Can an online curriculum improve the daily socio-emotional lives of middle-aged adults exposed to childhood Trauma?

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ABSTRACT

One pathway linking experiences of childhood trauma to poorer mental and physical health in midlife are disruptions in daily socio-emotional regulation. However, there is a dearth of effective and accessible treatments that meet the needs of trauma-exposed individuals and their communities. Through a randomized controlled trial, this research examines whether an online social intelligence training (SIT) program improves social-emotional regulation compared to an attention-control (AC) condition. During the pre- and post-test phases of the study, participants ($N = 230$) completed online surveys for 14-days that included measures of social connectedness, emotional awareness, and perspective-taking. In the SIT condition, multi-level analyses revealed significant increases in daily levels of "in-tune" social interactions, emotional awareness, and perspective-taking, and attenuated within-person changes in social engagement on stressful and uplifting days. Participants who reported greater childhood trauma exhibited the strongest increases in daily social engagement and emotional awareness, suggesting that program benefits were largest for those reporting greater exposure to trauma in childhood. Our findings shed light on the potential reversibility of socio-emotional mechanisms linking childhood trauma to poorer mental and physical health in midlife, and support the utility of widely accessible, low-cost intervention methods for individuals and communities.

Quality social relationships are fundamental to the wellbeing of people at any age and learning to navigate the complexities of one's social world is one of the major developmental tasks across the lifespan (Baumeister & Leary, 1995; Bugental, 2000). The importance of developing relational capacities is evident when the robust associations between social functioning and mental and physical health are considered. Those lacking social connections are at a greater risk for anxiety, depression, and suicidal ideation (Cohen, 2004). Decades of research on loneliness has shown that a sense of disconnection with others wears on our minds and bodies (Hawkley & Cacioppo, 2010). Empirical evidence links strong social relations to a range of physical health outcomes including more rapid immune responses to pathogens and healthier cardiovascular and endocrine functioning (Uchino, Cacioppo, & Kiecolt-Glaser, 1996; Umberson & Karas Montez, 2010). With the health benefits of quality social relationships in mind, researchers have called for interventions that target socio-emotional skills as a way to build resilience (Castro & Zautra, 2016; Holt-Lunstad, Smith, & Layton, 2010). Nonetheless, there is a dearth of empirically-supported programs that enhance socio-emotional regulation, with the exception of socio-emotional programs for children and adolescents

(Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). We evaluate an online social intelligence training (SIT) program designed to enhance social connectedness, emotional awareness, and perspective-taking in middle-aged adults and whether the effects are strongest for individuals who experienced childhood trauma.

1. The value of social relationships

Empirical evidence confirms a robust association between social functioning and health of people across the lifespan. Individuals with strong social relationships are less likely to exhibit declines in physical health, become disabled in old age, and are more likely to live longer (Hawkley & Cacioppo, 2010; Holt-Lunstad et al., 2010). Mental health also relies on quality social relationships. Anxiety and depression are linked to stressful, or lost, social bonds, and those without social connections are at greater risk of suicide (Tsai, Lucas, & Kawachi, 2015; Umberson & Karas Montez, 2010). Resilience researchers have emphasized the value of positive, sustainable social bonds for human development (Luthar, Crossman, & Small, 2015) and how social relationships should be a target for intervention across the lifespan

(Infurna & Luthar, 2018; Luthar & Eisenberg, 2017).

The capacity to engage and navigate complex social relationships develops throughout the lifespan. This capacity depends on a willingness to trust, built from a foundation of close family relationships early in childhood. Those with troubled childhoods often have more difficulty with emotion regulation, and forming and maintaining positive social bonds (e.g., Burns, Jackson, & Harding, 2010). Nonetheless, the presence of early adversity is potentially reversible later in life, breaking the link to later difficulties with relationships and social-emotional regulation (Davidson & McEwen, 2012; Masten, 2001; Miller, Chen, & Parker, 2011).

Despite the potential of social-emotional interventions for children (Durlak et al., 2011), few programs have been developed and tested for middle-aged adults. A meta-analytic review highlights the potential of interventions designed to equip individuals with skills to build new friendships (Siette, Cassidy, & Priebe, 2017). These intervention trials indexed several outcomes, including depression, social support, and quality of life, and found that befriending was related to better patient-reported outcomes. However, these programs tend to occur in one-on-one or group settings and require considerable resources. To maximize public health applicability, interventions need to be relatively accessible and be delivered at a low cost. These objectives shaped the training program that we designed and tested in the present study. To the best of our knowledge, no evaluation of an online, self-guided program that targets social-emotional regulation at midlife has yet appeared in the literature.

2. Social intelligence

Social intelligence (SI) was originally defined as the ability to understand, manage, and act wisely in human relations (Thorndike, 1920). While SI was once thought of as merely an application of general intelligence and there is some overlap in neural networks, social neuroscience research has identified regions of the brain that constitute a SI system separate from other constructs (Fox et al., 2005; Lieberman, 2013, pp. 1–25). General and SI can even function in opposition to one another at times, with activation of one inhibiting the other (Van Overwalle, 2011). Whereas intelligence has historically been considered a largely stable construct, many investigators define SI as a fluid ability organized around cognitive principles that permit accurate judgment and wise choices in one's social interactions (e.g. Kihlstrom & Cantor, 2011). From this perspective, SI is developed through careful self-reflection and deliberate action, along with improved understanding of the social world and dedication to becoming more attentive to others (Reis, Bailey, Dunn, & Phillips, 2012; Snow, 2010). Yeager and colleagues (2012; 2016) have shown that teaching students the view that socially relevant traits are malleable fosters resilient socio-emotional responses to adversity. These benefits may also translate to individuals in adulthood and old age; therefore, underlying the program evaluated here are principals that socio-emotional capacities, including emotional awareness and perspective taking, can be cultivated through deliberate, consistent effort.

Modern definitions of SI include one's capacities for social connection (Snow, 2010), knowledge of processes that underlie social development (Kihlstrom & Cantor, 2011), and a commitment to curbing prejudice towards others (Castro & Zautra, 2016). When individuals adopt this framework, they enhance their understanding of how the mind develops social expectations and schemas from past experiences, and how to overcome past difficulties to create and maintain positive social bonds. The SIT program tested here is guided by these objectives, with lesson plans informed by contemporary neuroscience, psychology, and related fields (Zautra, 2013), and includes strategies that facilitate social connections (Devine, Forscher, Austin, & Cox, 2012).

The SIT used in the present study was designed to broaden awareness of processes underlying social development and interactions (Kihlstrom & Cantor, 2011), and to modify key socio-emotional skills

(e.g., emotional awareness, perspective-taking) regarding how people engage with others (Masi, Chen, Hawkley, & Cacioppo, 2010). The SIT was also designed to target key implicit mindsets, encouraging the view that social-emotional capacities, such as perspective-taking and emotional awareness, are malleable and can be developed with effort (Schumann, Zaki, & Dweck, 2014; Yeager & Dweck, 2012). Indeed, considering the powerful effects observed by other investigators when students learned about neuroplasticity (Yeager and Dweck, 2012; 2016), these concepts are presented at the start of the program tested here. A previous version of the SIT program was recently tested on a group of 207 undergraduate students in Spain, with facilitation by classroom instructors (Zautra, Zautra, Gallardo, & Velasco, 2015). Results indicated that students improved on key social cognitions, including sensitivity to others, social self-confidence, and the willingness to take another's perspective (Zautra et al., 2015).

3. Are the consequences of childhood trauma reversible?

Adverse experiences early in life can have significant consequences for one's mental and physical health in midlife and beyond. Childhood trauma includes experiences such as emotional, physical, and sexual abuse, a harsh family environment, and poverty (Repetti, Taylor, & Seeman, 2002). In addition to less emotional support and more relational strain in adult life (Zautra, 2013, pp. 185–196), adverse experiences have been associated with lower levels of well-being (Whitelock, Lamb, & Rentfrow, 2013), early onset of functional limitations, disease, and premature mortality (e.g., Division of Behavioral and Social Research, National Institute on Aging, 2013), and greater likelihood of psychosomatic symptoms and cancer (Morton, Schafer, & Ferraro, 2012; Schafer & Ferraro, 2013).

