answers to this question. Answer as if you were giving the answers to yourself, not to somebody else. Write the answers in the order that they occur to you. Don't worry about logic or "importance." Go along fairly fast, for time is limited.

Trait affect factors

Several relevant questionnaires that represent trait affect were measured within the scope of the *ReSource Project*. In order to reduce the complexity of the data, a principal component analysis was applied. Trait affect was assessed with various measures including relevant sub-scales and items from the Adult Temperament Questionnaire, the Beck Depression Inventory, the Mental Health Continuum, the Neuroticism, Extraversion & Openness Five-Factor-Inventory (NEO-FFI), the Positive and Negative Affect Schedule, the Short Affect Intensity Scale, and the Types of Positive Affect Scale (Beck, Steer, & Hautzinger, 1994; Borkenau & Ostendorf, 1993; Geuens & De Pelsmacker, 2002; Keyes, 2009; Krohne, Egloff, Kohlmann, & Tausch, 1996; Lamers, Glas, Westerhof, & Bohlmeijer, 2012; Ostendorf & Angleitner, 2004).

The final solution yielded three factors including general positive affect, general negative affect, and low arousal positive affect. For the validation of the emotional word use we focused on the general positive and negative trait affect factors. For further details about the extraction of the factors, see Chapter 10.4 (Singer et al., 2016). In the Supplemental Data S2, we additionally show the validation of emotional word use with the positive and negative affect sub-scales of the NEO-FFI, which is conceptually most representative of the emotional content of the self-concept. All participants filled out the questionnaires between week 9 and week 13 at all four time points (T0–T3) via the online platform. For the validation of the emotional word use we only used T0 data, which was available from $N = 316$ participants for the trait affect factors, and from $N = 318$ participants for the NEO-FFI.

TST data analyses

Each TST statement was first spell-checked with a standard word processor and subsequently manually checked for any remaining spelling errors as an additional quality control step. Regarding TST content, the following exclusion criteria were applied: (i) incomplete responses,

(ii) deliberate repetition of the same word(s), and (iii) presence of non-words. TST data-sets with any of the above were removed from further analysis. Finally, the words "I am" were deleted if they were repeated at the beginning of a statement because they were regarded as redundant information. Emotional words of the self-descriptions were extracted with the LIWC software (Version LIWC2015), a widely used text analysis software counting the relative word frequency based on predefined function and content word categories (Pennebaker, Booth, Boyd, & Francis, 2015; Pennebaker et al., 2001). A preexisting and validated German version of the LIWC dictionary was used for the extraction of emotional words in the current study (Wolf et al., 2008).

Data analyses

For the T0 validation of emotional word use, raw data variables were checked for outliers by defining outliers as values higher or lower than three standard deviations from the mean. Any raw data values that were labeled as outliers were subsequently winsorized to the respective three standard deviation upper and/or lower boundaries, and results are reported using winsorized variables. Because the frequency of positive and negative emotional words at baseline was not normally distributed, Spearman's rank correlations (r_s) were used to test whether emotional words in the TST could be validated with the positive and negative trait affect factors. For the analysis of change, the same outlier detection procedure as described above was applied for the positive vs. negative difference scores (across time points), which were normally distributed. For the overall emotional word use variable, a natural log transformation with a constant of 1 was applied for it to reach normality (for further details see Supplemental Data S3) (Schultheiss, 2013). To identify whether there was a specific module-induced change in emotional word use, a linear mixed model (including the intercept) with the fixed within-subject factor time (T0, T1, T2, T3) and the fixed between-subject factor cohort (TC1, TC2, TC3, RCC) was used, a random subject factor (including the intercept) was added, continuous time was added as a repeated statement with the AR(1) covariance structure, and sex as well as mean-centered age were included as control variables of no interest. In order to compare differences between change in emotional word use pre versus post as well as between the different training modules, *post hoc* contrasts were specified within the above model. The Perspective effect in TC1 (T2–T3) and TC2 (T1–T2) was compared to the Presence effect (both TC1 and TC2 between T0 and T1) and Affect effect in TC1 (T1–T2) and TC2 (T2–T3), and to the RCC between T1 and T3. The Presence effect in TC1 and TC2 and the Affect effect in TC3 were also contrasted to the RCC between T0 and T1. Contrasts were not corrected for multiple comparisons. Within the multilevel model framework used here, estimates are "shrunk" toward a common mean; this "partial pooling" corrects for the increased risk of false positives typically incurred by multiple comparisons without compromising power (Gelman, Hill, & Yajima, 2012). Effect sizes of the main and interaction effects were calculated with Omega-squared (ω^2) by taking the difference from 1 of the variance of the residuals of the full model divided by the variance of the residuals of the model without the respective factor of interest (Xu, 2003). A small effect-size is represented by $\omega^2 \geq .010$, a medium effect-size by $\omega^2 \geq .059$ and a large effect-size by $\omega^2 \geq .138$ (Kirk, 1996).

Table 2. Descriptive values of word count and emotional word use per cohort and time point.

	T0		T1		T2		T3	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Word count								
RCC	75.02	75.80	58.78	44.13	55.16	41.76	59.60	48.11
TC1	62.61	42.93	71.04	50.89	64.71	57.93	62.66	50.91
TC2	73.91	55.19	70.43	53.13	70.11	57.04	69.59	66.20
TC3	79.04	64.33	69.93	49.29				
Overall emotion								
RCC	18.23	11.23	22.98	11.80	23.21	13.86	23.10	13.25
TC1	19.37	9.86	17.21	9.19	19.35	11.75	22.39	13.67
TC2	16.38	8.44	16.78	9.18	19.91	11.00	19.35	10.80
TC3	16.93	10.73	18.83	10.45				
Positive emotion								
RCC	13.29	8.76	17.71	9.61	17.70	12.35	18.54	12.38
TC1	14.37	8.20	12.61	6.89	15.01	9.98	16.88	10.41
TC2	12.74	7.86	12.58	6.92	15.46	9.51	15.19	9.21
TC3	13.15	8.99	15.11	9.73				
Negative emotion								
RCC	4.94	5.08	5.27	5.56	5.51	5.46	4.55	4.31
TC1	5.00	4.91	4.60	5.07	4.29	3.83	5.51	6.42
TC2	3.64	3.38	4.19	4.57	4.45	4.75	4.17	4.25
TC3	3.79	3.93	3.72	3.51				

Notes: Description of the mean (*M*) and standard deviation (SD) of overall word count, and raw scores of the relative frequency of overall, negative, and positive emotional word use in % per cohort and time point.

