

# Altering the Trajectory of Affect and Affect Regulation: the Impact of Compassion Training

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**Abstract** A growing literature has begun to document the effects of compassion training on a variety of important interpersonal behaviors (e.g., helping behavior). What is not yet well understood, however, is what impact compassion training has on affect and affect regulation. To examine this issue, we implemented a 9-week compassion training program in which 51 adults provided twice-daily ratings of four affective states (anxiety, calm, fatigue, alertness) as well as their desire and capability to regulate these affective states. In addition, participants provided weekly responses regarding five specific regulatory strategies. Analysis of day-to-day trajectories of affective experience showed a decrease in anxiety and increase in calmness. Day-to-day trajectories of affect regulation demonstrated that participants were more likely to choose to accept and thus not influence or modulate affective experience (as opposed to dampen, enhance, or hold on to or maintain the affective state). At the same time, participants also reported being more capable in meeting their respective regulatory goals. Finally, analysis of week-to-week trajectories of specific regulatory strategies over the course of the compassion training program demonstrated that participants shifted to

lesser use of expressive suppression and greater acceptance when experiencing stress/anxiety. These results suggest that interventions such as compassion training may help modulate specific affective states and modify the use of and self-efficacy for specific regulatory strategies.

**Keywords** Affect · Affect regulation · Affective trajectories · Affect dynamics · Self-efficacy · Compassion · Diary study · Experience sampling · Ecological momentary assessment · Multilevel analysis

One commonly cited definition of compassion is a “feeling that arises in witnessing another’s suffering and that motivates a subsequent desire to help” (Goetz et al. 2010b, p. 352). To date, much of the research on compassion has focused on the latter part of this definition—trait compassion has been shown to predict things such as generosity (Saslow et al. 2013), volunteerism (Omoto et al. 2009), and altruistic behavior (Batson et al. 1999). Structured compassion training programs have been shown to be effective in improving altruism and caring behaviors (e.g., Jazaieri et al. 2016a; Weng et al. 2013). Much less is known about the association between compassion training and people’s affective responses, their attempts at regulating these affective responses, and their self-efficacy beliefs (i.e., their beliefs about their ability to regulate these affective states).

Affect is an overarching term that includes states such as stress, mood, and emotion (Gross and Thompson 2007). Affective states unfold over time and vary in type, quality, intensity, duration, and frequency (Gross and Thompson 2007). Such variations in affective states are consequential for health and well-being and may be influenced both by an individual’s attempts at regulating these affective states and by his or her affect regulation self-efficacy.

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One method of examining affect trajectories has been daily experience sampling. While daily experience sampling has been utilized to examine affect in non-clinical populations (e.g., Brans et al. 2013; Brose et al. 2015; Brown and Ryan 2003; Csikszentmihalyi and Hunter 2003; Goetz et al. 2010a; Killingsworth and Gilbert 2010), most of these studies have utilized relatively short-term daily assessments (e.g., ranging from 2 to 21 days). Due to the relative ease of assessment, most empirical studies with non-clinical populations have utilized weekly assessments to examine affective trajectories (e.g., Srivastava et al. 2009; Tamir et al. 2007).

Affect regulation refers to attempts made to influence what, when, and how a person experiences various affective states (e.g., Jazaieri et al. 2013b). One crucial determinant of affect regulation is the goals people have at any given time (Gross and Jazaieri 2014). For example, regulatory goals may include increasing (enhancing), decreasing (dampening), keeping around (maintaining), or accepting (embracing while not modulating at all) one's current affective state. A second important determinant of affect regulation is the specific strategies that one chooses in order to achieve one's regulatory goal(s) (Gross and Jazaieri 2014).

Two of the most well-researched regulatory strategies are cognitive reappraisal and expressive suppression (Gross 2002). *Cognitive reappraisal*, largely considered to be an "adaptive" strategy (e.g., Gross 2002; John and Gross 2004), refers to efforts made to alter one's affect by modifying the subjective meaning of the situation. When employed appropriately, cognitive reappraisal can modify one's reactions to affect-provoking situations and enhance psychological flexibility and emotional well-being (Gross and Thompson 2007). On the other hand, *expressive suppression* is mostly considered to be a "maladaptive" regulatory strategy (e.g., Gross 2002; John and Gross 2004) and refers to efforts made to alter one's own physiological, experiential, or behavioral responses in a given situation. Expressive suppression is used once one has experienced the onset of the affective experience. Across affect, social functioning, and well-being, converging empirical research suggests that individuals who engage in cognitive reappraisal seem to fare much better in life than those who rely primarily on suppression (e.g., Gross 2002; John and Gross 2004).