The effects of early life adversity in midlife are set in motion through biopsychosocial processes that unfold over time to increase risk for ill health. Plausible mechanisms include biological programming, behavioral habits, social relationships, and reactivity to stressors (Miller et al., 2011). In addition to unhealthy habits, such as smoking, alcohol dependency, and overeating (e.g., Power et al., 2005), harsher childhood environments have been linked to more hostile and mistrusting beliefs in others (Lynch, Kaplan, & Salonen, 1997), smaller social networks, more conflict, and less social support (Graves, Wang, Mead, Johnson, & Klag, 1998). Childhood trauma may disrupt one's regulation of emotions and social relationships, which accumulates to compromise health in midlife (Shields & Cicchetti, 1998).

It is possible that the capacity for social connections is malleable beyond early adulthood (e.g., Blakemore & Choudhury, 2006; Vaillant, 2012; Zautra, Infurna, & Zautra, 2016). Recent work proposes that social-emotional skills can be modified through training programs that encourage active self-reflection and intentional activities, especially for those who experienced childhood adversity (Davidson & McEwen, 2012). Moreover, although individuals who experienced greater early life adversity show stronger increases in negative emotions on days that stressors occur, they also show stronger increases in positive emotions on days that positive events occur (Infurna, Rivers, Reich, & Zautra, 2015). This heightened sensitivity to daily negative *and* positive events suggests that this population may be especially responsive to interventions designed to help them attain more positive social experiences (Infurna et al., 2015; Pluess & Belsky, 2013). Childhood trauma may put individuals at risk for poorer mental and physical health in midlife through increased sensitivity to ongoing stressors and the inability to form and maintain social relationships, but also may differentially boost well-being through greater responsiveness to lasting changes that have a positive valence. Therefore, a focus on childhood trauma is important not only because this population is at greatest risk, they may also be most responsive to social interventions. Given that the program tested here is designed to encourage consistent self-reflection and deliberate choices to foster positive social experiences, we expected that those who experienced greater childhood trauma will show the strongest

improvement in socio-emotional regulation.

4. The present study

In the present study, we focused on outcome measures of socio-emotional regulation, including social connectedness, emotional awareness, and perspective-taking, related to health and development. A sense of close and positively-experienced social relationships is robustly linked to emotional well-being and resilient adaptation to stress (Seppala, Rossomando, & Doty, 2013). Awareness of one's own emotions is a core component of emotion regulation and social competence (Boden & Thompson, 2015), and perspective-taking is needed to facilitate social coordination and foster interpersonal bonds (Galinsky, Ku, & Wang, 2005). Furthermore, we examine socio-emotional regulation as a dynamic process, defined as one's ability to manage their emotions and social relations in the context of specific stimuli (in this case, daily negative and positive events; Gross, 1998). We use "reactivity" to refer to daily within-person changes in social-emotional outcomes associated with daily negative events (i.e., stressors), and "responsiveness" for within-person changes in outcomes associated with daily positive events (i.e., uplifts; Zautra, Affleck, Tennen, Reich, & Davis, 2005). Prior work has shown that exhibiting less emotional reactivity to stressors is associated with better mental and physical health (Charles, Piazza, Mogle, Sliwinski, & Almeida, 2013; Sin, Graham-Engeland, Ong, & Almeida, 2015), whereas higher responsiveness to uplifts is associated with clinical depression (Bylsma, Taylor-Clift, & Rottenberg, 2011). Thus, improvements in these processes would be shown by weakened associations between daily stressors (i.e., less reactivity) or uplifts (i.e., less responsiveness) and socio-emotional outcomes from pre- to post-treatment.

To evaluate the efficacy of the SIT program, the present study utilizes daily survey data obtained from a randomized clinical trial in which 230 middle-aged adults from the community who were randomized to either SIT or a healthy lifestyle informational program. The latter program served as an attention-control (AC) condition that mimics nonspecific aspects of an intervention (e.g., expectations for improvement, delivery format), providing a more rigorous examination of theoretically "active ingredients" (MacCoon et al., 2012; Moos, 2007). We examined pre- and post-test daily survey data for effects of SIT and AC conditions on overall levels of socio-emotional regulation, as well as day-to-day stressor-reactivity and uplift-responsiveness. Participants completed these daily surveys for 14-days prior to beginning the SIT or AC condition and for 14-days after completion of either the SIT or AC condition.

We had several hypotheses for the current study. Hypothesis 1 was that the SIT group would show increases from pre-to-post in overall levels of social engagement, "in-tune" interactions, emotional awareness, and perspective-taking. Hypothesis 2 was that the SIT group would show attenuated stressor-related and uplift-related changes in socio-emotional outcomes following completion of the program (post-test). Hypothesis 3 was that individuals who reported greater childhood trauma would show pronounced improvements in overall levels and event-related changes in outcomes.

5. Methods

5.1. Participants

We recruited participants from the AS U Live Project, which was a large-scale study of middle-aged (aged 40–65) residents of the Phoenix metro area focusing on identifying individual, familial, and community contributors to resilience (for more information, see Infurna et al., 2015; Sturgeon et al., 2016). This study originally recruited a total of 800 participants between 2007 and 2012 through mailed recruitment letters and follow up door knocking, with a final number of 782 participating in the initial component of the study that involved self-report

questionnaires (*M* age = 54, *SD* = 7; 54% women; 61% employed; 80% White; two-thirds of the sample reported incomes between $15,000 and $100,000). At the end of participation in the original study, individuals were asked whether they could be contacted about future studies, and 557 of the 782 participants (71.2%) consented to being recontacted.

Sampling and Recruitment. We attempted to contact those 557 individuals interested in participating in future studies through (1) mailed recruitment letters that provided an update on the original study, and (2) research assistants followed-up one to two weeks after the recruitment letter was sent with a phone-call or e-mail. Follow-ups provided more information on the current study and requested participation. Participants were compensated up to $173 US dollars for participation in the study (i.e., questionnaires, home visit, phone interview). Inclusion criteria for recruitment were the participant was over the age of 40 years and had daily access to the internet (whether in the home or community). The study was approved by the Arizona State University Institutional Review Board. Participants gave written informed consent prior to participation.

Of the 557 eligible individuals, 248 (44.5%) consented to participate in the study and 230 (41.2%) completed the initial pre-test questionnaire. After consenting, participants were randomly assigned to either the SIT program or the AC condition, which consisted of healthy living tips. There were 122 individuals enrolled into the SIT program and considered intent-to-treat, with 89 completing the program and providing daily survey data at both pre- and post-test. Participants in the SIT program averaged 60.70 years of age (*SD* = 6.73, range 44–71) and 67.1% were women. There were 108 individuals enrolled into the AC condition and considered intent-to-treat, with 74 completing the program and providing daily survey data at both pre- and post-test. Participants in the AC condition were, on average, 60.52 years of age (*SD* = 7.51, range 40–71) and 62.7% were women. The two groups were comparable in age and gender (*Fs* < 0.80, *ps* > .85). Overall, the sample was primarily Caucasian (80%) with an average annual family income of $80,471. Table 1 provides further demographic information for the SIT and AC groups. Compared to the larger sample from which our sample was drawn, the participants in the current study were more likely to be women and have more family income.

5.2. Procedures

Once potential participants were contacted, the next step was a 30 min in-person meeting at their home or community location, where study staff who were blind to condition explained the procedures and assessments (online educational materials and questionnaires) and obtained informed consent. Prior to beginning either of the two programs, participants completed a pre-test questionnaire, along with 14 days of daily surveys (described further below). Following the immediate completion of the program, participants completed a post-test questionnaire and a second round of 14-day daily surveys, as well as 3- and 6-month follow-up assessments. We report on results from the 14-day daily pre- and post-test survey data.

