AMERICAN PSYCHOLOGICAL ASSOCIATION

Emotion

ISSN: 1528-3542

2022, Vol. 22, No. 1, 30–45
https://doi.org/10.1037/emo0001035

The Goods in Everyday Love: Positivity Resonance Builds Prosociality

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The positivity resonance theory of coexperienced positive affect (Fredrickson, 2016) identifies the emotion of love as a collective state. This state, termed positive resonance, is defined by the presence of three key features: shared positive affect, caring nonverbal synchrony, and biological synchrony. The current study examined whether a modest behavioral intervention focused on increasing social connectedness could increase study participants' perceptions of day-to-day positivity resonance with corollary impacts on their tendencies for prosociality and self-centeredness. Adults (N = 416, M age = 33.8) were randomized to one of four study conditions: either of two variants of the social connectedness intervention or either of two control groups. Positivity resonance, prosociality, and self-centeredness were measured nightly for 35 consecutive days. Dynamic multilevel factor models of nightly reports showed significant growth in positivity resonance, relative to a passive control group, for the two intervention groups and higher mean levels of prosociality for one of them. In addition, significant dose-response relations were evident (both between persons and within persons), linking positivity resonance to both prosociality and self-centeredness. The within-persons effect for prosociality (but not self-centeredness) was significantly stronger for those randomized to the intervention groups, relative to both passive and active control groups. Taken together, findings suggest that the affective quality of people's day-to-day social encounters may have implications for community flourishing. Discussion centers on theoretical and practical implications as well as directions for future research.

Keywords: positive psychology, broaden-and-build theory, positive emotions, social integration

Supplemental materials: https://doi.org/10.1037/emo0001035.supp

Love is a many-splendored thing. Among love's many forms, it is vital to distinguish love, the emotion, from love, the relationship. As an offshoot of the broaden-and-build theory of positive emotions (Fredrickson, 1998, 2001, 2013), the positivity resonance theory of coexperienced positive affect (Fredrickson, 2016) offers a framework for understanding how recurrent, day-to-day experiences of love, the emotion, compound over time to build enduring personal resources, including love, the relationship, as well as a more general sense of belonging to one's community. Love, the emotion, according to the positivity resonance theory, is a collective emotion defined as a macrolevel, affective phenomenon that emerges from emotional dynamics coexperienced between and among individuals who are mutually engaged and responding to situations together (Goldenberg et al., 2020). Just as individuals' emotions are short-lived phenomena that produce coordinated changes in multiple response systems (i.e., experiential, behavioral, physiological; Levenson et al., 2017), love, the emotion (or positivity resonance), is theorized to occur when two or more individuals partake in an episode of social contact characterized by three intertwined collective and coherent responses: (a) shared positive affect (experiential), (b) caring nonverbal synchrony (behavioral), and (c) biological synchrony (physiological; Fredrickson, 2016).[1] Although popular viewpoints (and countless love songs) paint love, the emotion, as cupid's arrow striking a cartoon heart to create instant and intense lifelong bonds, consistent with evidence about the consequences of

This article was published Online First November 29, 2021.
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Computed study variables and analytic code are available on the Open Science Framework at https://osf.io/7dsa3/. This research was supported by a grant from the Templeton World Charity Foundation (TWCF0325) awarded to Barbara L. Fredrickson. We thank Emily Stokes for data collection and data management, Catherine J. Berman, and Kelly R. Tan for helpful comments on earlier versions of the article, and Alexandra M. Gray for putting together the bibliography. The authors have no known conflicts of interest to report.

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[1] We note that our current articulation of the three intertwined, defining features of positivity resonance has shifted slightly from its initial presentation (Fredrickson, 2016). Previously, the trio of collective responses was articulated as "(1) shared positive emotion, (2) mutual care, and (3) biobehavioral synchrony" (Fredrickson, 2016, p. 852). Our new phrasing decouples behavioral from biological synchrony to better align with the operationalized divisions among coordinated emotion response systems into experiential indicators (i.e., shared positive-valence affect), behavioral indicators (i.e., caring and synchronized nonverbal behaviors), and biological indicators (i.e., physiological linkage).

positive emotions for well-being (Diener et al., 1991), in theory, positivity resonance need not be intense or prolonged to elevate each interactant's well-being. Instead, the frequency of mild positivity resonance—everyday love—may be what matters most.