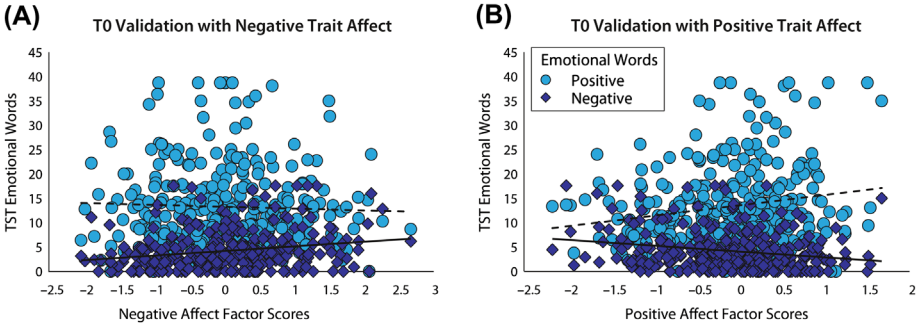

Figure 2. Illustration of spearman's rho correlations between emotional word use and the negative trait affect factor (panel A), and the positive trait affect factor (panel B).
Notes: Light blue circles represent positive emotional words, and dark blue squares represent negative emotional words. Dashed lines depict the linear relationship between positive emotional words and trait affect, and solid lines depict the linear relationship between negative emotional words and trait affect.

Results

Validation of emotional word use before training onset

The descriptive values for each cohort and time point are shown in Table 2.

At baseline (i.e., at T0), participants (belonging to TC1, TC2, TC3, and RCC) wrote 72.84 words on average and used 17.71% emotion words (13.37% positive and 4.34% negative) in their self-descriptions. A Wilcoxon Signed-Ranks Test showed that negative emotion words were used significantly less often compared to positive emotion words ($Z = -14.056$, $p < .001$).

At T0, positive emotional word use was significantly correlated with scores from the positive trait affect factor ($r_s = .173$, $p = .004$), but not with scores from the negative trait affect

factor (r_s = –.028, p = n.s.). Negative emotional word use, by contrast, was positively correlated with scores from the negative trait affect factor (r_s = .190, p = .002), and negatively with scores from the positive trait affect factor (r_s = –.223, p < .001). *P*-values for correlations between trait affect factors and emotional word use were Bonferroni-corrected (N = 316). Results are depicted in Figure 2. Further corroborating these results, the correlation between scores from the positive trait affect factor and positive emotional word use was significantly larger than with negative emotional word use (Fisher's r to Z = 5.292, p < .001), while scores from the negative trait affect factor were correlated significantly stronger with negative emotional word use as compared to positive emotional word use (Fisher's r to Z = 2.878, p = .004). Similarly, positive emotional word use was correlated significantly stronger with scores from the positive trait affect factor than with scores from the negative trait affect factor (Fisher's r to Z = 2.25, p = .024), and negative emotional word use was correlated with scores from the negative trait affect factor to a significantly larger extent than with scores from the positive trait affect factor (Fisher's r to Z = 4.686, p < .001). The above comparison of correlation coefficients from dependent samples was performed online at http://quantpsy.org/corrtest/corrtest2.htm (two-tailed; N = 316). A very similar pattern of results was observed when only using the trait affect sub-scales from the NEO-FFI (N = 318; see Supplemental Data S2).

Training-related change in overall emotional word use

The linear mixed model with the fixed between-subject factor cohort (RCC, TC1, TC2, TC3) and the fixed within-subject factor time (T0, T1, T2, T3) revealed a significant main effect of time (F(3, 593.35) = 7.31, p < .001) with an increase in overall emotional word use from T0 to T3: t(634.20) = 4.61, p < .001, 95% CI [.099, .245], and a medium effect-size (ω^2 = .071). There was no main effect of cohort (F(3, 319.85) = 1.86, p = .136). In addition, a significant interaction between time and cohort (F(7, 577.90) = 2.98, p = .004) with a small effect-size (ω^2 = .017) was found, suggesting that emotional word use increased differentially over the course of the different modules of the *ReSource* training.

Indeed, *post hoc* pairwise comparisons showed a specific increase in emotional word use after the Perspective Module (but not after the Presence and Affect Modules) for TC1 (t(614.76) = 2.08, p = .037, 95% CI [.008, .261]), and for TC2 (t(592.83) = 2.65, p = .008, 95% CI [.043, .287]). In addition, overall emotional word use increased from T0 to T1 in the RCC (t(598.85) = 3.96, p < .001, 95% CI [.117, .348]), and marginally in TC3 (t(588.14) = 1.93, p = .054, 95% CI [–.002, .237]). No other *post hoc* comparisons were significant. Results are depicted in Figure 3, panel A. Further *post hoc* contrasts were specified in order to compare the Perspective Module-specific change in TC1 and TC2 to change in the other training modules and in the RCC. Change in emotional word use after the Perspective training in TC1 and TC2 was significantly greater as compared to the RCC (t(723.95) = 2.95, p = .003, 95% CI [.054, .269]), and as compared to the Presence training (t(588.86) = 2.75, p = .006, 95% CI [.055, .331]), as well as moderately greater as compared to the Affect training (t(411.78) = 1.73, p = .085, 95% CI [–.018, .281]). Change in emotional word use after the Affect training in TC1 and TC2 was not significantly greater as compared to the RCC (t(719.65) = .55, p = .583, 95% CI [–.077, .138]), and not significantly different from the Presence training (t(572.96) = .87, p = .386, 95% CI [–.078, .200]). Change in emotional word use from T0 to T1 was significantly greater in the RCC compared to the Presence training (t(599.77) = 3.75, p < .001, 95%