The participants who received either condition were instructed to view the online 7-module, 42-session programs using a computer they had access to (either home or at a community location, such as a library). They were provided a username and password, and were instructed to complete one module per week, for a total of seven weeks to complete the program. Each module lasted approximately 60–90 min. Average completion time for the SIT program was 8.18 weeks (*SD* = 4.67, range: 1.86 to 25.43) and was 7.94 weeks (*SD* = 4.20, range: 1.43 to 24.29) for the AC condition.

5.3. Social intelligence training program

Program Elements. The value orientation that underlies the SIT program is "humanization" (Castro & Zautra, 2016). People are fundamentally social (Lieberman, 2013), and true connection comes from

Table 1
Demographic information for the social intelligence training (SIT) and attention control (AC) groups.

	SIT	AC
Sex		
Female	67.1%	62.7%
Male	32.9%	37.3%
Ethnic-Racial background		
Caucasian	79.4%	81.4%
Black/African American	4.4%	2.7%
American Indian/Alaska Native	.7%	0%
Asian	2.2%	1.8%
2 or more Ethnic-Racial Identities	13.2%	14.2%
Marital Status		
With Spouse/Romantic Partner	57.1%	61.1%
Without Spouse/Romantic Partner	42.9%	38.9%
Employment Status		
Currently Employed	45.0%	49.2%
Not Currently Employed	55.0%	50.8%
Educational Attainment		
< High School Diploma/GED	1.5%	2.5%
High School Diploma/GED	8.1%	7.4%
Trade/Vocation/Technical School Certificate	5.9%	5.7%
Some College	25.2%	28.7%
College Degree	29.6%	27.9%
Some Graduate School	8.9%	4.9%
Graduate/Professional Degree	20.7%	23.0%
Mean		
Income	70,631.47	91,119.45
Age	60.70	60.52
Completion of program (in weeks)	8.18	7.94

Note. SIT = Social Intelligence Training. AC = Attention Control.
SIT: *N* = 122. AC: *N* = 108. For completion of program, the *N* for SIT is 89 and the *N* for AC is 74.

understanding and feeling for one another (Jolliffe & Farrington, 2006). Effective social interactions require both emotional awareness and perspective-taking to recognize feelings and thoughts in others (De Waal, 2009; Galinsky et al., 2005). Guided by this principle, the online curriculum consisted of seven thematic learning modules. Content videos, YouTube videos, whiteboard animations, and interactive quizzes are common to all 42 sessions of the program (www.socialintelligenceinstitute.org).

The first module, called Neuroplasticity, addressed brain development and the life-long capacity of each person to form new neuroconnections that can support their future social relations (Klimecki, Leiberg, Ricard, & Singer, 2013). To illustrate how the curriculum unfolded within each module, we provide more detail about the six sessions in the Neuroplasticity module. The first session began with a content video defining neuroplasticity, followed by several brief YouTube videos related to neurons and synapses, and a whiteboard animation video suggesting new actions to practice in their daily lives. The second and third sessions provided audio-visual displays of neurons connecting via synapses, how "brain sculpting" occurs as unused neural connections are pruned, and how new connections are strengthened with use. The fourth session focused on the "teen brain", and how this phase of development leads to new neural connections across brain regions such as between the amygdala and the pre-frontal cortex. This session was followed by a fifth session that discussed the role of genetic predispositions, emphasizing that genes do not control one's destiny. The last session of this module, like each other module in the program, provided a neuroplasticity wrap-up, relating the content back to their lives.

The second module introduced the contagious nature of emotions, conscious and unconscious processing, describing how the brain processes information, guided by individual schemas and heuristics, as well as overarching cognitive biases. These heuristics and schemas can

exacerbate biases; however, awareness of these biases can improve the accuracy of social perceptions (e.g., Kahneman, 2011). This module explained how being aware of the benefits and consequences of these ways of thinking improves the capacity to understand oneself and others.

The third module, perspective-taking, addressed the ability to identify feelings and thoughts of another person in order to respond appropriately and predict how others may react to one's actions. This module introduced perspective-taking as a skill that improves with deliberate attention to the feelings and actions of others (Galinsky et al., 2005).

The fourth module discussed in-group and out-group biases. It addressed how one's thoughts and behavior toward others are shaped by in-group favoritism, which often occurs outside of conscious awareness (Harris & Fiske, 2006; Haslam, 2006). These sessions were designed to raise awareness of the nature of prejudice (Crisp & Turner, 2009; Seppala, 2013) and offered thoughtful ways of responding to out-group members.

The fifth module explored face-to-face and online communications and discussed the ebb and flow of positive face-to-face social interactions as well as factors that disturb that natural cadence. The importance of connecting with others was addressed by contrasting the plentiful but relatively shallow online connections and the potential richness of connecting face-to-face (Bayer, 2013; Ybarra & Winkielman, 2012). Pathways to improving communication with one another, through awareness and practice, were introduced (Reis et al., 2012).

Resistance to learning new ways of relating to others was confronted directly in the sixth module (Bowlby, 1969; Hughes & Ensor, 2007). This module addressed how past experiences, particularly interactions with parents and other family members early in life, shape schemas formed about the trustworthiness of social relationships, and the willingness to engage meaningfully with others.

The final module emphasized choice. Specifically, each person is not destined to repeat old patterns of relating. People have the capacity to form new social connections, modify their schemas, and enhance the quality of long-standing relations in need of repair, if they choose to do so. Well-established ways of relating can be changed through both awareness and self-regulation efforts (Snow, 2010).

Delivery Method. The program was constructed to be self-administered online, with materials and exercises presented by an avatar. Web-based interventions have displayed comparable efficacy (e.g., Hedman et al., 2011) and even outperformed face-to-face interventions in some cases (e.g., Steele, Mummery, & Dwyer, 2007). Recent reviews have identified communication training programs as among the most successful online behavior change interventions (Brouwer, Kroeze, & Crutzen, 2011). Nevertheless, web-based programs vary significantly in attrition rates (e.g., Cugelman, Thelwall, & Dawes, 2011; Robroek, Lindeboom, & Burdor, 2012), and effect sizes of behavior change (Cugelman et al., 2011). To address these issues, the delivery methods of program materials were selected to sustain attention and motivation by incorporating the following recommendations made by Guo (2013): (1) session lengths average 10 min, (2) content is displayed through attractive visual and auditory mediums, (3) frequent use of engaging online YouTube material, and (4) on-screen fixed images change within 3–5 s to sustain attention. Furthermore, the program encouraged application of SI principles to the participants' own relationships.

At the end of each session, participants were prompted to write their responses to awareness-raising questions designed to provoke thoughtful attention to current and past personal experiences relevant to the material presented. Each session ended with instructions that moved the participant from awareness to a practice exercise, intended to enhance readiness to change and self-efficacy. Furthermore, the sessions built on one another, gradually increasing in depth of awareness and cognitive-behavioral engagement with the material to instill the habit of socially intelligent reasoning and thoughtful action. The program included reward badges for completion of each module, and a

Certificate of Completion, suitable for framing (Steele et al., 2007).

5.4. Attention control condition: healthy living tips

The AC condition was referred to as The Healthy Living Tips program, which provides information about different aspects of health. The program is expanded from prior online attention-control conditions (see Davis & Zautra, 2013). The AC condition encompasses 42 brief sessions that were delivered online (similar to SIT) and each embedded into one of seven modules: Heart Health and Exercise; Sleep; Aging; Oral Health; Nutrition; Relaxation; and Cold and Flu. The course follows the same structure as the SIT program, gradually presenting new material in short, engaging videos. Each session contains a 5–15 min video lesson, followed by reflection questions where participants evaluate their health choices. After each module, participants are awarded a digital badge for their achievement. Engagement is encouraged also by gamification and animated whiteboards after each module that review the covered concepts. The AC condition controls for non-specific factors associated with providing attention to participants that may yield positive outcomes in the absence of specified treatment. It also provides a face valid minimal intervention that prevents differential dropout between the two conditions.