The regulatory strategy of *situation modification* refers to attempts to alter external (rather than internal) features of one's environment in an effort to influence one's affect. Situation modification can be used in anticipation of problematic affect and before the full onset of the affective state. Situation modification is considered to be problem focused coping (Lazarus and Folkman 1984) whereby affective states are modulated via stimulus control. Another regulatory strategy is *attentional deployment*, which refers to efforts to direct (or redirect) attention in such a way as to alter one's affective response. Two of the most well-researched forms of attentional deployment

are distraction and rumination—both largely considered to be maladaptive strategies (Gross 2014). Finally, *acceptance* has recently been considered to be a skillful method for regulating one's affect (e.g., Gratz and Roemer 2004; Hayes et al. 1994, 1996; Linehan 1993, 2015). Rather than trying to change or control one's affect in some way, acceptance refers to allowing one's experience and affect to arise and change effortlessly of their own accord. Empirical research has found that paradoxically, acceptance is quite effective in reducing negative affective states (Aldao et al. 2010; Hayes et al. 2012; Keng et al. 2016; Levitt et al. 2004). While some researchers conceptualize acceptance as a form of cognitive reappraisal, we have followed the conceptualization put forth by others (see Aldao et al. 2010) who study mindfulness-based programs and examine acceptance as a separate regulatory strategy, distinct from cognitive reappraisal.

Commonly, researchers focus on the *frequency of use* of specific regulatory strategies such as those listed above (Gross and John 2003). However, more recently, researchers have become interested in examining regulatory self-efficacy or capability, the belief one has in one's abilities to implement specific regulatory strategies (e.g., Goldin et al. 2009; Goldin et al. 2012a). Regulatory self-efficacy or capability has become an increasingly important construct to measure and has been shown to be predictive of longer term treatment outcomes (e.g., Goldin et al. 2012a). Self-efficacy beliefs have also been linked to enhanced affect regulation and psychosocial functioning more generally (e.g., Bandura et al. 2003).

There are likely many ways of influencing affect trajectories, affect regulation, and affect regulation self-efficacy. The most common approach to date has been to use formal clinical treatment interventions with clinical samples (e.g., Aldao et al. 2014; Goldin et al. 2014; Jazaieri et al. 2016b). However, such treatments are often expensive and are generally limited to individuals who meet criteria for specific psychopathology. It is possible that sub-clinical or "healthy" individuals who also experience challenging affective states might benefit from enhancing skills to alter affective trajectories and enhance regulation and self-efficacy.

This has motivated researchers to explore novel intervention programs, such as compassion training. Compassion is a multidimensional construct that includes an affective component (e.g., Goetz et al. 2010a; Jinpa 2015; Jinpa and Weiss 2013). Some scholars have even conceptualized compassion training as a form of cognitive reappraisal (e.g., Dahl et al. 2015; Engen and Singer 2015); however, only recently has compassion as a state, trait, and intervention been researched in Western science (e.g., Hutcherson et al. 2008; Klimecki et al. 2012; Weng et al. 2013). The foundation of compassion training is mindfulness, or the ability to notice and pay attention (in the case of compassion, paying attention to suffering). The empirical literature has established that mindfulness

trainings can influence affect and regulation in clinical (e.g., Goldin and Gross 2010; Goldin et al. 2012b; Jazaieri et al. 2016b) and non-clinical populations (e.g., Chambers et al. 2008; Jha et al. 2010); however, far less is known about affect and affect regulation within the context of compassion training more generally.

To date, the majority of theoretical and empirical work on compassion's relationship to affect has focused on one specific component of compassion, for example, self-compassion (e.g., Raes 2010; Van Dam et al. 2011). When considering positive psychology interventions aimed at increasing positive emotions, loving-kindness meditation (one specific component or form of compassion practice where one cultivates the wish of happiness for others) has been shown to be beneficial for one's affective state (Cohn and Fredrickson 2010; Fredrickson et al. 2008). What has not yet been addressed, however, is the impact of broader compassion training interventions on affective outcomes.

Our goal in the present study was to investigate affective outcomes (trajectories, regulation, and self-efficacy) in CCT within a community sample of adults. With regard to day-to-day affective experience, we predicted reductions in anxiety and fatigue and increases in calmness and alertness following compassion training. We also predicted that compassion training would induce a greater desire to downregulate or dampen negative affective states (anxiety and fatigue) and upregulate or enhance positive affective states (calmness and alertness). Relatedly, we predicted that participants would endorse greater capabilities in meeting all of their regulatory goals. With regard to week-to-week trajectories of regulatory strategy use, we predicted that participants would report decreases in situation modification and attentional deployment when interacting with others and decreases in expressive suppression when experiencing stress/anxiety. Lastly, we predicted that participants would report increases in cognitive reappraisal when interacting with others and increases in acceptance when experiencing stress/anxiety.