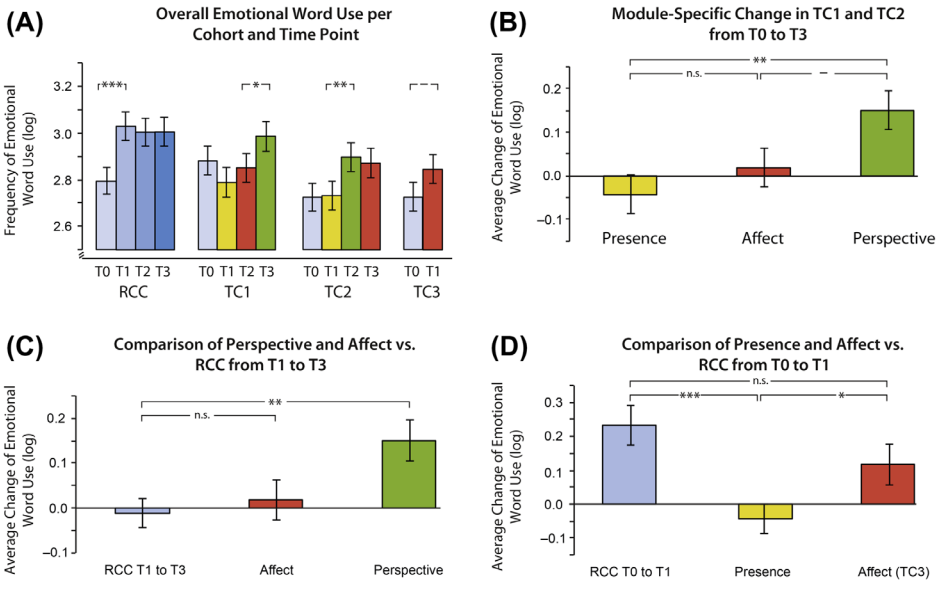

Figure 3. Emotional word use overall, and module-specific change in emotional word use from T0 to T3.
Notes: Results in the figure are shown with natural log transformed estimated marginal means from the linear mixed model. Panel A depicts the estimated marginal means of overall emotional word use for the RCC, TC1, TC2, and TC3. The order of bars from left to right reflects the measurement time points T0, T1, T2, and T3, respectively. In TC1 and TC2, emotional word use selectively increased after the Perspective Module (and not after the Presence and Affect Modules) in both TC1 (T2 to T3) and TC2 (T1 to T2). Emotional word use also increased in the RCC and marginally in TC3 (both from T0 to T1). Panel B shows that change in emotional word use was greater after the Perspective Module as compared to the Presence Module, and marginally greater as compared to the Affect Module. Panel C illustrates that change in emotional word use was only greater after the Perspective Module as compared to the RCC (always calculated as cumulative change from T1 to T3). Finally, panel D shows that change in emotional word use from T0 to T1 was significantly greater in the RCC as compared to the Presence Module in TC1 and TC2, but not as compared to the Affect Module in TC3. Finally, change after the Affect Module in TC3 was significantly greater as compared to the Presence Module in TC1 and TC2. ***$p < .001$, **$p < .01$, *$p < .05$, -$p < .10$.

CI [.131, .420]), but not as compared to the Affect training in TC3 ($t(593.30) = 1.36$, $p = .173$, 95% CI [−.051, .281].) The difference in emotional word use after the Presence training was significantly lower as compared to the Affect training in TC3 ($t(592.69) = -2.13$, $p = .033$, 95% CI [−.308, −.013]). Results are depicted in Figure 3, panels B, C, and D.

Training-related change in valence difference scores of emotional word use

Because we found a significant time x cohort interaction for overall emotional word use (driven by specifically increased emotional word use after Perspective training; see above), we conducted an additional exploratory analysis to check for valence-specific differences using valence difference scores (positive emotional word use vs. negative emotional word use). Positive valence difference scores indicate greater positive emotional word use in contrast to negative emotional word use, and negative valence difference scores indicate greater negative emotional word use in contrast to positive emotional word use.

A linear mixed model with the fixed between-subject factor cohort (RCC, TC1, TC2, TC3) and the fixed within-subject factor time (T0, T1, T2, T3) showed a significant main effect of time ($F(3, 597.77) = 8.00$, $p < .001$) with a medium effect-size ($\omega^2 = .077$), and a significant increase from T0 to T3 ($t(603.94) = 4.29$, $p < .001$, 95% CI [1.616, 4.342]). The cohort x time interaction was significant ($F(7, 593.93) = 2.38$, $p = .021$) with a small effect-size ($\omega^2 = .012$). The main effect of

cohort was not significant ($F(3, 329.44) = 1.51$, $p = .211$). *Post hoc* pairwise comparisons showed that the valence difference scores increased after the Perspective training in TC2 from T1 to T2 ($t(619.68) = 2.23$, $p = .026$, 95% CI [.304, 4.815]), but not in TC1 from T2 to T3 ($t(642.09) = .57$, $p = .569$, 95% CI [−1.657, 3.014]). In addition, the valence difference scores increased from T0 to T1 in the RCC ($t(627.73) = 3.71$, $p < .001$, 95% CI [1.898, 6.158]), and marginally in TC3 ($t(616.65) = 1.85$, $p = .065$, 95% CI [−.130, 4.278]). No other *post hoc* comparisons were significant. Further *post hoc* contrasts were conducted using combined valence difference scores from TC1 and TC2 after the Perspective training. Valence difference scores after the Perspective training were significantly greater as compared to the Presence training ($t(607.71) = 2.07$, $p = .039$, 95% CI [.142, 5.229]), but not significantly different as compared to the RCC from T1 to T3 ($t(738.11) = .929$, $p = .353$, 95% CI [−1.054, 2.947]), and from the Affect training ($t(438.12) = .19$, $p = .853$, 95% CI [−2.482, 3.00]). Valence difference scores after the Affect training in TC1 and TC2 were marginally different as compared to the Presence training ($t(592.79) = 1.86$, $p = .063$, 95% CI [−.136, 4.991]), but not as compared to the RCC ($t(733.92) = .68$, $p = .499$, 95% CI [−1.310, 2.686]). From T0 to T1, increase in positive vs. negative words was significantly greater in the RCC as compared to the Presence training ($t(628.35) = 3.75$, $p < .001$, 95% CI [2.427, 7.761]), but not as compared to Affect training in TC3 ($t(621.98) = 1.25$, $p = .211$, 95% CI [−1.112, 5.019). Finally, positive vs. negative word use increased less after Presence training as compared to Affect training in TC3 ($t(621.05) = -2.26$, $p = .024$, 95% CI [−5.868 −.414]). These results show that the RCC used more positive vs. negative emotional words at the second measurement time point (T1) compared to baseline (T0), which could indicate a retest effect. Greater positive vs. negative emotional word use after the Perspective training was only found in TC2 and not in TC1, and when combined, there were no reliable significant differences compared to the RCC and to the other training modules. Therefore, there appears to be no reliable module-specific valence effect for the Perspective training. Results are shown in Figure S4 in the Supplemental Data.[1]

Discussion

The present study aimed at investigating the influence of three distinct contemplative mental practices on change in the emotional content of the self-concept in healthy adults as a function of cultivating either (a) attentional and interoceptive, (b) socio-affective, or (c) socio-cognitive skills. To assess change in the emotional content of the self-concept we used the Twenty Statement Test (TST; Kuhn & McPartland, 1954), an open-ended measure of self-concept capable of detecting subtle changes that might remain undetected by more explicit self-related measures.