5.5. Measures

Prior experiences are not simply recalled later as they happen, but instead are shaped by ways of thinking about those experiences, and subsequent events, leading to biases in recall (Pearson, Ross, & Dawes, 1992). Thus, we utilized daily assessments to better capture the socioemotional lives of the participants. Such measures improve the reliability of self-reports and increase confidence of inferences drawn from the data (Almeida, 2005). These 1-item measures were designed to index key aspects of socio-emotion regulation (Zautra, 2003) and are appropriate when trying to reduce participant burden (Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012).

5.6. Measures: daily diary

Positive and Negative Daily Events. Each night, prior to going to sleep, participants responded on their computer, tablet or smartphone to questions regarding daily uplifts and stressors (for previous use, see Infurna et al., 2015). The specific wording for daily uplifts was, "*Think of the most positive event that occurred today, even if it may not have been too positive. Which category was this event in?*" The wording for stressors was, "*Think of the most stressful event that occurred today, even if it may not have been too stressful. Which category was this event in?*" The categories for both type of events were spouse/partner, family, friends, work, finances, health, other, and "no positive/stressful event occurred." Two dichotomous variables were created from these items, one for uplifts and one for stressors, to indicate whether participants reported a stressful/uplifting event during a given day. If participants indicated an uplift or stressor in the domains of spouse/partner, family, friends, work, finances, health, or other, then the uplift/stressor dichotomous variable was coded as 1, with a 0 for days indicative of no uplift/stressor. On average, a stressor was reported on 62% of days and an uplift was reported on 86% of days.

Social Engagement. The extent to which participants could stay engaged with close others in the past 24 h was assessed via one item ("I could stay engaged with people I care about") on a 5-point scale that ranged from 1 (*Not at all*) to 5 (*Very much*). The intraclass correlation (ICC) for social engagement across all days was 0.50.

"In Tune" Interactions. The extent to which participants felt "in-tune" during valued interactions was assessed via one item ("I felt "in-tune" with the person/people in the social interactions that mattered most to me") on a 5-point scale that ranged from 1 (*Not at all*) to 5 (*Very much*). The ICC for "in-tune" interactions across all days was 0.43.

Emotional Awareness. The extent to which participants were aware of their own emotions was indexed via one item ("I was aware of my feelings") on a 5-point scale that ranged from 1 (*Not at all*) to 5 (*Very much*). The ICC for emotional awareness across all days was 0.61.

Perspective-taking. The extent to which participants were aware of other people's emotions was indexed via one item ("I took time to understand another person's feelings") on a 5-point scale that ranged from 1 (*Not at all*) to 5 (*Very much*). The ICC for this measure was 0.44.

5.7. Measures: pre-test questionnaire

Childhood Trauma. The childhood trauma questionnaire (CTQ) was used to retrospectively assess the extent to which individuals experienced emotional, physical, and sexual abuse before the age of 18 (Bernstein et al., 2003). Ten items were answered on a 5-point Likert scale, ranging from 1 (*Never True*) to 5 (*Very Often True*), using the stem "When I was growing up". Sample items include "People in my family called me things like "stupid", "lazy", or "ugly"" and "Someone molested me". A mean score was created across the ten items, with higher scores indicating higher levels of childhood trauma ($M = 1.72$, $SD = 0.87$). The CTQ was completed prior to completion of pre-test daily surveys. Reliability in the current study was 0.91.

5.8. Analytic approach

Daily survey data were analyzed using Multilevel Models (MLM) with PROC MIXED in SAS, Version 9.4 (SAS Institute, Cary, NC). In the analysis of daily data (and other hierarchical or time-series datasets), MLM is preferable to traditional univariate approaches because it allows for the construction of statistical models that account for the non-independence of observations, and also provides maximum-likelihood estimation using all available data, retaining participants with only partial data, which increases power to detect effects (Raudenbush & Bryk, 2002).

Full information likelihood estimation (FIML) was used to estimate regression coefficients (i.e., fixed) and variance (i.e., random) parameters (Peugh, 2010). All multilevel models were computed with denominator degrees of freedom set at between-within. An [AR (1)] autoregressive covariance structure was used at Level-1 in both pre-test and pre-to-post-test analyses to account for autocorrelated residuals from equally spaced observations inherent in daily survey designs. Simulation studies have shown that in intensive longitudinal data with 20–40 observations per cluster, autoregressive (1) structures are preferable (i.e., provides less biased random intercept estimates and fixed effect standard error estimates) to unstructured covariance structures at Level-1 (Jahng & Wood, 2017). All analyses included an unstructured covariance at Level-2. In all models, intercepts and both daily stressor and uplift event slopes were set to vary randomly across clusters (i.e., individuals) to increase generalizability of results to the population from which observations were drawn.

Multilevel modeling partitions variance into two components: in this case, daily reports (Level-1) clustered within 230 individuals (Level-2). To index the proportion of total variance in daily outcomes that was between-person (Level-2), unconditional mean models were computed for each outcome, which yielded intraclass correlations (ICC). These ICC estimates indicated that 50%, 43%, 61%, and 44% of the total variance in social engagement, "in-tune" interactions, emotional awareness, and perspective-taking, respectively, were at the between-person level. These ICC values also indicated ample variance at the within-person level to proceed with multilevel analysis.[1] The Level-

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[1] We realize that certain academic contexts view the ICC as indicators of reliability, usually when examining relatively stable qualities that do not fluctuate across longer time scales (e.g., weeks and months, rather than days). The ICC values for our measures, consistent with our theoretical and methodological

1 variables in the current analyses were Stressful days (0 = No Stressor, 1 = Stressor), Uplifting days (0 = No Uplift, 1 = Uplift), and Time (0 = Pre, 1 = Post) ; Level-2 variables were Group assignment (0 = AC, 1 = SIT) and a continuous (grand-mean centered) childhood trauma variable.

Changes in overall levels, stressor-reactivity, and uplift-responsiveness were assessed for all outcomes. Following procedures from previous daily-diary evaluations of intervention effects (Davis et al., 2015), multilevel analysis using the SAS PROC MIXED program were employed in stages. First, we determined whether groups were comparable prior to the intervention by testing group differences at pre-test in overall levels, and stressor- and/or uplift-related changes (i.e., stressor-reactivity and uplift-responsiveness); these models included Group, Stressor/Uplift, and Group X Stressor/Uplift interactions as predictors of each outcome. Next, we tested whether stressor-reactivity and/or uplift-responsiveness changed significantly from pre-to-post for each group separately with models that included Time, Stressor/Uplift, and Time X Stressor/Uplift interactions as predictors in each model. Then, we tested whether groups differed in the magnitude of change from pre-to-post with models that included Group main effects, Time main effects, and interaction terms in the models. In this set of analyses, the basic equation testing differences between the SIT and AC conditions in their effects on overall levels, and stressor- and/or uplift-related changes in socio-emotional outcomes was:

$$Outcome = \beta_0 + \beta_1(Group) + \beta_2(Stressor) + \beta_3(Uplift) + \beta_4(Group\ X\ Stressor) + \beta_5(Group\ X\ Uplift) + \beta_6(Time) + \beta_7(Group\ X\ Time) + \beta_8(Time\ X\ Stressor) + \beta_9(Time\ X\ Uplift) + \beta_{10}(Group\ X\ Time\ X\ Stressor) + \beta_{11}(Group\ X\ Time\ X\ Uplift) + r$$

β_0 yields an estimate of the intercept at pre-test for the outcome of interest. Coefficients β_1- β_{11} provide slope estimates of predictor variables, with β_7 slope testing between-group differences in pre-to-post changes in overall daily levels, and β_{10} and β_{11} slopes testing for between-group differences in pre-to-post changes in stressor-reactivity and uplift-responsiveness, respectively. The r reflects the within-person residual. The final set of analyses tested whether childhood trauma (CT) moderated: (1) pre-treatment stressor/uplift-related changes in outcomes; and (2) pre-to-post changes in overall levels of and stressor/uplift-related changes in outcomes for those in the SIT group. The pre-treatment moderation models included Stressor/Uplift and Stressor/Uplift X CT interactions as predictors of each outcome. The pre-to-post moderation models included Time, Stressor/Uplift, Time X Stressor/Uplift, and Time X Stressor/Uplift X CT interactions as predictors in each model. In the latter analyses, the equation testing CT moderation of SIT effects on overall levels, and stressor- and/or uplift-related changes in outcomes was:

$$Outcome = \beta_0 + \beta_1(Time) + \beta_2(Stressor) + \beta_3(Uplift) + \beta_4(Time\ X\ Stressor) + \beta_5(Time\ X\ Uplift) + \beta_6(CT) + \beta_7(CT\ X\ Time) + \beta_8(CT\ X\ Stressor) + \beta_9(CT\ X\ Uplift) + \beta_{10}(CT\ X\ Time\ X\ Stressor) + \beta_{11}(CT\ X\ Time\ X\ Uplift) + r$$