## Method

### Participants

Participants in this study were a subset (only those participants randomized to immediate CCT as the participants in the waitlist condition did not provide daily or weekly responses) of a larger randomized controlled trial (Jazaieri et al. 2013a). In this paper, we examine daily and weekly responses regarding affective trajectories, regulation, and self-efficacy from the 51 participants who received the CCT intervention and had at least a 50% response rate across all daily and weekly assessment points over the 10-week period (9 out of the 60 participants randomized to immediate CCT did not meet this

criteria). A full CONSORT diagram is available in Jazaieri et al. (2013a) (Fig. 1). Participants in this study were primarily middle aged ( $M$  (years) = 44.36,  $SD$  = 12.14), women (70.6%;  $n$  = 36), and Caucasian (76.5%;  $n$  = 39).

### Procedure

Potential participants were recruited through web-based online community listings throughout the San Francisco Bay Area, email listservs, and advertisements on community bulletin boards. Potential participants had to pass an initial online screening procedure which excluded individuals who self-endorsed bipolar disorder, major depressive disorder, psychosis, or active suicidal ideation. Participants provided informed consent in accordance with Stanford University Human Subjects Committee rules and were not paid for their participation.

The screenshot shows an iPhone interface with the following elements:

- Top status bar: AT&T signal, Wi-Fi icon, time 2:57, and battery level.
- Question: "How **anxious** are you feeling right now?"
- Slider: A horizontal slider with a blue bar and a white knob, ranging from 1 to 7.
- Labels: "1", "2", "3", "4", "5", "6", "7" below the slider. "Not at all" below "1" and "Very Much" below "7".
- Question: "With regards to this feeling, do you currently want to"
- Options:
  - a) Dampen it
  - b) Maintain it
  - c) Enhance it
  - d) Not influence it at all
- Question: "Do you feel capable of achieving this?"
- Slider: A horizontal slider with a blue bar and a white knob, ranging from 1 to 7.
- Labels: "1", "2", "3", "4", "5", "6", "7" below the slider. "Not at all" below "1" and "Very Much" below "7".
- Button: A white button with the text "Next" in blue.

**Fig. 1** Screenshot example of iPhone question assessing anxiety, desire to regulate anxiety, and capability of regulating anxiety

## Compassion Cultivation Training

Compassion Cultivation Training (CCT) is a comprehensive compassion training program with a dialectical focus on (a) how one relates to suffering (that of oneself and others) and (b) how one intentionally generates positive feelings for oneself and others (loving-kindness). On the one hand, CCT develops compassion, a mental capacity to regulate distress (e.g., stress and anxiety) and maintain calm in response to suffering (for oneself and others). On the other hand, CCT generates loving-kindness, or the mental capacity to generate positive states such as care, connectedness, and appreciation for oneself and others. These two dialectics, compassion and loving-kindness, are cultivated in an effort to more willingly and effectively engage with any suffering that is present. Training of present moment attention and the willingness to hold both suffering *and* loving-kindness is intended to help people relate to emotion and difficult experiences in a new way (Jazaieri et al. 2014).

CCT is designed to be a structured, secular, and comprehensive, self- and other-focused compassion meditation training program. CCT consists of a 2-h introductory orientation, eight once weekly 2-h classes, and daily compassion-focused meditation practices. Specific content of the program includes progressing through six sequential steps starting with the essential and foundational skill of settling and focusing the mind (attention training). Steps 2–5 pertain to the actual compassion cultivation including loving-kindness and compassion for a loved one (step 2), loving-kindness and compassion for oneself (step 3), establishing the basis for compassion towards others (step 4), cultivating compassion for others (step 5), and lastly, active compassion practice (step 6). For a more detailed description of the six steps in CCT, see Jinpa (2015) and Jinpa and Weiss (2013). Each step in CCT builds upon the prior, always beginning with settling and focusing the mind (step 1). To integrate these practices into daily life, participants are expected and encouraged to engage in daily home meditation practice for at least 15 min (building up to approximately 30 min) using recorded guided meditations. The feasibility of enhancing compassion through CCT has been established (see Jazaieri et al. 2013a). When utilizing pre-to-post assessments, CCT has been shown to produce significant increases in trait mindfulness and happiness and decreases in worry, stress, and suppression of emotional expression (Jazaieri et al. 2014).