Results indicated that positive emotional word use in the TST was correlated with scores on the positive trait affect factor, and negative emotional word use in the TST was correlated with scores on the negative trait affect factor at baseline. This convergent validation demonstrates that emotional word use in self-descriptions represents a suitable marker for assessing the emotional content of the self-concept. Most importantly, the current findings revealed that contemplative mental training can reliably increase the amount of emotional word use during self-descriptions over the course of the training, suggesting behavioral plasticity in the emotional dimension of the self-concept in healthy adults ranging from age 20 to 55 years.

Interestingly, training-induced change in the emotional content of the self-concept was only found after participants underwent the Perspective Module, a module training meta-cognitive skills and perspective-taking on self and others. This finding indicates that not every

type of contemplative practice is suited for inducing changes in emotional aspects of one's self-concept. Given the scarcity of studies focusing on the effects of contemplative practice on self-related processing (Campanella et al., 2014; Crescentini & Capurso, 2015; Dahl et al., 2015), with a predominance of mindfulness-based interventions, our findings reveal several interesting points. First, practices such as training sustained attention on present-moment experiences including the breath, different body parts, or sounds and tastes forming the core of typical mindfulness-based intervention programs such as mindfulness-based stress reduction (MBSR; Kabat-Zinn, 2003) and mindfulness-based cognitive therapy (MBCT; Teasdale, Williams, & Segal, 2014), are not sufficient to alter the emotional content of the self-concept. This is interesting, because it has been previously discussed that body awareness might be fundamental for representing higher-order aspects of the self, such as the narrative self, the latter being linked to the self-concept (Damasio, 2003; Gallagher, 2000). Based on such interrelations between bodily and narrative aspects of the self, one could have expected that an increased focus on bodily states also influences narrative aspects of the self, particularly because we found increases in body awareness and regulation after the Presence training in participants of the *ReSource Project* (Bornemann et al., 2015). Similarly, the socio-affective mental training (i.e., Affect Module) that cultivated care, compassion and gratitude, how to generate a prosocial motivation as well as how to cope with difficult emotions, was also not effective in inducing change in the emotional dimension of the self-concept. Hence, focusing on training a better understanding and regulation of one's own emotions without linking these emotions explicitly to conceptions of the self does not seem to automatically relate emotional processes to the self-construct. Furthermore, change in emotional word use from T0 to T1 was observed in the RCC and also marginally in the replication cohort that underwent training in the Affect Module only (TC3), but not after the Presence training in TC1 and TC2. Given that increases in emotional word use in the RCC and TC3 did not differ, they most likely represent a retest effect. Furthermore, the increase in emotional, and specifically positive emotional word use in the RCC could also be related to the tendency to more strongly engage in self-referential processing and self-evaluation with each repetition of the TST, a tendency that might be buffered by the training. For example, training in the Presence Module could potentially decrease self-referential processing through directing one's attention to the object of breathing, and therefore reducing the focus on self-evaluation. This effect would be consistent with prior research showing that engagement in mindfulness-based meditation can lead to a greater focus on the present moment, and is accompanied by reduced self-referential processing (Farb et al., 2007). Also, training in the Affect Module could potentially decrease self-referential processing through focusing one's attention on generating positive emotions and compassion for others. Indeed, previous findings from the *ReSource Project* revealed that the exercises from the Presence Module increase feelings of presence and body awareness while decreasing past- and future-related, as well as negative thoughts; whereas the exercises from the Affect Module increase positive thoughts about other people (Kok & Singer, 2017).

Instead, our results indicate that solely the Perspective Module – in which the focus was on training meta-cognition on one's own thoughts and perspective-taking on self and others through daily intersubjective dyads with a partner – was effective in inducing changes in the emotional content of the self-concept. Our data therefore support research from the clinical domain demonstrating that targeted interventions such as cognitive therapy (Hofmann et al., 2013) or MBCT (Kuyken et al., 2010), the latter combining aspects of both the Presence and Perspective Module, are effective in reducing habitual negative self-related thinking patterns.

Several mechanisms could underlie the observed changes in the current study. First, an important mechanism for inducing change in the emotional content of the self-concept could be the daily practices performed on inner parts (Holmes et al., 2007; Schwartz, 1997). Based on the Internal Family System approach (Schwartz, 1997) and Inner Parts Work (Holmes et al., 2007), participants identified a set of different inner parts like the "inner critic" or "inner motivator." Such inner parts can best be regarded as self-schemas that are linked to specific thoughts, beliefs, and emotions, and guide the perception of reality and behavioral action tendencies (Holmes et al., 2007; Schwartz, 1997). The daily work with these inner parts within the Perspective Dyad allowed participants to get acquainted with their own personality structure and to accept more negative inner parts such as anxious, depressed, or shameful parts. In addition, the intersubjective component of the Perspective Dyad also allowed participants to improve socio-cognitive abilities, such as taking perspective on the complex inner personality dynamics of other people. Interestingly, recent findings from our lab showed that after training in the Perspective Module, the naming of a greater number of (particularly negatively valenced) inner parts was associated with improved perspective-taking on the beliefs and intentions of others (Böckler, Hermann, Holmes, & Singer, under review). Further findings from our lab suggest that daily training of the Perspective Dyad increases social closeness (Kok & Singer, 2016). These findings indicate that the active engagement with different inner parts throughout the Perspective Module could potentially alter the emotional content of the self-concept through an increased meta-awareness on the complexity of inner self-dynamics, as well as switching perspectives on inner parts (Böckler et al., under review; Holmes et al., 2007; Kok & Singer, 2016). On the other hand, the observing-thoughts meditation also trained meta-cognitive mechanisms such as noticing and labeling the content of thoughts, and distancing oneself from one's thoughts (Luoma & Hayes, 2003). Training these mechanisms during the Perspective Module might have increased participant's cognitive flexibility, thereby allowing them to extend and potentially integrate novel emotional aspects into the emotional content of their self-concept. Future research will have to disentangle the specific effects of these particular practices in driving change in emotional self-conception.