Initial research has confirmed that the three coexperienced responses that define positivity resonance—shared positive affect, caring nonverbal synchrony, and biological synchrony—indeed unfold simultaneously (e.g., within seconds across interactants; Chen et al., 2020; Otero et al., 2020). Positivity resonance has also been linked to higher levels of flourishing mental health and resilience and lower levels of anxiety, depressive symptoms, and loneliness (Major et al., 2018; Prinzing et al., 2020). The value added by any new scientific construct is strengthened to the degree that its nomological network can be discriminated from closely related constructs. As such, initial research on the collective state of positivity resonance has sought to distinguish its hypothesized effects from those of individual-level positive emotions and has provided preliminary evidence for the unique benefits of positivity resonance (Brown et al., 2021; Major et al., 2018; Otero et al., 2020; Prinzing et al., 2020; West et al., 2021). More generally, coexperienced emotions are theorized to lead to the formation of group-level qualities (Barsade & Gibson, 2012; Goldenberg et al., 2020), such as collective identity or affective culture. Consistent with this prediction, dyad-level markers of positivity resonance have been found to predict spouses' combined reports of their marital satisfaction (Brown et al., 2021; Otero et al., 2020). Global assessments of relationship quality are associated with positivity resonance, both when positivity resonance is holistically coded from behavioral indicators (Otero et al., 2020) and when it is indexed by its defining facets, such as coexperienced positive affect (Brown et al., 2021) or physiological synchrony (Chen et al., 2020).

Does positivity resonance build more than mental health and good personal relationships? Might it also build compassionate communities or those that function with goodwill and civility? The research reported here begins to address these questions by testing whether a behavioral intervention to increase social connectedness can increase day-to-day experiences of love, indexed as perceived positivity resonance, and whether such increases build prosocial tendencies and diminish self-centered ones. In step with developmental and personality psychology (e.g., Lapsley & Narvaez, 2014; Schnitker et al., 2019), we define prosocial tendencies as other-oriented virtues, reflecting dispositional habits (the "doing side" of personality) that transcend self-interest. Prosocial tendencies, from this perspective, are more action oriented than values, ideals, or traits (the "having side" of personality). Prosocial tendencies represent a subset of virtuous habits that, when enacted, promote or maintain harmonious communities. These include actions that sensibly stem from pervasive and self-transcendent feelings of unity or interconnectedness across all of humanity, such as altruism, compassion, and humility.

From the perspective of the broaden-and-build theory, love (like other positive emotions) is theorized to momentarily broaden individuals' mindsets in ways that blur the boundaries between self and other to produce self-other overlap and feelings of "oneness" (Fredrickson, 2013; Waugh & Fredrickson, 2006). That is, in moments when positivity resonates between and among individuals, mutual other-focus and felt unity become more probable, whereas self-focus and self-interest may fade. Broadened mindsets that accompany the emotion of love function to build consequential personal and social resources over time (Fredrickson, 2013). We posit here that because moments of positivity resonance broaden individual awareness to transcend self-interest, the recurrence of such moments can serve to build enduring prosocial tendencies.