## Measures

**Daily Experience Sampling** Participants were contacted at fixed times twice daily throughout the duration of the course, once in the morning and once in the evening (for additional details, see Jazaieri et al. 2016a). To assess the affect trajectories of anxiety, calm, fatigue, and alert, participants responded

to the question: “How [affective state] are you feeling right now?” on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*). To assess affect regulation, participants responded to the question: “With regards to this feeling, do you currently want to:” “dampen it,” “maintain it,” “enhance it,” or “not influence it at all.” To assess affect regulation self-efficacy, participants were asked, with regard to the selected strategy (dampen, maintain, enhance, or not influence), “Do you feel capable of achieving this?” again rated on a 7-point scale ranging from 1 (not at all) to 7 (very much). See Fig. 1 for an example of how these three questions appeared within the context of anxiety.

**Weekly Diaries** To investigate weekly changes in affect regulation during CCT, we administered an inventory that our laboratory has developed and have utilized in other studies (e.g., Aldao et al. 2014; Goldin et al. 2014). Participants were trained on the use of the weekly inventory prior to the start of the CCT program. During CCT, participants were emailed the weekly questionnaire each week, on the day prior to their CCT class. Instructions were to “select the percentage that indicates how often you used a particular strategy to reduce any stress or anxiety. 0% indicates that you used a particular strategy 0% of the time and 100% indicates that you used a particular strategy 100% of the time” during the past week.

Specifically, to assess the regulatory strategy of situation modification we asked, “How often did you try to modify your interactions with others (change the situation itself)?” To assess attentional deployment we asked, “How often did you try to distract yourself during interactions with others?” To assess cognitive reappraisal we asked, “How often did you try to change the way you were thinking or interpreting while interacting with others?” To assess expressive suppression we asked, “How often did you try to hide any visible signs of your stress or anxiety?” Finally, to assess acceptance we asked, “How often did you try to just accept your stress or anxiety and not change it in any way?” In the weekly assessment situation modification, attention deployment, and cognitive reappraisal were pertaining to interactions with others while expressive suppression and acceptance were pertaining specifically to states of stress or anxiety.

## Data Analyses

The daily data have a two-level structure, (diary ratings (level 1) nested within participant (level 2)), which is best analyzed with multilevel modeling procedures. Univariate analyses examined daily changes in affect trajectories (feeling anxious, calm, fatigued, alert), affect regulation (dampen, maintain, enhance, or not influence), and affect regulation self-efficacy (for anxiety, calm, fatigue, alertness). Separately, multivariate analysis examined whether the changes in affect regulation self-efficacy during CCT were related to changes in affect

trajectories as well as to changes in affect regulation for each of the four affective states.

The weekly data have a similar two-level structure, with weekly measures (level 1) nested within participant (level 2). Univariate analysis examined the weekly changes in affect regulation (situation modification, attentional deployment, reappraisal, suppression, acceptance).

Multilevel analyses were conducted using the following approach: (a) To account for serial dependency in repeated measures, we specified an autoregressive residual covariance matrix. This specification ensures that each dependent variable represents a change in relation to previous scores. (b) For the daily analyses, the diary number (e.g., diary #3, diary #4) was included as a level-1 predictor to test for variation in affect trajectories and affect regulation during CCT. For the weekly analyses, week was included as a level-1 predictor. (c) All intercepts and slopes were specified as random effects, with covariances allowed among all random components. Our primary interest was in the covariance across time in (1) affect regulation self-efficacy and affect trajectories and (2) affect regulation self-efficacy and the desire to regulate affect.

The daily analyses were based on 112 ratings per person collected over the CCT course. The weekly analyses were based on ratings (assessed once per week) collected over the CCT course. Missing values (daily, 23.4%; weekly, 2.9%) were handled using full-information maximum likelihood (FIML) estimation procedures, which generate unbiased parameter estimates and standard errors using all available observations (Enders 2001). On average, the percentage of missing data increased slightly from week 1 (17%) to week 8 (31%); however, no common or consistent patterns of day-to-day “missingness” were found throughout CCT. Univariate analyses were conducted using SAS PROC MIXED (for continuous outcomes) and PROC GLIMMIX (for binary outcomes); multivariate analyses were conducted in Mplus v.6.1 (Muthén and Muthén 1998–2010). All predictors were group-mean centered which standardizes within-person responses and is typical for analyses targeting intraindividual change.