All models were first run using all available data (i.e., including those who did not complete either SIT or AC programs), then only using complete data (i.e., including those who completed either SIT or AC programs and post-test diaries). The direction and magnitude of effects, and probability values, were nearly identical. Thus, figures, tables, and results section are based on analyses using only complete data. The supplemental materials show the SAS syntax for each of the models

(footnote continued)

approach, show that there are both between-person and within-person variation indicating some stability but potential for variability from day-to-day. We believe the ICCs across the four outcomes examined indicate that these constructs are more state-like versus trait-like, offering a window for daily intervention.

Table 2
Examining emotional reactivity/responsiveness in key outcomes as a function of daily negative and positive events: Findings from the social intelligence program condition.

	Social Engagement (1–5)	"In-Tune" Interactions (1–5)	Emotional Awareness (1–5)	Perspective-Taking (1–5)
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept	3.70** (0.10)	3.22** (0.13)	3.71** (0.11)	3.03** (0.13)
Time	0.09 (0.08)	0.21* (0.10)	0.16* (0.07)	0.22* (0.06)
Stressor	−0.29** (0.05)	−0.15* (0.07)	−0.02 (0.05)	−0.16* (0.06)
Uplift	0.50** (0.08)	0.72** (0.10)	0.21** (0.07)	0.55** (0.10)
Stressor x Time	0.13* (0.06)	−0.13 (0.08)	0.04 (0.06)	0.04 (0.08)
Uplift x Time	−0.18** (0.08)	−0.12 (0.10)	−0.14 (0.07)	−0.27* (0.10)
Random Effects				
Intercept	0.57** (0.11)	0.72** (0.15)	0.65** (0.13)	0.89** (0.18)
Stressor	0.06** (0.02)	0.14** (0.05)	0.06** (0.02)	0.03 (0.03)
Uplift	0.12** (0.04)	0.16** (0.07)	0.11** (0.04)	0.21** (0.08)
AR (1)	0.24** (0.02)	0.20** (0.02)	0.24** (0.02)	0.22** (0.02)
Residual	0.48** (0.01)	0.74** (0.02)	0.38**(0.01)	0.83**(0.03)

Note. Models based on 2676 observations nested within 89 individuals.
*$p < .05$, **$p < .01$.

Table 3
Examining emotional reactivity/responsiveness in key outcomes as a function of daily negative and positive events: Findings from the attentional control condition.

	Social Engagement (1–5)	"In-Tune" Interactions (1–5)	Emotional Awareness (1–5)	Perspective-Taking (1–5)
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept	3.59** (0.13)	3.45** (0.16)	3.78** (0.13)	3.15** (0.14)
Time	0.04 (0.11)	−0.18 (0.13)	−0.07 (0.09)	−0.17 (0.13)
Stressor	−0.12* (0.05)	−0.21** (0.06)	−0.02 (0.04)	−0.12* (0.06)
Uplift	0.42** (0.10)	0.46** (0.13)	0.12 (0.09)	0.31** (0.11)
Stressor x Time	−0.06 (0.06)	0.07 (0.07)	−0.06 (0.05)	0.02 (0.08)
Uplift x Time	−0.03 (0.11)	0.15 (0.13)	0.07 (0.09)	0.09 (0.13)
Random Effects				
Intercept	0.60** (0.14)	0.85** (0.22)	0.77** (0.16)	0.60** (0.16)
Stressor	0.02 (0.02)	N/A	0.01 (0.01)	0.01 (0.02)
Uplift	0.08* (0.05)	0.21** (0.09)	0.08* (0.04)	0.04 (0.05)
AR (1)	0.21** (0.02)	0.19** (0.02)	0.24** (0.02)	0.20** (0.02)
Residual	0.47** (0.02)	0.65** (0.02)	0.34** (0.01)	0.72** (0.02)

Note. Models based on 2266 observations nested within 74 individuals. N/A refers to convergence issues when estimating the variance in stressor for "in-tune" interactions and therefore, the stressor variance was not estimated for this outcome.
*$p < .05$, **$p < .01$.

reported below in Tables 2–5.

6. Results

6.1. Pre-treatment group comparisons of daily survey reports

The initial set of models examined whether the presence of a stressor and/or uplift event were related to same-day changes in socio-emotional outcomes in the pre-test daily surveys, and whether groups differed in their pre-test reactivity/responsiveness to daily events. Results from within-group models were consistent with prediction. Reporting a daily stressor was related to a same-day decrease in social

Table 4
Examining emotional reactivity/responsiveness in key outcomes as a function of daily negative and positive events: Findings from combined conditions.

	Social Engagement (1–5)	"In-Tune" Interactions (1–5)	Emotional Awareness (1–5)	Perspective-Taking (1–5)
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept	3.62** (0.13)	3.43** (0.16)	3.77** (0.13)	3.19** (0.16)
Time	0.01 (0.11)	−0.16 (0.13)	−0.06 (0.10)	−0.20 (0.14)
Stressor	−0.11* (0.05)	−0.21** (0.07)	−0.02 (0.05)	−0.11 (0.06)
Uplift	0.39** (0.10)	0.48** (0.13)	0.13 (0.09)	0.27* (0.13)
SIT Group	0.07 (0.17)	−0.22 (0.20)	−0.06 (0.17)	−0.17 (0.20)
Stressor x Time	−0.06 (0.07)	0.06 (0.08)	−0.06 (0.06)	0.03 (0.08)
Uplift x Time	−0.01 (0.11)	0.14 (0.13)	0.06 (0.10)	0.13 (0.14)
SIT x Time	0.08 (0.13)	0.37* (0.16)	0.22 (0.12)	0.43* (0.17)
SIT x Stressor	−0.17* (0.07)	0.06 (0.09)	0.01 (0.07)	−0.05 (0.09)
SIT x Uplift	0.12 (0.13)	0.24 (0.16)	0.08 (0.12)	0.30 (0.16)
SIT x Stressor x Time	0.20* (0.09)	−0.18 (0.11)	0.10 (0.08)	0.02 (0.11)
SIT x Uplift x Time	−0.18 (0.13)	−0.26 (0.17)	−0.20 (0.12)	−0.41* (0.17)
Random Effects				
Intercept	0.59** (0.09)	0.76** (0.12)	0.71** (0.10)	0.80** (0.13)
Stressor	0.04** (0.01)	0.06** (0.02)	0.04** (0.01)	0.02 (0.02)
Uplift	0.10** (0.03)	0.18** (0.05)	0.10** (0.03)	0.13** (0.05)
AR (1)	0.22** (0.02)	0.20** (0.02)	0.24** (0.02)	0.21** (0.02)
Residual	0.47** (0.01)	0.70** (0.02)	0.37** (0.01)	0.78** (0.02)

Note. SIT = Social Intelligence Training. Models based on 4942 observations nested within 163 individuals.
*p < .05, **p < .01.

engagement with close others (*ps* < .01) for both the SIT and AC groups. Alternatively, daily uplifts were related to same-day increases in social engagement and "in-tune" interactions (*ps* < .01) for both the SIT and AC groups. Importantly, groups were comparable in their overall levels of socio-emotional outcomes (*ps* > .50) and stressor-reactivity/uplift-responsiveness across all outcomes (*ps* > .05). Taken together, these findings suggest that random assignment yielded groups that were comparable at pre-test. AR (1) estimates (i.e.,
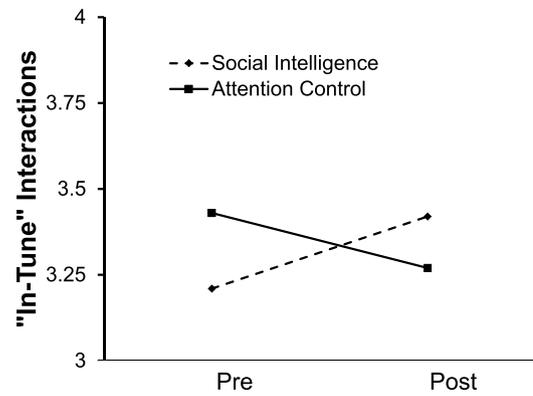

Fig. 1. Graphical illustration of changes in "in-tune" interactions from pre-to post-test in the social intelligence training and attention control condition. Individuals in the social intelligence training program, on average, showed increases in "in-tune" interactions from pre-to post-test.

autocorrelations) from these models were as follows for each outcome: social engagement (0.19), "in-tune" interactions (0.17), emotional awareness (0.24), and perspective-taking (0.17).