An extreme emotional evaluation of the world can result in attentional biases and cognitive distortions. For example, in depression, internal and external events are perceived as overly negative (Beck, 2008). Certain meditation techniques, such as mindfulness meditation practices, aim at overcoming such extreme evaluative tendencies and reducing associated cognitive biases (Hanley et al., 2013; Vago & Silbersweig, 2012). In the current study, we found valence-specific differences in the change of emotional word use after the Perspective training in the TC2 from T1 to T2, and in the RCC from T0 to T1. These results may indicate that the RCC evaluated themselves more positively (rather than negatively) after being tested the second time (i.e. at T1). Such pattern could potentially represent a retest effect, and possibly also indicate a social desirability bias (Schwarz, 1999). However, given that only TC2, but not TC1, used more positive words (as compared to negative words) after the Perspective training, we cannot conclude that the Perspective training increased positive valence attribution to the self in general (see also Supplementary Material S4). Furthermore, we cannot conclude that the Perspective training reduced self-evaluative biases, or that it made participants more accepting regarding negative attributes of their self. In contrast, the Perspective Module may have increased participants' emotional granularity, which allowed them to describe themselves in a more elaborate and differentiated affective manner

(Smidt & Suvak, 2015). Greater degrees of emotional granularity are associated with more fine-grained representations of feelings states, which in turn are linked with greater flexible and adaptive psychological functioning, including increased emotion regulation abilities (Smidt & Suvak, 2015).

The current results show that open-ended self-report measures are sensitive in detecting change in the emotional content of the self-concept. Prior discussions emphasized that the conceptual understanding of items in closed-format self-report measures of mindfulness is influenced by meditation experience (Grossman, 2008; Vago & Silbersweig, 2012). Furthermore, it is known that closed-format questionnaires are influenced by social desirability effects, which can obscure potential effects that consequently remain undetected (Chung & Pennebaker, 2007; Pennebaker, Mehl, & Niederhoffer, 2003; Schwarz, 1999). As shown in the present study, the usage of more implicit measures like language use in open-ended self-report measures are effective in assessing subtle change effects and could thus help to circumvent potential response biases. Finally, we investigated whether a more nuanced and fine-grained selection of words that specifically represent emotional states yields the same pattern of results observed with the emotional words from the standard LIWC dictionary. The pattern of results with the newly generated revised emotional word list showed consistent findings to the results obtained using the standard LIWC dictionary (see Supplemental Data S5).

Overall, the current findings provide a first indication that the emotional content of the self-concept can be altered through targeted socio-cognitive training. These findings are interesting with regard to state and trait-like aspects of personality, because changes in state-like aspects of the self, including thoughts and feelings, are discussed to be essential mediators between environmental influences and changes in more stable personality traits (Roberts & Jackson, 2008). The change in overall emotional word use could therefore represent a revision of thoughts and feelings related to state-like aspects of the self through the repeated engagement with one's inner self aspects during the Perspective Dyad. More specifically, the formation of new beliefs about the self could potentially underlie a repeated activation of new self-related information in the autobiographical memory (Peters & Gawronski, 2011). However, the small effect size of the current findings suggests that self-induced change in state-like aspects related to personality requires time and is in line with the idea that environmental factors lead to changes in personality in an incremental way (Roberts & Jackson, 2008). Even within clinical populations, change in habitual, maladaptive self-referential thinking through interventions such as cognitive therapy often requires several months up to years of therapy. Previous evidence shows that cognitive training can induce change in trait-like aspects of personality in elderly individuals (Jackson, Hill, Payne, Roberts, & Stine-Morrow, 2012). However, a recent study showed that a 100-day cognitive training only had prolonged effects on certain aspects of personality traits (Sander, Schmiedek, Brose, Wagner, & Specht, in press). These findings suggest that it is important to consider the type and duration of training, and whether measures represent state or trait-like aspects of personality when investigating the influence of self-induced change in aspects of personality. Future studies should take such considerations into account. Our current study showed that a socio-cognitive training that was specifically designed to alter personality aspects was successful in inducing change in the emotional content of the self-concept, which supports the assumption that it is important to consider the type of training and the type of measure studied. Interestingly,

our findings also support traditional contemplative views on the self. Within Buddhism, affective distortions of the self are believed to underlie suffering, and contemplative trainings are applied to transform the experience from a rigid toward a more fluid view of the self (MacKenzie, 2016).

Limitations and future directions

One limitation of the current study is that we cannot disentangle which of the above discussed mechanisms specifically contributed to the induced change in the emotional content of the self-concept. Future studies should investigate the unique effects of the different core exercises by studying them separately and consider additional types of contemplative training exercises. The focus on single words alone disregards linguistic information such as semantic relationships between words that might provide useful information. However, advanced textual analyses can only be used with open-ended questions that demand greater sample-sizes (Schwartz & Ungar, 2015). To overcome this limitation, future studies could make use of similar open-ended questions and recruit larger sample sizes.

In addition, the usage of predefined language categories limits the recognition rate only to words that are contained in the dictionary. Depending on the specific topic of interest, future studies could extend and adapt the predefined dictionaries to their study needs. A previous study followed a similar approach by creating training-specific dictionaries, and found that the word use of training-related concepts increased after an 8-week mindfulness-based relapse prevention in alcohol-addicted participants (Collins et al., 2009). The scope and aim of the current study was to specifically investigate training-induced change in the emotional content of the self-concept by means of emotional word use. However, the qualitative nature of the current data-set offers additional material, which could be analyzed with complementary qualitative methods in future work. With such analyses, other structural aspects and other types of content of the self-concept could be further explored. Finally, neuroscientific studies can further the understanding of potential neural mechanisms that underlie change in the emotional content of the self-concept.

Taken together, the current study shows that change in the emotional content of the self-concept can be intentionally induced by means of contemplative mental training focusing on meta-cognitive processes and perspective-taking on the self and others in healthy participants. The finding that specifically socio-cognitive training with an explicit focus on getting a better understanding of inner self aspects, but not mindfulness-based or compassion training was able to induce changes in the emotional content of the self-concept could be useful for the design and application of future training programs in educational settings. Overall, the current evidence about training-induced behavioral plasticity in individual's emotional self-concept content might also be relevant for the domain of mental health, given that distorted emotional self-referential processing is a common factor in psychopathology.

Note

1. The pattern of results stayed consistent when rerunning the models without the control variables of no interest (age, sex).

Acknowledgments

We are thankful to all the members of the Department of Social Neuroscience involved in the *ReSource* study over the many years, in particular to *all ReSource* teachers who taught the intervention program, to Astrid Ackermann, Christina Bochow, Matthias Bolz, and Sandra Zurborg for managing the large-scale longitudinal study, to Hannes Niederhausen, Henrik Grunert and Torsten Kästner for their technical support, to Sylvia Tydeks, Elisabeth Murzick, Manuela Hofmann, Sylvie Neubert, and Nicole Pampus for their help with recruitment and data collection, and to Bethany Kok for her statistical guidance. Finally, we would like to thank Markus Wolf and Roger Booth who assisted us with the LIWC software.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Tania Singer, as principal investigator, received funding for the *ReSource Project* from (a) the European Research Council under the European Community's Seventh Framework Program [FP7/2007-2013/ ERC Grant Agreement Number 205557 to T.S.], and (b) from the Max Planck Society.