## Results

All trajectories are displayed in Figs. 2, 3, and 4; estimates are reported in Table 1. With regard to affect trajectories, during CCT there were significant decreases in anxiety ( $\gamma = -.02$ ,  $p = .01$ ) and increases in calmness ( $\gamma = .04$ ,  $p < .01$ ) with significant variance across participants ( $p$ 's  $< .01$ ). Fatigue and alertness did not change significantly over time, but did vary across individuals ( $p$ 's  $< .01$ ).

With each successive rating, participants were less likely to want to reduce their anxiety (OR=.989, 95% CI=(.983, .994)) and fatigue (OR = .987, 95% CI=(.981, .994)), as well as less

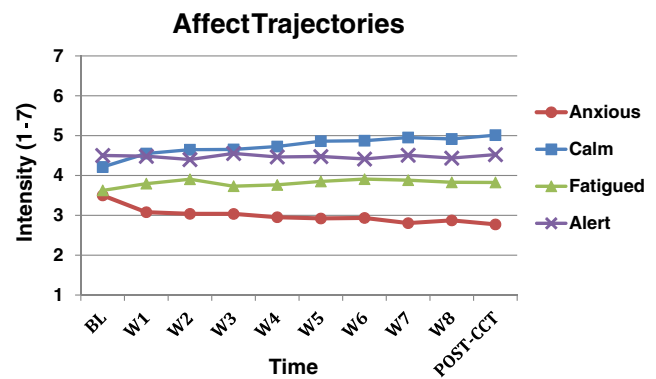


Fig. 2 Day-to-day affect trajectories during CCT (reported as means)

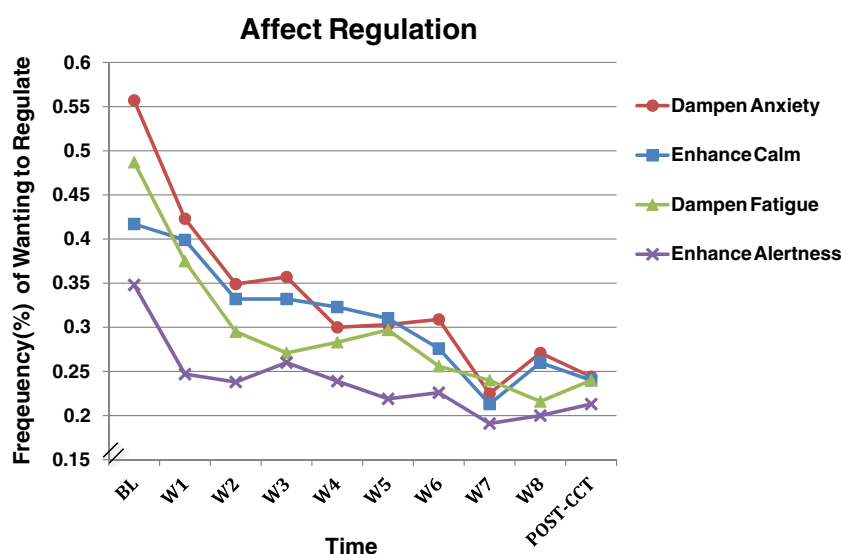
likely to want to enhance their feelings of calmness (OR = .989, 95% CI = (.983, .995)) and alertness (OR = .993, 95% CI = (.988, .998) (Fig. 3). Participants also reported feeling more capable of regulating their affective states of anxiety ( $\gamma = .03$ ,  $p = .04$ ), calmness ( $\gamma = .03$ ,  $p = .03$ ), fatigue ( $\gamma = .03$ ,  $p = .05$ ), and alertness ( $\gamma = .03$ ,  $p = .04$ ), with significant individual variability in these trajectories ( $p$ 's  $< .01$ ). While feelings of self-efficacy or capability in regulating one's affective states *increased* throughout CCT, the desire to actually regulate affect (i.e., downregulate negative affect, upregulate positive affect) *decreased* (Fig. 4)—hinting again at the paradoxical effects of acceptance within the context of this comprehensive compassion training program.

During CCT, we found an inverse relationship between reductions in anxiety and increases in regulation self-efficacy of anxiety ( $r = -.68$ ,  $p < .01$ ). Similarly, increases in calmness were related to increases in regulation self-efficacy of calmness ( $r = .67$ ,  $p < .01$ ). These correlations did not differ in size between anxiety and calmness ( $\chi^2(1) = .71$ ,  $p > .05$ ) (significance was evaluated using the difference in  $-2$  log-likelihood values obtained from a focal model and comparison (nested) model, which is chi-square distributed). A similar pattern of correlational results for fatigue and alertness and their respective regulation self-efficacy were found. However, given the non-significant trajectories in the fatigue and alertness trajectories, these correlations are not as meaningful and interpretable.