Here, we focused on three prosocial tendencies—spirituality, altruism, and humility—because each bears a specific connection to the defining features of positivity resonance. Spirituality is defined as the tendency to orient oneself to the interconnectedness of all life (Piedmont, 1999) or to the nontheistic sanctification of human bondedness (Pargament et al., 2017). Our prediction that spirituality is enhanced through experiences of positivity resonance is grounded in experimental evidence showing that self-transcendent positive emotions (e.g., elevation, admiration, appreciation, wonder, awe) produce increases in spirituality, especially among nonreligious individuals (Saroglou et al., 2008; Van Cappellen & Saroglou, 2012; Van Cappellen et al., 2013). We conceptualize the two other prosocial tendencies we target—altruism and humility—as offshoots of self-transcendent feelings of interconnectedness. Altruism is defined as behavior marked by helpfulness and compassion (Lapsley & Narvaez, 2014). Our expectation that positivity resonance can increase altruism is informed by experimental evidence that shows nonverbal synchrony between strangers to be sufficient to unlock compassion and costly helping behavior (Valdesolo & DeSteno, 2011). Humility, by contrast, is defined as a realistic and balanced appreciation of one's own strengths and weaknesses, the belief that one is no better or worse than the average person, joined with an appreciation for the value and contributions of others (Kruse et al., 2017; Stellar et al., 2017). Our prediction that positivity resonance enhances humility stems from experimental evidence showing that induced gratitude, an other-oriented positive emotion, increases expressions of humility following an imagined conflict, as judged by coders blind to hypotheses and experimental condition (Kruse et al., 2014). Additional grounding comes from experimental evidence that priming perceptions of partner responsiveness (an aspect of the caring synchrony facet of positivity resonance) increases intellectual humility, evident as openness to alternative or conflicting perspectives (Reis et al., 2018). In the present study, we investigated whether love builds these three prosocial tendencies. Specifically, we tested whether spirituality, altruism, and humility are strengthened in step with day-to-day experiences of positivity resonance.

We further speculate that the self-transcendent feelings of interconnectedness with humanity, hypothesized to grow from positivity resonance, might be especially facilitated by interactions with weak social ties. Weak ties are defined as social contacts that have little history and low intimacy. Despite these features, past research has shown that the frequency of interaction with weak ties contributes to individuals' positive affect and sense of community independently from the frequency of interaction with strong ties, defined as people's established relationships with close others (Sandstrom & Dunn, 2014b). Experimental work also demonstrates that people can build their sense of community by improving the affective quality of weak tie interactions (Sandstrom & Dunn, 2014a). Weak tie interactions may also come to represent people's global perceptions of community or humanity. Finally, opportunities for weak tie interactions are also abundant in many people's daily lives and thereby arguably provide ideal contexts in which people can experiment with cultivating frequent, mild states of positivity resonance, provided they overcome

common indifference to and fears of connecting with strangers (Epley & Schroeder, 2014; Sandstrom & Boothby, 2021).

Aligned with a foundational principle in positive psychology, we do not assume that building positive qualities and habits necessarily implies a diminishment of negative qualities and habits. We therefore tested whether love also reduced self-centered tendencies. Although past research has more frequently contrasted prosociality with antisociality (e.g., Marsh, 2019), we targeted self-centeredness because we suspected it to be more frequent in everyday life. We define self-centered tendencies to be a set of vices that reflect dispositional habits that prioritize self-interest over concern for others. Although many habits can be described as such, we focused on three that plausibly undermine the prosocial tendencies we targeted. Contrasting with spirituality, we examined materialism, defined as the tendency to prioritize the acquisition of material goods to signal success and pursue happiness (Richins, 2004). Contrasting with altruism, we examined hostility, exemplified by anger, bitterness, and verbal aggression (Bryant & Smith, 2001; Buss & Perry, 1992). Contrasting with humility, we assessed entitlement, defined as a pervasive sense that one deserves more than others and expects reward (Campbell et al., 2004). To parallel the test of whether love builds prosocial tendencies, we tested whether materialism, hostility, and entitlement are diminished in step with day-to-day experiences of positivity resonance.