6.2. Intervention effects within groups from pre-to-post test

The next set of models examined pre-to-post changes in overall levels of and stressor/uplift-related changes in each outcome within each group. The results are shown in Table 2 for the SIT group and Table 3 for the AC group. The SIT group showed significant increases in overall levels of "in-tune" interactions (β = 0.21, *p* < .05), emotional awareness (β = 0.16, *p* < .05), and perspective-taking (β = 0.22, *p* < .05) following completion of the program (see Figs. 1–3). From pre-to post-test, on stressor days, the SIT group showed attenuated decreases in social engagement (Time X Stressor β = 0.13, *p* < .05). On uplift days, they also showed attenuated increases in social engagement (Time X Uplift β = −0.18, *p* < .05) and perspective-taking (Time X Uplift β = −0.27, *p* < .05). In contrast, the AC group (Table 3) showed no pre-to post-test changes in overall levels or associations between stressors and uplift events with each of the outcomes (*ps* > .10).
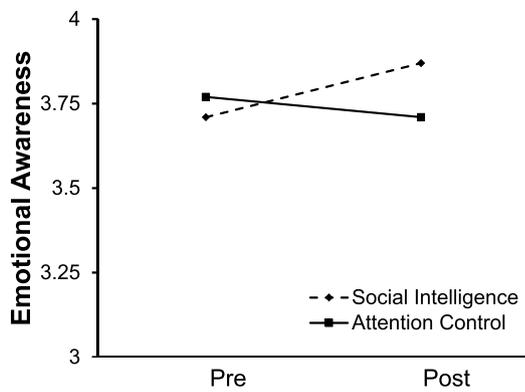
Table 5
Examining emotional reactivity/responsiveness in key outcomes as a function of daily negative and positive events: Findings from the social intelligence program condition; moderation by childhood trauma (CT).

	Social Engagement (1–5)	"In-Tune" Interactions (1–5)	Emotional Awareness (1–5)	Perspective-Taking (1–5)
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Fixed Effects				
Intercept	3.80** (0.10)	3.28** (0.13)	3.80** (0.11)	3.06** (0.14)
Time	0.02 (0.08)	0.18 (0.10)	0.08 (0.08)	0.20 (0.11)
Stressor	−0.28** (0.05)	−0.11 (0.07)	−0.01 (0.05)	−0.15* (0.06)
Uplift	0.44** (0.08)	0.68** (0.10)	0.13 (0.07)	0.54** (0.11)
CT	−0.34** (0.10)	−0.23 (0.12)	−0.21* (0.10)	0.07 (0.13)
Stressor x Time	0.13* (0.06)	−0.14 (0.08)	0.04 (0.06)	0.06 (0.08)
Uplift x Time	−0.12 (0.08)	−0.08 (0.11)	−0.06 (0.08)	−0.27* (0.11)
CT x Time	0.15* (0.08)	0.06 (0.10)	0.23** (0.07)	−0.14 (0.10)
CT x Stressor	−0.05 (0.05)	−0.16* (0.07)	−0.06 (0.05)	−0.13* (0.06)
CT x Uplift	0.20** (0.07)	0.15 (0.08)	0.22** (0.06)	0.05 (0.09)
CT x Stressor x Time	0.01 (0.06)	0.07 (0.08)	0.02 (0.06)	0.05 (0.08)
CT x Uplift x Time	−0.17* (0.08)	−0.12 (0.10)	−0.26** (0.07)	0.08 (0.10)
Random Effects				
Intercept	0.48** (0.10)	0.68** (0.15)	0.62** (0.12)	0.93** (0.19)
Stressor	0.05** (0.02)	0.10** (0.04)	0.06** (0.02)	0.02 (0.02)
Uplift	0.10** (0.04)	0.14* (0.06)	0.10** (0.04)	0.21** (0.08)
AR (1)	0.23** (0.02)	0.21** (0.02)	0.24** (0.02)	0.22** (0.02)
Residual	0.47** (0.01)	0.75** (0.02)	0.39** (0.01)	0.83** (0.03)

Note. CT = childhood trauma. Models based on 2622 observations nested within 87 individuals.
*p < .05, **p < .01.

Fig. 2. Graphical illustration of changes in emotional awareness from pre-to post-test in the social intelligence training and attention control condition. Individuals in the social intelligence training program, on average, showed increases in emotional awareness from pre-to post-test.
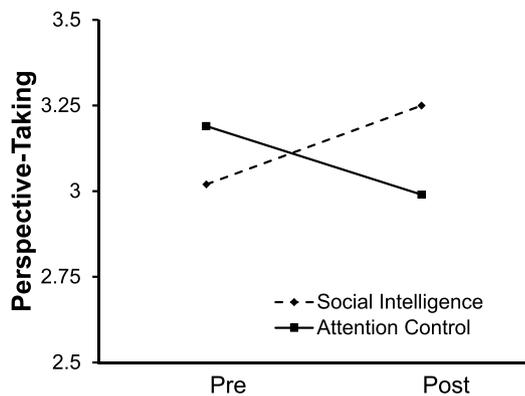

Fig. 3. Graphical illustration of changes in perspective-taking from pre-to post-test in the social intelligence training and attention control condition. Individuals in the social intelligence training program, on average, showed increases in perspective taking from pre-to post-test.

6.3. Group differences in magnitude of pre-to-post intervention changes

Models comparing groups in the magnitude of change in stressor-reactivity and uplift-responsiveness from pre-to post-test are shown in Table 4. The findings from these models generally corroborated results analyzing groups separately indicating that the SIT group showed the largest improvements from pre-to post-test. The SIT group yielded larger pre-to post-test increases in overall levels of "in-tune" interactions (Group X Time $\beta = 0.37$, $p < .05$) and perspective-taking (Group X Time $\beta = 0.43$, $p < .05$) compared to the AC group. Fig. 4 shows that, compared to AC, the SIT group showed attenuated stressor-related decreases in social engagement (Group X Time X Stressor $\beta = 0.20$,

$p < .05$), and (as shown in Fig. 5) attenuated uplift-related increases in perspective-taking (Group X Time X Uplift $\beta = -0.41$, $p < .05$).

6.4. Moderation of SIT effects by childhood trauma

The final models examined whether childhood trauma (CT) moderated: (1) pre-test stressor/uplift-related changes in each outcome; and (2) pre-to post-test changes in overall levels of, and stressor/uplift-related changes in, each outcome for those in the SIT group. Results from the latter models are shown in Table 5. All pre-treatment analyses that tested stressor/uplift-related changes in outcomes were repeated including a (grand-mean centered) CT main effect and its interaction terms in the models. At pre-treatment, results indicated that CT predicted lower daily levels of social engagement ($\beta = -0.34$, $p < .01$) and "in-tune" interactions ($\beta = -0.31$, p $< .01$). Regarding moderation, on stressor days, CT heightened decreases in "in-tune" interactions (CT X Stressor $\beta = -0.12$, $p < .05$) and, on uplift days, boosted increases in social engagement (CT X Uplift $\beta = 0.21$, $p < .01$), "in-tune" interactions (CT X Uplift $\beta = 0.22$, $p < .01$), and emotional awareness (CT X Uplift $\beta = 0.15$, $p < .01$). This indicates that individuals reporting higher levels of childhood trauma were, on average, more likely to report poorer overall socio-emotional regulation prior to the SIT, and were more responsive to daily uplifts.