References

Back, M. D., Schmukle, S. C., & Egloff, B. (2009). Predicting actual behavior from the explicit and implicit self-concept of personality. *Journal of Personality and Social Psychology, 97*, 533–548.

Baumeister, R. F. (2011). Self and identity: A brief overview of what they are, what they do, and how they work. *Annals of the New York Academy of Sciences, 1234*, 48–55. doi:10.1111/j.1749-6632.2011.06224.x

Beck, A. T. (2008). The evolution of the cognitive model of depression and its neurobiological correlates. *American Journal of Psychiatry, 165*, 969–977. doi:10.1176/appi.ajp.2008.08050721

Beck, A. T., Steer, R. A., & Hautzinger, M. (1994). *Beck-Depressions-Inventar:(BDI); Testhandbuch* [Beck-Depression-Inventory: (BDI); test book]. Bern: Huber.

Bech, P., Rasmussen, N.-A., Olsen, L. R., Noerholm, V., & Abildgaard, W. (2001). The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. *Journal of Affective Disorders, 66*, 159–164. doi:10.1016/S0165-0327(00)00309-8

Böckler, A., Hermann, L., Holmes, T., & Singer, T. (under review). Know thy selves: Learning to understand oneself increases the ability to understand others.

Borkenau, P., & Ostendorf, F. (1993). *NEO-Fünf-Faktoren Inventar:(NEO-FFI); nach Costa und McCrae* [NEO Five-Factor Inventory: (NEO-FFI); according to Costa and McCrae]. Göttingen: Hogrefe.

Bornemann, B., Herbert, B. M., Mehling, W. E., & Singer, T. (2015). Differential changes in self-reported aspects of interoceptive awareness through 3 months of contemplative training. *Frontiers in psychology, 5*, 1–13. doi:10.3389/fpsyg.2014.01504

Browning, M., Holmes, E. A., & Harmer, C. J. (2010). The modification of attentional bias to emotional information: A review of the techniques, mechanisms, and relevance to emotional disorders. *Cognitive, Affective, & Behavioral Neuroscience, 10*, 8–20. doi:10.3758/CABN.10.1.8

Campanella, F., Crescentini, C., Urgesi, C., & Fabbro, F. (2014). Mindfulness-oriented meditation improves self-related character scales in healthy individuals. *Comprehensive Psychiatry, 55*, 1269–1278. doi:10.1016/j.comppsych.2014.03.009

Chung, C. K., & Pennebaker, J. W. (2007). The psychological function of function words. In K. Fiedler (Ed.), *Social communication: Frontiers of social psychology* (pp. 343–359). New York: Psychology Press.

Chung, C. K., & Pennebaker, J. W. (2008). Revealing dimensions of thinking in open-ended self-descriptions: An automated meaning extraction method for natural language. *Journal of Research in Personality, 42*, 96–132.

Collins, S. E., Chawla, N., Hsu, S. H., Grow, J., Otto, J. M., & Marlatt, G. A. (2009). Language-based measures of mindfulness: Initial validity and clinical utility. *Psychology of Addictive Behaviors, 23*, 743–749. doi:10.1037/a0017579

Crescentini, C., & Capurso, V. (2015). Mindfulness meditation and explicit and implicit indicators of personality and self-concept changes. *Frontiers in psychology, 6*, 1–6. doi:10.3389/fpsyg.2015.00044

Dahl, C. J., Lutz, A., & Davidson, R. J. (2015). Reconstructing and deconstructing the self: Cognitive mechanisms in meditation practice. *Trends in Cognitive Sciences, 19*, 515–523. doi:10.1016/j.tics.2015.07.001

Damasio, A. (2003). Feelings of emotion and the self. *Annals of the New York Academy of Sciences, 1001*, 253–261. doi:10.1196/annals.1279.014

Farb, A. S., Segal, Z. V., Mayberg, H., Bean, J., McKeon, D., Fatima, Z., & Anderson, A. K. (2007). Attending to the present: Mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive Affective Neuroscience, 2*, 313–322. doi:10.1093/scan/nsm030

Fox, K. C., Zakarauskas, P., Dixon, M., Ellamil, M., Thompson, E., & Christoff, K. (2012). Meditation experience predicts introspective accuracy. *PLoS ONE, 7*, e45370. doi:10.1371/journal.pone.0045370

Gallagher, S. (2000). Philosophical conceptions of the self: Implications for cognitive science. *Trends in Cognitive Sciences, 4*, 14–21. doi:10.1016/S1364-6613(99)01417-5

Gelman, A., Hill, J., & Yajima, M. (2012). Why we (usually) don't have to worry about multiple comparisons. *Journal of Research on Educational Effectiveness, 5*, 189–211.

Geuens, M., & De Pelsmacker, P. (2002). Developing a Short Affect Intensity Scale. *Psychological Reports, 91*, 657–670.

Gore, J. S., & Cross, S. E. (2011). Defining and measuring self-concept change. *Psychological Studies, 56*, 135–141. doi:10.1007/s12646-011-0067-0

Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: Current status and future directions. *Annual Review of Clinical Psychology, 6*, 285–312. doi:10.1146/annurev.clinpsy.121208.131305

Grossman, P. (2008). On measuring mindfulness in psychosomatic and psychological research. *Journal of Psychosomatic Research, 64*, 405–408. doi:10.1016/j.jpsychores.2008.02.001

Hanh, T. N. (2011). *Peace is every breath: A practice for our busy lives*. New York: Harper Collins.

Hanley, A., Garland, E., Canto, A., Warner, A., Hanley, R., Dehili, V., & Proctor, A. (2013). Dispositional mindfulness and bias in self-theories. *Mindfulness, 6*, 202–207. doi:10.1007/s12671-013-0245-3

Hayes, S. C., & Wilson, K. G. (2003). Mindfulness: Method and process. *Clinical Psychology: Science and Practice, 10*, 161–165. doi:10.1093/clipsy.bpg018

Hofmann, S. G., Grossman, P., & Hinton, D. E. (2011). Loving-kindness and compassion meditation: Potential for psychological interventions. *Clinical Psychology Review, 31*, 1126–1132. doi:10.1016/j.cpr.2011.07.003

Hofmann, S. G., Asmundson, G. J., & Beck, A. T. (2013). The science of cognitive therapy. *Behavior Therapy, 44*, 199–212. doi:10.1016/j.beth.2009.01.007

Holmes, T., Holmes, L., & Eckstein, S. (2007). *Parts work: An illustrated guide to your inner life*. Kalamazoo: Winged Heart Press.