In addition, increases in regulation self-efficacy were related to decreases in the desire to regulate affect. Specifically, there were inverse associations between regulation self-efficacy and desire to regulate for anxiety ( $r = -.51$ ,  $p < .01$ ), calmness ( $r = -.71$ ,  $p < .01$ ), fatigue ( $r = -.55$ ,  $p < .01$ ), and alertness ( $r = -.38$ ,  $p < .05$ ).

All affect regulation trajectories are displayed in Fig. 5; estimates are reported in Table 1. Throughout the course of the compassion intervention the use of suppression decreased ( $\gamma = -.02$ ,  $p = .002$ ) and the use of acceptance increased ( $\gamma = .02$ ,  $p = .002$ ) when experiencing stress/anxiety. The

**Fig. 3** Day-to-day desire to regulate affect during CCT (reported as frequency percentages)



frequency with which participants engaged in situation modification, attentional deployment, and cognitive reappraisal during interactions with others did not change over time; however, these trajectories varied across individuals ( $p$ 's < .01).

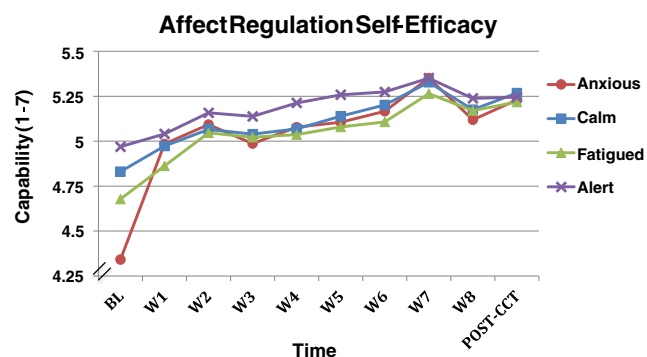
## Discussion

The goal of this study was to investigate affect trajectories, affect regulation, and affect regulation self-efficacy in a community sample of adults enrolled in a 9-week compassion training program. We sought to extend the literature in four important ways. First, rather than focusing on one specific aspect of compassion (e.g., self-compassion or loving-kindness), we utilized a 9-week comprehensive compassion meditation training program (CCT) that has been shown to enhance multiple forms of compassion (Jazaieri et al. 2013a). Second, we sought to broaden the examination of affect regulation beyond cognitive reappraisal and expressive suppression and also consider the regulatory strategies of

situation modification, attentional deployment, and acceptance. Third, we sought to utilize more nuanced methodological approaches (daily and weekly reports) to examine the stability and change of affect and regulation. Finally, we sought to add to the literature by examining these affective outcome trajectories over an extended period of time (9-weeks).

In partial support of our hypothesis with regards to day-to-day experiences of affect trajectories, we found reductions in anxiety and increase in calmness trajectories over the course of the intervention. There were no changes in the states of fatigue or alertness over the course of CCT. When considering day-to-day intention to regulate affect, contrary to our hypotheses, participants were more likely to choose to *not* influence their affective states (as opposed to down-regulate negative states of anxiety and fatigue or upregulate positive states of calmness and alertness). Participants also reported being more capable in meeting their respective regulatory goals. Interestingly, although we did not predict this, while participants reported being *more* capable at regulating affective states, they simultaneously reported *less* desire to regulate. Finally, when considering the week-to-week trajectories of affect regulation over the course of the program, participants reported decreases in expressive suppression and increases in acceptance of affective states (stress/anxiety). Contrary to our hypotheses, there were no changes in situation modification, attentional deployment, or cognitive reappraisal during interactions with others.

While the absence of a comparison condition prohibits making conclusive interpretations of these results, preliminary evidence from this study suggests that this compassion training program may reduce anxiety and increase feelings of calm, which may be related to increases in the capability to regulate both of these states. Prior research has shown that



**Fig. 4** Day-to-day affect regulation self-efficacy during CCT (reported as means)

**Table 1** Fixed and random effects from the multilevel analyses of affect trajectories, affect regulation, and affect regulation self-efficacy