To test these ideas, we used an intensive longitudinal experimental approach, with community participants, randomized across four groups, invited to provide nightly reports of their actions and experiences for 35 days. At the start, two experimental groups viewed a brief psychoeducational video that cast "love" as everyday moments of positive social connection, which was followed by a request to make small shifts in daily behavior to prioritize such moments.[2] One experimental group adopted this social goal in general (social connectedness-general), whereas the other was encouraged to do so specifically with strangers and acquaintances (social connectedness-weak ties). This allowed us to explore whether connectedness with weak ties is particularly conducive to building prosocial tendencies and reducing self-centered ones. We contrasted these two experimental groups with two control groups: a no-intervention control group, in which participants provided nightly reports but were not asked to make shifts in their daily behavior (monitoring passive control), plus an active control group in which participants were asked to create more frequent moments of mindful awareness, a high-quality mental state characterized by attending to the present moment (mindfulness active control).

We preregistered this randomized controlled trial to test five hypotheses (see https://osf.io/7dsa3/registrations). First, we predicted that the two variants of our behavioral intervention focused on social connectedness (general and weak ties) would alter people's experiences and behavior in ways predicted by positivity resonance theory. Specifically, Hypothesis (H) 1 stated that, relative to the monitoring passive control group, the two social connectedness groups would show elevations in daily reports of perceived positivity resonance (Figure 1a, Path H1). Support for H1 could be evident as higher mean levels of perceived positivity resonance (i.e., a main effect of group), increasing levels over time (i.e., a Group × Time interaction), or both. Second, H2 stated that, again relative to the monitoring passive control group, the two social connectedness groups would show differences in daily reports of prosocial and self-centered tendencies (Figure 1a, Path H2), again evident as differences in mean levels (i.e., main effects of group), changing levels over time (i.e., Group × Time interactions), or both.

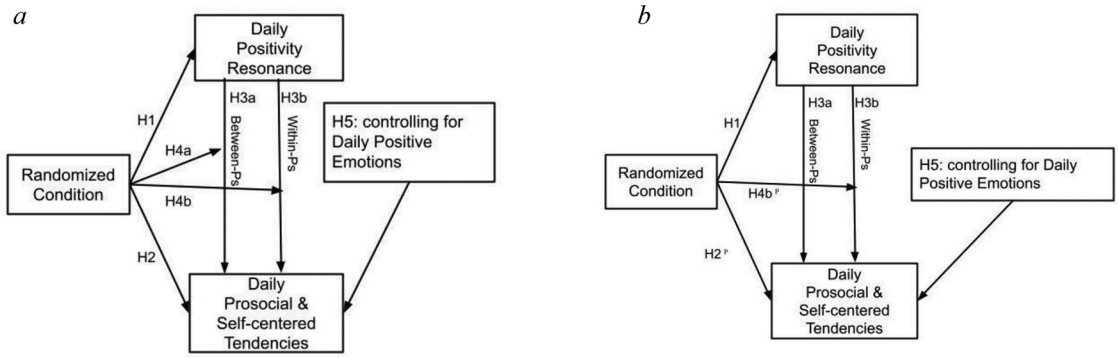
Third, we predicted "dose-response" relations between positivity resonance on the one hand and tendencies for prosociality and self-centeredness on the other. We partitioned the variance associated with these dose-response relations into between-persons effects (reflecting individual differences) and within-persons effects (reflecting day-to-day processes), the latter of which better match theoretical questions about change over time (Curran & Bauer, 2011). Specifically, H3a stated that individuals who, on average, experienced more positivity resonance (relative to other individuals) would enact and experience more prosocial and fewer self-centered tendencies (between-persons effects; Figure 1a, Path H3a). In addition, H3b stated that on days in which individuals experienced more positivity resonance (relative to other days), they would enact and experience more prosocial and fewer self-centered tendencies (within-persons effects; Figure 1a, Path H3b).