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science, 6*, 537–559. doi:10.1177/1745691611419671

Isbell, L. M., McCabe, J., Burns, K. C., & Lair, E. C. (2013). Who am I?: The influence of affect on the working self-concept. *Cognition & Emotion, 27*, 1073–1090.

Jackson, J. J., Hill, P. L., Payne, B. R., Roberts, B. W., & Stine-Morrow, E. A. (2012). Can an old dog learn (and want to experience) new tricks? Cognitive training increases openness to experience in older adults. *Psychology and Aging, 27*, 286–292.

Jazaieri, H., Jinpa, G. T., McGonigal, K., Rosenberg, E. L., Finkelstein, J., Simon-Thomas, E., … Goldin, P. R. (2013). Enhancing compassion: A randomized controlled trial of a compassion cultivation training program. *Journal of Happiness Studies, 14*, 1113–1126.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*, 144–156. doi:10.1093/clipsy.bpg016

Kabat-Zinn, J. (2005). *Coming to our senses: Healing ourselves and the world through mindfulness*. New York: Hyperion.

Kanske, P., Böckler, A., Trautwein, F.-M., & Singer, T. (2015). Dissecting the social brain: Introducing the EmpaToM to reveal distinct neural networks and brain–behavior relations for empathy and Theory of Mind. *NeuroImage, 122*, 6–19. doi:10.1016/j.neuroimage.2015.07.082

Keyes, C. L. (2009). *Brief description of the mental health continuum short form (MHC-SF)*. Atlanta, GA: Emory University.

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science, 330*, 932–932. doi:10.1126/science.1192439

Kirk, R. E. (1996). Practical significance: A concept whose time has come. *Educational and Psychological Measurement, 56*, 746–759.

Klein, S. B., & Gangi, C. E. (2010). The multiplicity of self: Neuropsychological evidence and its implications for the self as a construct in psychological research. *Annals of the New York Academy of Sciences, 1191*(1), 1–15. doi:10.1111/j.1749-6632.2010.05441.x

Kok, B. E., & Singer, T. (2016). Effects of contemplative dyads on engagement and perceived social connectedness over 9 months of mental training a randomized clinical trial. *Training, 17*, 26–29. doi:10.1001/jamapsychiatry.2016.3360

Kok, B. E. & Singer, T. (2017). Phenomenological fingerprints of four meditations: Differential state changes in affect, mind-wandering, meta-cognition, and interoception before and after daily practice across 9 months of training. *Mindfulness, 8*, 1218–1231. doi:10.1007/s12671-016-0594-9

Kok, B. E., Waugh, C. E., & Fredrickson, B. L. (2013). Meditation and health: The search for mechanisms of action. *Social and Personality Psychology Compass, 7*, 27–39. doi:10.1111/spc3.12006

Konrath, S., & Bonadonna, J. P. (2014). Physiological and health-related correlates of the narcissistic personality. In A. Besser (Ed.), *Psychology of Narcissism*. Hauppauge, NY: Nova Science Publishers, Inc.

Krans, J., de Bree, J., & Moulds, M. L. (2015). Involuntary cognitions in everyday life: Exploration of type, quality, content, and function. *Frontiers in psychiatry, 6*, 1–11. doi:10.3389/fpsyt.2015.00007

Krishnamurti, J. (1993). *On mind and thought*. San Francisco: Harper Collins.

Krohne, H. W., Egloff, B., Kohlmann, C.-W., & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der "Positive and Negative Affect Schedule" (PANAS) [Investigations with a German version of the "Positive and Negative Affect Schedule" (PANAS)]. *Diagnostica, 42*, 139–156.

Kuhn, M. H., & McPartland, T. S. (1954). An empirical investigation of self-attitudes. *American Sociological Review, 19*, 68–76. doi:10.2307/2088175.

Kuyken, W., Watkins, E., Holden, E., White, K., Taylor, R. S., Byford, S., … Dalgleish, T. (2010). How does mindfulness-based cognitive therapy work? *Behaviour Research and Therapy, 48*, 1105–1112. doi:10.1016/j.brat.2010.08.003

Lamers, S. M., Glas, C. A., Westerhof, G. J., & Bohlmeijer, E. T. (2012). Longitudinal evaluation of the mental health continuum-short form (MHC-SF). *European Journal of Psychological Assessment, 28*, 290–296.

Leary, M. R. (2007). Motivational and emotional aspects of the self. *Annual Review of Psychology, 58*, 317–344. doi:10.1146/annurev.psych.58.110405.085658

Leary, M. R., & Tangney, J. P. (2003). The self as an organizing construct in the behavioral and social sciences. *Handbook of Self and Identity,* 3–14.

Luoma, J., & Hayes, S. (2003). *Cognitive defusion. Cognitive behavior therapy: Applying empirically supported techniques in your practice*. New York: Wiley.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*, 163–169. doi:10.1016/j.tics.2008.01.005

Lutz, J., Brühl, A. B., Doerig, N., Scheerer, H., Achermann, R., Weibel, A., & Herwig, U. (2016). Altered processing of self-related emotional stimuli in mindfulness meditators. *NeuroImage, 124*, 958–967. doi:10.1016/j.neuroimage.2015.09.057

MacBeth, A., & Gumley, A. (2012). Exploring compassion: A meta-analysis of the association between self-compassion and psychopathology. *Clinical Psychology Review, 32*, 545–552. doi:10.1016/j.cpr.2012.06.00

MacKenzie, M. (2016). (Re-) Constructing the self. *Journal of Consciousness Studies, 23*, 105–124.

Markus, H. (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology, 35*, 63–78. doi:10.1037/0022-3514.35.2.63

Markus, H., & Kunda, Z. (1986). Stability and malleability of the self-concept. *Journal of Personality and Social Psychology, 51*, 858–866.

Neff, K. D. (2009). The role of self-compassion in development: A healthier way to relate to oneself. *Human Development, 52*, 211–214. doi:10.1159/000215071

Neff, K. D., & Dahm, K. A. (2015). Self-compassion: What it is, what it does, and how it relates to mindfulness. In B. D. Ostafin et al. (Eds.), *Handbook of Mindfulness and Self-Regulation* (pp. 121–137). New York: Springer.