	Fixed effects		Random effects	
	Intercept ( $\gamma_{00}$ )	Slope ( $\gamma_{01}$ )	Intercept ( $\tau_{00}$ )	Slope ( $\tau_{11}$ )
Daily				
Affect trajectories <sup>a</sup>				
Anxiety	3.096**	-.022*	.403**	.0024**
Calmness	4.532**	.039**	.567**	.0036**
Fatigue	3.759**	.011	.620**	.0041**
Alertness	4.486**	-.002	.479**	.0030**
Affect regulation <sup>b</sup>				
Reduce anxiety	-.380	-.011**	1.774**	.0003
Enhance calmness	-.524 <sup>†</sup>	-.011**	3.216**	.0003**
Reduce fatigue	-.598*	-.013**	2.355**	.0004
Enhance alertness	-1.324**	-.007**	2.941**	.0002
Affect regulation self-efficacy <sup>a</sup>				
Anxiety	4.973**	.025*	1.091**	.0060**
Calmness	4.950**	.029*	1.082**	.0075**
Fatigue	4.898**	.028*	1.344**	.0091**
Alertness	5.051**	.027*	1.051**	.0072**
Weekly				
Affect regulation				
Situation modification	.299**	-.006	.036**	.0010**
Attentional deployment	.383**	-.008	.047**	.0008**
Cognitive reappraisal	.259**	-.001	.024**	.0006**
Expressive suppression	.408**	-.017**	.040**	.0004
Acceptance	.343**	.017**	.018**	.0007*

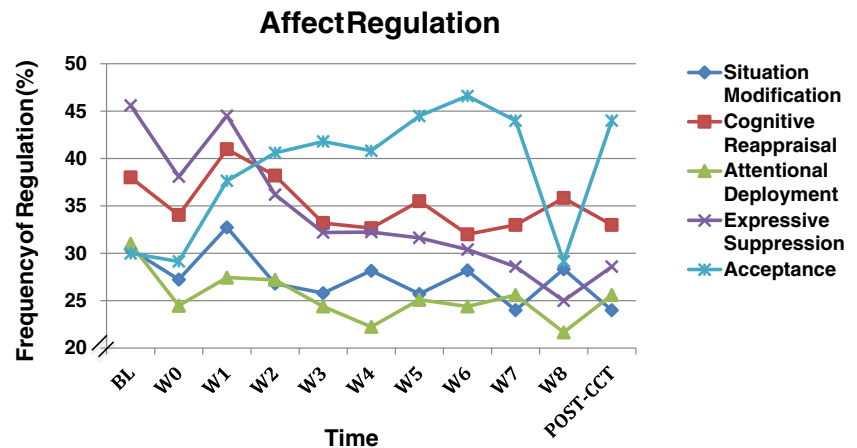
<sup>†</sup>  $p < .06$ , \*  $p < .05$ , \*\*  $p < .01$ . Unstandardized estimates are reported

<sup>a</sup> Slope parameters were generated from rescaled outcome variables (multiplied by 10) to facilitate reporting of estimates. Rescaling does not affect statistical significance

<sup>b</sup> Outcomes are binary, so the fixed effect estimates reflect log-odds ratios. Traditional odds ratios ( $e^{\beta}$ ) are reported in the text

compassion training can increase positive affective experiences, even in response to witnessing others in distress (Klimecki et al. 2012). Furthermore, experimental studies with expert practitioners of compassion meditation have

shown that compassion meditation primarily increased positive affect and that cognitive reappraisal primarily decreased negative affect when viewing video clips of people in distress (Engen and Singer 2015). While not the goal of compassion

**Fig. 5** Week-to-week affect regulation during CCT (reported as frequency percentages)

practice, the literature suggests that compassion meditation (and specific subtypes such as loving-kindness meditation) is associated with increases in positive affect and decreases in negative affect (for reviews, see Hofmann et al. 2011; Zeng et al. 2015). The current study provides some preliminary evidence that calm, a low arousal positive state that is considered to be a valued state (Koopmann-Holm et al. 2013), may be able to be increased through compassion training. A randomized controlled trial with a comparison condition will be able to more definitively address the role of compassion training on the affective state of calm. Although not tested here, it is possible that these increases in calm may be related to decreases in personal distress, which in turn may be linked to increased regulatory self-efficacy. This is an important area for continued investigation.