All within-group analyses for participants in the SIT group that tested pre-to post-test changes in overall levels and stressor/uplift-related changes in outcomes were repeated including a CT main effect and its interaction terms. Results indicated that CT moderated pre-to-post changes (see Figs. 6 and 7); those reporting greater childhood trauma showed pronounced increases in overall levels of social engagement (CT X Time $\beta = 0.15$, $p < .05$) and emotional awareness (CT X Time $\beta = 0.23$, $p < .01$). CT did not moderate pre-to-post changes in stressor-reactivity for any outcome ($ps < .10$) but did moderate changes in uplift-responsiveness. Specifically, those reporting greater childhood trauma, on uplift days, showed smaller increases in social engagement (CT X Time X Uplift $\beta = -0.17$, $p < .05$) and emotional awareness (CT X Time X Uplift $\beta = -0.26$, $p < .01$). This indicates that individuals reporting higher levels of childhood trauma, on average, showed stronger improvements in social engagement and emotional awareness following the SIT.

7. Discussion

This randomized controlled trial examined the effects of a SIT program on middle-aged adults' socio-emotional regulation. We expected that socio-emotional regulation would have both trait-like and state-like qualities in that it is flexible enough to change but stable enough to reach new, relatively consistent levels with dedicated training and practice. The ICCs for each outcome confirmed this reasoning: measures were somewhat stable over time within individuals but also varied considerably within individuals from day-to-day.

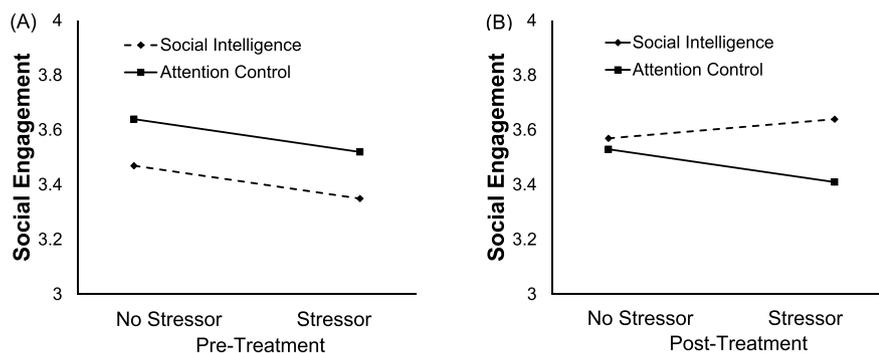Three aspects of this investigation were particularly novel: the focus

Fig. 4. Graphical illustration of stressor-related changes in social engagement from pre-test (A) to post-test (B). Individuals in the social intelligence training program, on average, showed less of a decrease in social engagement following completion of the program, whereas the attention control condition showed similar decreases in both pre-test and post-test.
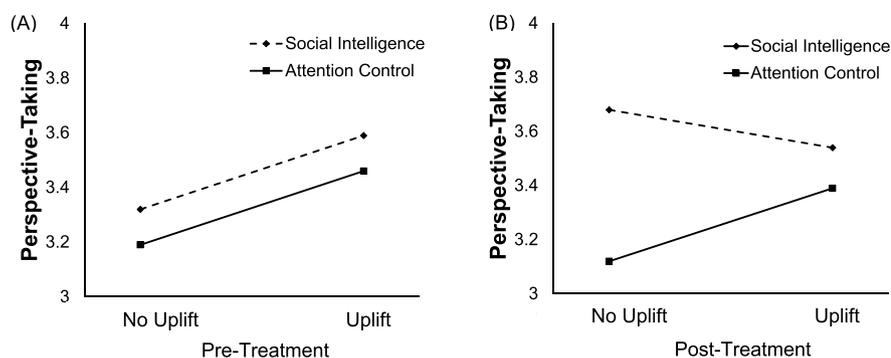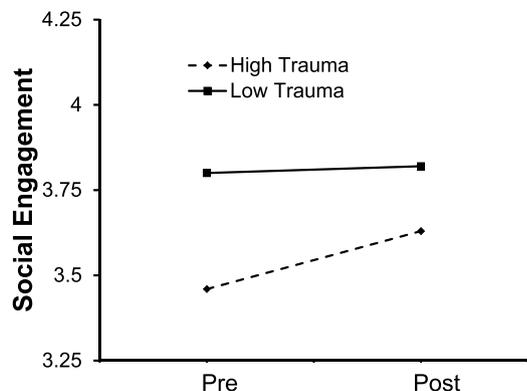
Fig. 6. Graphical illustration of changes in social engagement in the social intelligence training program, moderation by childhood trauma. Individuals who reported higher levels of childhood trauma showed stronger increases in social engagement from pre-to post-test.
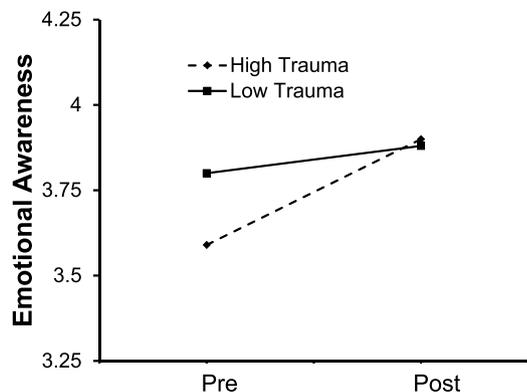

Fig. 7. Graphical illustration of changes in emotional awareness in the social intelligence training program, moderation by childhood trauma. Individuals who reported higher levels of childhood trauma showed stronger increases in emotional awareness from pre-to post-test.

on enhancing socio-emotional regulation among middle-aged adults, the use of the internet to deliver the program, and the use of daily surveys to evaluate efficacy. Results were generally consistent with our hypotheses. Individuals in the SIT program reported improvements in daily levels of "in-tune" social interactions, emotional awareness, and perspective-taking from pre-to post-test. Following completion of the SIT, individuals demonstrated an enhanced capacity to maintain social engagement on days that stressors occurred and showed higher levels of social engagement and perspective-taking on days without positive events. Focusing on the AC condition, no outcome improved significantly from pre-to post-test. As expected, the degree of improvement

in the SIT program was greater than the AC condition across outcomes. We also observed that individuals who reported higher levels of childhood trauma, on average, showed stronger increases in overall levels of social engagement and emotional awareness and less reliance on positive events to maintain social engagement and emotional awareness (indexed by improvements in uplift-responsiveness for social engagement and emotional awareness). Our discussion focuses on the implications of our findings for informing the broader discussion of improving socio-emotional regulation, especially for individuals who experienced childhood trauma.

7.1. The value of social relationships

Social connectedness, emotional awareness, and perspective-taking are key aspects of quality of life that are often overlooked in the evaluation of treatments. The program tested here improved these key outcomes, which are strongly associated with emotional well-being, social competence, and resilient adaption to stress (Boden & Thompson, 2015; Galinsky et al., 2005; Seppala et al., 2013). Our results suggest that online training that focuses on social intelligence can improve middle-aged adult's daily capacity to connect with other people and maintain emotional awareness of oneself and others through an empirically-informed curriculum designed to sharpen attention to social relations and emotions. Prior to the training, when individuals reported a stressful day, on average, they experienced declines in social engagement. After completion of the SIT program, individuals, on average, showed no reduction in their sense of engagement with others on stressful days, which may confer long-term benefits in mental and physical health by improving the way that individuals emotionally react to daily stressors (Charles et al., 2013; Sin et al., 2015). The improvements in daily positive social interactions are relevant when considering studies associating them with better mood (Bernstein et al., 2018), lower blood pressure (Cornelius, Birk, Edmondson, & Schwartz, 2018), and less inflammation (Bajaj et al., 2016). Overall, the gains reported here in socio-emotional regulation are especially noteworthy given the dearth of such programs for middle-aged adults (Durlak et al., 2011). They also offer preliminary evidence that the capacity for social connection is malleable beyond early adulthood (e.g., Blakemore & Choudhury, 2006).