Neff, K. D., & Germer, C. K. (2013). A pilot study and randomized controlled trial of the mindful self-compassion program. *Journal of Clinical Psychology, 69*, 28–44. doi:10.1002/jclp.21923

Neff, K. D., Kirkpatrick, K. L., & Rude, S. S. (2007). Self-compassion and adaptive psychological functioning. *Journal of Research in Personality, 41*, 139–154. doi:10.1016/j.jrp.2006.03.004

Nejad, A. B., Fossati, P., & Lemogne, C. (2013). Self-referential processing, rumination, and cortical midline structures in major depression. *Frontiers in human neuroscience, 7*, 1–9. doi:10.3389/fnhum

Northoff, G. (2005). Is emotion regulation self-regulation? *Trends in Cognitive Sciences, 9*, 408–409.

Ostendorf, F., & Angleitner, A. (2004). *NEO-Persönlichkeitsinventar nach Costa und McCrae, Revidierte Fassung (NEO-PI-R)* [NEO-Personality-Inventory according to Costa and McCrae, Revised Version (NEO-PI-R)]. Göttingen: Hogrefe.

Oyserman, D., Elmore, K., & Smith, G. (2012). Self, self-concept, and identity. *Handbook of self and identity, 2*, 69–104.

Pennebaker, J. W., Francis, M. E., & Booth, R. J. (2001). *Linguistic inquiry and word count: LIWC 2001*. Mahway: Lawrence Erlbaum Associates.

Pennebaker, J. W., Mehl, M. R., & Niederhoffer, K. G. (2003). Psychological aspects of natural language use: Our words, our selves. *Annual Review of Psychology, 54*, 547–577. doi:10.1146/annurev.psych.54.101601.145041

Pennebaker, J. W., Booth, R. J., Boyd, R. L., & Francis, M. E. (2015). *Linguistic inquiry and word count: LIWC2015*. Austin, TX: Pennebaker Conglomerates. Retrieved from www.LIWC.net

Peters, K. R., & Gawronski, B. (2011). Mutual influences between the implicit and explicit self-concepts: The role of memory activation and motivated reasoning. *Journal of Experimental Social Psychology, 47*, 436–442.

Ricard, M. (2008). *Meditation*. Munich: Nymphenburger.

Roberts, B. W., & Jackson, J. J. (2008). Sociogenomic personality psychology. *Journal of Personality, 76*, 1523–1544.

Ruby, F. J., Smallwood, J., Engen, H., & Singer, T. (2013). How self-generated thought shapes mood – The relation between mind-wandering and mood depends on the socio-temporal content of thoughts. *PLoS ONE, 8*, e77554, 1–7. doi:10.1371/journal.pone.0077554

Salzberg, S. (1995). *Lovingkindness: The revolutionary art of happiness*. Boston, MA: Shambhala Publications.

Sander, J., Schmiedek, F., Brose, A., Wagner, G. G., & Specht, J. (in press). Long-term effects of an extensive cognitive training on personality development. *Journal of Personality*.

Schultheiss, O. C. (2013). Are implicit motives revealed in mere words? Testing the marker-word hypothesis with computer-based text analysis. *Frontiers in psychology, 4*, 1–20.

Schwartz, R. C. (1997). *Internal family systems therapy*. New York: Guilford Press.

Schwartz, H. A., & Ungar, L. H. (2015). Data-driven content analysis of social media a systematic overview of automated methods. *The ANNALS of the American Academy of Political and Social Science, 659*, 78–94. doi:10.1177/0002716215569197

Schwarz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist, 54*, 93–105. doi:10.1037/0003-066X.54.2.93

Sedikides, C. (1992). Changes in the valence of the self as a function of mood. *Review of personality and social psychology, 14*, 271–311.

Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. *Neuroscience & Biobehavioral Reviews, 30*, 855–863. doi:10.1016/j.neubiorev.2006.06.011

Singer, T. (2012). The past, present and future of social neuroscience: A European perspective. *NeuroImage, 61*, 437–449. doi:10.1016/j.neuroimage.2012.01

Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology, 24*, R875–R878. doi:10.1016/j.cub.2014.06.054

Singer, T., Kok, B. E., Bornemann, B., Zurborg, S., Bolz, M., & Bochow, C. A. (2016). *The resource project. Background, design, samples, and Measurements*. Leipzig: Max Planck Institute for Human Cognitive and Brain Sciences.

Smidt, K. E., & Suvak, M. K. (2015). A brief, but nuanced, review of emotional granularity and emotion differentiation research. *Current Opinion in Psychology, 3*, 48–51. doi:10.1016/j.copsyc.2015.02.007

Tausczik, Y. R., & Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology, 29*, 24–54.

Teasdale, J. D., Williams, J. M. G., & Segal, Z. V. (2014). *The mindful way workbook: An 8-week program to free yourself from depression and emotional distress*. New York: Guilford.

Vago, D. R., & Silbersweig, D. A. (2012). Self-awareness, self-regulation, and self-transcendence (S-ART): A framework for understanding the neurobiological mechanisms of mindfulness. *Frontiers in human neuroscience, 6*, 1–30. doi:10.3389/fnhum.2012.00296

Vreeswijk, M. V., Spinhoven, P., Eurelings-Bontekoe, E., & Broersen, J. (2014). Changes in symptom severity, schemas and modes in heterogeneous psychiatric patient groups following short-term schema cognitive-behavioural group therapy: A naturalistic pre-treatment and post-treatment design in an outpatient clinic. *Clinical Psychology & Psychotherapy, 21*, 29–38. doi:10.1002/cpp.1813

Williams, J. M. G., & Kuyken, W. (2012). Mindfulness-based cognitive therapy: A promising new approach to preventing depressive relapse. *The British Journal of Psychiatry, 200*, 359–360. doi:10.1192/bjp.bp.111.104745

Wittchen, H., & Pfister, H. (1997). *DIA-X-Diagnostisches Expertensystem für Psychische Störungen* [DIA-X-Diagnostic Expert System for Psychological Illnesses]. Frankfurt: Harcourt Test Services.

Wittchen, H.-U., Zaudig, M., & Fydrich, T. (1997). *Skid. Strukturiertes klinisches Interview für DSM-IV*. Achse I und II. Handanweisung [Skid. Structured clinical interview for DSM-IV. Axis I and II. Instruction]. doi:10.1026//0084-5345.28.1.68

Wolf, M., Horn, A. B., Mehl, M. R., Haug, S., Pennebaker, J. W., & Kordy, H. (2008). Computergestützte quantitative Textanalyse: Äquivalenz und Robustheit der deutschen Version des Linguistic Inquiry and Word Count [Computer-aided quantitative textanalysis: Equivalence and reliability of the German adaptation of the Linguistic Inquiry and Word Count]. *Diagnostica, 54*, 85–98. doi:10.1026/0012-1924.54.2.85

Xu, R. (2003). Measuring explained variation in linear mixed effects models. *Statistics in Medicine, 22*, 3527–3541.