Preliminary findings from this study suggest that CCT may result in increased abilities to regulate affective experience while also shifting towards choosing to not influence affective states in any way—perhaps suggesting that participants in this compassion training may be more willing to accept one's affective states (both positive and negative) without choosing to influence them in any way. This increase in self-efficacy or perceived capability to regulate affective states may have led to a greater willingness to experience and/or acceptance of different affective states, with concomitant decreases in the need to implement any form of regulation. These intriguing findings highlight the potential role of affect regulation self-efficacy in promoting acceptance of affect experience. Given that CCT is a comprehensive compassion training program with a dialectical focus on how one relates to suffering (i.e., recognizing and approaching, rather than avoiding, suffering) and also loving-kindness (a state of generating positive emotions for oneself and others), it is reasonable to expect an increase in acceptance of both positive and negative states. While this increase in one's self-efficacy in regulating affect would likely yield fewer failed regulatory experiences, it is also possible that people are more efficacious in their regulatory attempts which may lead to fewer repeated attempts of regulation. In the present study, it is difficult to assess the directionality of the actual regulatory efficacy and desire to regulate affective states—future research employing a true experimental design will be able to address the causal nature of this intriguing relationship.

These daily findings converge nicely with our findings from the weekly assessments of specific emotion regulatory strategies, which demonstrated decreases in suppression and increases in acceptance of affective states (stress/anxiety). These findings also parallel prior research of pre-post CCT individual difference findings of emotion regulation which utilized the Emotion Regulation Questionnaire (ERQ; Gross and John 2003) and demonstrated a reduction in expressive suppression, but no changes in general use of cognitive reappraisal following CCT when compared to the waitlist control

condition (Jazaieri et al. 2014). Taken together, these preliminary daily and weekly data paired with the prior trait level data from the randomized controlled trial suggests that on a daily, weekly, and trait level, this type of compassion training program may reduce expressive suppression of affect and increase acceptance of positive and negative affective states.

### Limitations and Future Research

The present investigation should be interpreted in the context of several important limitations. This study examined a new and comprehensive compassion training program. Without utilizing a comparison condition in addition to CCT, it is difficult to understand to what extent compassion training influenced daily and weekly affect and affect regulation. Future research examining affect trajectories, affect regulation, and affect regulation self-efficacy in compassion training would benefit from utilizing an active control condition to fully understand the effects. In the daily experience sampling, we examined four specific affective states—*anxious*, *calm*, *fatigued*, and *alert*—that represent different combinations of valence and arousal. We did not find effects on the states of *alert* (a high arousal, positive state) or *fatigue* (a low arousal, negative state). Future research may choose to examine additional combinations of high and low arousal and positive and negative affective states such as *joy*, *awe*, and *boredom*. Relatedly, in our weekly diary, we were interested in expanding the focus beyond cognitive reappraisal and expressive suppression to examine additional forms of affect regulation including situation modification, attentional deployment, and acceptance. It is only through detailed empirical investigation into additional strategies that we can more fully understand the effectiveness (or potential ineffectiveness) of different regulatory strategies. Given that dozens of regulatory strategies exist (for a review, see Webb et al. 2012), future research may choose to examine additional strategies (e.g., situation selection; Gross 1998), or subtypes of strategies (e.g., mindfulness as a form of attentional deployment; Neacsu et al. 2014). It will also be important to use similar context frames across all strategies (e.g., all related to stress/anxiety contexts or all items related to social interactions with others) in order to address the generalizability of improvements in regulatory strategy use. Finally, this study relied on daily and weekly self-reports of affect and regulation. Future studies of compassion training must move beyond self-report to include implicit or behavioral measures, observer reports (e.g., romantic partners, co-workers, peers), and physiological markers.

Collectively, the findings from this study suggest that interventions such as this comprehensive compassion training program may help modulate specific affective states (anxiety and calm), and modify one's self-efficacy and use of various affect regulation strategies. This study was novel in that it utilized nuanced methodological approaches ranging from



daily experience sampling to weekly diaries, which allowed us to look at trajectories of change, while also sampling a variety of regulation strategies beyond cognitive reappraisal and expressive suppression. Taken together, this study provides valuable preliminary information about the stability and change related to affective processes during a comprehensive compassion training program.

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**Author Contributions** HJ co-designed the study, executed the study, assisted with data analyses, and wrote the manuscript. KM taught CCT and assisted with editing of the manuscript. IL conducted data analyses and assisted with writing and editing of the manuscript. TJ created CCT and assisted with the editing of the manuscript. JD assisted with editing of the manuscript. JG collaborated in the writing and editing of the manuscript. PG co-designed the study and collaborated in the writing and editing of the manuscript.

**Compliance with Ethical Standards** The research study was approved by the ethics committee at Stanford University, prior to participant recruitment.

**Conflict of Interest** The authors declare that they have no conflicts of interest.

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**Human and Animal Rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

**Informed Consent** Informed consent was obtained from all individual participants prior to their inclusion in the study.

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