Despite government agencies, health care providers, and workplaces being slow to recognize the value of social relationships, advancing social connection has become a public health priority in the United Stated (Holt-Lunstad, Robles, & Sbarra, 2017). Evidence for emotional abuse and other active displays of inhumanity even between family members and peers is also mounting in the social science literature (e.g., Cooper, Selwood, & Livingston, 2008; Schafer and Ferraro, 2013). As many as 1 in 7 adolescents are repeatedly mistreated by their peers (Wang, Iannotti, & Nansel, 2009). Among college students, there has been a drop of 48% in empathic concern and a 34% drop in perspective-taking, with the steepest declines over the last 10 years (Konrath, O-Brien, & Hsing, 2011). These trends in relationships signal the need for

affordable and accessible programs that encourage quality social connections, emotional awareness, and perspective-taking throughout the lifespan. Programs like the one tested here could be implemented into a range of contexts, such as an online tool offered by health insurance companies, government agencies, or workplaces. It is also useful to consider whether these programs could help boost adolescent's social connections during stressful transitions, such as entry to high school, and college life, where risk of failure to advance is substantial (Lee, Draper, & Lee, 2001; Sladek & Doane, 2015; Taylor, Doane, & Eisenberg, 2013). The present study provides initial evidence supporting the efficacy of the SIT program as a low cost, online curriculum that improves key socio-emotional skills to enhance social relationships and boost resilience.

7.2. Are the consequences of childhood trauma reversible?

Those who experienced trauma in childhood are likely to show difficulties with socio-emotional regulation later in life (Infurna et al., 2015; Miller et al., 2011). Results from pre-test analyses supported this notion; those who experienced greater childhood trauma, on average, rated themselves as less socially engaged and "in-tune" with close others in everyday life. Moreover, they demonstrated sharper declines in "in-tune" interactions on days that stressors occurred *and* stronger increases in socio-emotional regulation (i.e., social engagement, in-tune interactions and emotional awareness) on days that uplifts occurred, suggesting a heightened sensitivity to negative and positive events (Pluess & Belsky, 2013). Collectively, our findings indicate that individuals who experienced childhood trauma, on average, show greater reactivity to daily stressors and rely more on daily uplifts to maintain high levels (i.e., comparable to those with low trauma) of socio-emotional regulation.

Given the socio-emotional difficulties of those who experienced childhood trauma, it is noteworthy that among participants in the SIT group, individuals reporting more childhood trauma, on average, showed the strongest improvements in social engagement with close others and emotional awareness of oneself. Moreover, after the training, those who experienced greater childhood trauma, on average, demonstrated less reliance on daily uplifts to maintain social engagement and emotional awareness, which may help these individuals stabilize positive emotional experiences from day-to-day (Bylsma et al., 2011). Comparison of autocorrelations from pre-to post-treatment generally indicated greater persistence across time (i.e., inertia) in socio-emotional states after the SIT. Together, these findings of reduced responsiveness and heightened inertia show that individuals demonstrated higher, more enduring (i.e., slow changing) socio-emotional regulation following the SIT program (for review of emotion dynamics, see Ong & Ram, 2017).

7.3. Limitations and strengths

Our study is not without limitations. First, aside from a non-randomized test with college students (Zautra et al., 2015), the generalizability of our findings is untested. Our sample consisted of middle-aged community members fluent in English who had daily access to the internet. Our goal was to examine on the utility and efficacy of the SIT program in a randomized control trial and to additionally examine whether this differed based on levels of childhood trauma. Future research is warranted that explores the extent to which the efficacy of the SIT program tested here extends to other portions of the lifespan (i.e., those in young adulthood and old age), as well as exploring other key moderators, such as education, marital status, and employment status. Second, because intervention effects on daily functioning were assessed immediately following treatment, we do not know whether the daily benefits of the SIT program were sustained over time. Although promising, inferences of the intervention's value should be limited to what was assessed in this study: daily socio-emotional regulation prior to and

immediately after completing the program. A third limitation is that all assessments were self-report; additional data from confidants of socio-emotional functioning would provide nuanced information about the "real world" impact of treatment effects. A fourth limitation is that the single outcome items were slightly idiosyncratic and could have been interpreted differently across individuals. For example, it is possible that the measurement of social engagement may have been interpreted by some participants as referring to their potential ability to engage ("I could stay engaged …") rather than the extent to which participants actually engaged. Focusing on the measurement of perspective-taking ("I took time to understand …"), this may have reflected invested time, perhaps effort, rather than actual success in considering other people's emotions.

Despite recommendations for online interventions to include multiple components (Seligman, Steen, Park, & Peterson, 2005), it is worth noting the difficulty in determining which program elements were responsible for efficacy demonstrated here. The SIT program tested in this study has the advantage of reaching a large audience due to its web-based nature, but the large amount of content makes it difficult to pinpoint which modules were most likely to predict changes in each outcome of interest. The SIT program included seven modules of content, and even within a single module there were multiple constructs explicitly targeted for manipulation (e.g., Module 2 was designed to increase awareness of emotional contagion and increase meta-awareness of one's own cognitive biases). Furthermore, it is unclear whether the many constructs were successfully manipulated because only four items were used to assess efficacy in this sample. For example, the emphasis on choice/agency in Module 7 could have been one of the most important drivers of change although it was not included in the present conceptualization of socio-emotional regulation. A previous evaluation of this program demonstrated changes in one's sense of choice in when and how to communicate (or not) with others (Castro & Zautra, 2016). Future studies that evaluate the multi-faceted nature of the SIT would benefit from assessing key outcomes during program participation to ascertain whether outcome changes correspond to specific modules.

The current investigation also had several strengths. First, we assessed intervention effects on various aspects of socio-emotional regulation via daily surveys. This approach allowed us to capture "life as it is lived," providing a snapshot of day-to-day improvements across outcomes following treatments. Electronic verification of timing of diary completion also increases confidence in the validity of the changes observed pre-to post-intervention. A second strength of the study was inclusion of an AC condition that was comparable to the SIT program in delivery format and amount of content. This provided guarded confidence that the beneficial changes observed in the SIT group were not simply a result of expectancy effects or passage of time. The automated delivery of both interventions also minimizes non-specific factors as an explanation for the findings, and lends support for theoretically "active ingredients" embedded in the SIT program (MacCoon et al., 2012; Moos, 2007).

8. Conclusion

In summary, we showed that an online, self-paced (8-hours of content that took, on average, 8 weeks to complete) training curriculum in SI improved the daily socio-emotional lives of middle-aged adults, especially those who experienced childhood trauma. After the training, individuals rated themselves as more "in-tune" with others during valued social interactions and more emotionally aware of themselves and others. They also demonstrated an improved capacity to maintain social engagement on stressful days and less reliance on positive events to maintain emotional awareness of others. In contrast, those assigned to the AC condition showed no improvements in any aspect of socio-emotional regulation. In addition, those who experienced greater childhood trauma started out lower on some positive indicators yet

gained more from the SIT program; they showed the strongest improvements in daily social engagement and emotional awareness of oneself, and heightened social engagement and emotional awareness on days without positive events. Though small in magnitude, the effects shown here reflect changes in day-to-day socio-emotional processes that may compound over time. The value and potential impact of public health interventions that are widely accessible, cost-effective, and easy to implement is substantial. We hope these findings encourage future efforts to design and test treatments that reach not only individuals but also whole communities.

Conflict of interest

Eva Zautra, is executive director of the Social Intelligence Institute, which developed the social intelligence training program used in our study. She and each of the co-authors do not have any financial interest that might be interpreted as influencing this research.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.brat.2019.03.012.

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