Fourth, we predicted that the hypothesized between- and within-persons dose-response effects (cf., H3a and H3b) would be strengthened by the two variants of the social connectedness intervention. This prediction is based on the broader assumption that positivity resonance and prosocial tendencies mutually influence one another in an upward spiral dynamic, as is common among positive psychological processes (Fredrickson & Joiner, 2018). Accordingly, as the connectedness intervention increases prosocial tendencies (cf., H2), these new habits of being virtuously oriented toward others may function as vantage resources that sensitize individuals to subsequent opportunities to forge positivity resonance (Van Cappellen et al., 2018), the product of which would be a tightened coupling between these two constructs. Thus, as people are encouraged through the interventions to prioritize social connection, the links between positivity resonance and prosociality should strengthen. Accordingly, H4 stated that, relative to the monitoring passive control group, the two types of dose-response relations (i.e., between persons and within persons) that link positivity resonance to prosocial tendencies would be larger for those randomized to the social connectedness groups (Figure 1a, Paths 4a and 4b, respectively). H4 extends to test whether similar dynamics also emerge, inversely, for self-centered tendencies.

Finally, we continued the effort to establish the unique nomological network of the collective-level construct of positivity resonance as distinct from individual-level affective phenomena. This effort is especially important given extensive early evidence that individual-level positive affect predicts prosocial tendencies (Carlson et al., 1988; Isen, 1987). Accordingly, H5 stated that any effects of perceived positivity resonance observed in tests of H3a,

[2] We underscore that the behavioral intervention targeted social connectedness and did not describe the affective state of positivity resonance per se or unpack its defining features. To do so not only could risk drawing unhelpful explicit attention to automatic social processes (like thinking too much about how to ride a bike) but could also backfire, as has been demonstrated when people strive to maximize their own happiness during positive situations (Mauss et al., 2011).

Figure 1
Conceptual Model of Hypothesized Relations



Note. 1a: Hypothesized pathways. 1b: Empirically supported pathways. In Figure 1b, all represented paths received full empirical support unless marked with the superscript P to indicate partial support. "Between-Ps" and "within-Ps" refer to between-persons and within-persons effects, respectively. H = hypothesis. For H2, only the social connectedness-weak ties group showed higher mean levels of prosocial tendencies relative to the monitoring passive control group. For H4b, the two social connectedness interventions only strengthened the within-persons dose-response relation linking positivity resonance to prosocial tendencies (and not self-centered tendencies), relative to both the monitoring passive control group and the mindfulness active control group.

H3b, H4a, and H4b would show independence from the effects of positive and negative emotions.

In addition, we tested two ancillary research questions (RQs): Does targeting the social connectedness intervention to weak ties yield greater benefits than a variant of the intervention described in more general terms (RQ1)? Does an active control group focused on mindfulness differ from other randomized groups (RQ2)?

Method

Participants

Using flyers and email listservs, we invited community members from and near the University of North Carolina at Chapel Hill to register their interest in participating in the "Daily Wellness Study" via a study-specific website. Advertisements indicated that individuals were eligible if they were between the ages of 20 and 65, working part- or full-time, not currently an undergraduate student, and able to access to a computer or mobile device at home. Graduate students were eligible, the majority of which were categorized as full-time employees of the university.

Based on a priori power calculations, our target sample size was 360. For these, we ran Monte Carlo simulations for the planned multilevel models (see "Data Analytic Plan") and determined that power at this sample size was excellent for all parameters (ranging from 90% to 96%), assuming moderate effect sizes and 20% attrition. Nevertheless, because interest in the study was high and resources were available, we increased the target sample size to 400 (prior to initiating data analysis). Although we received initial interest from 502 eligible individuals, many decided they were too busy or did not respond to multiple emails. Ultimately, we inadvertently overshot our target stopping rule, and 416 were randomized to one of the four groups. Because all hypotheses tested here rest on densely repeated daily data, we only included participants who provided at least one nightly report which left us with an analysis sample of N = 405 participants (M_{age} = 33.84, SD_{age} = 11.22). Eighty-one percent identified as women, 68% as White, 13% as Black or African American, 8% as Asian, and 7% as Hispanic, Latinx, or Spanish. We note that, for specific statistical models, sample sizes are lower than 405 because, following best practices (Bollen, 1989, p. 243), participants with few nightly reports were excluded based on the number of parameters estimated at the within-persons level in each model. Details of exclusion criterion and model-specific sample sizes are provided in the "Results" section. Participants received up to $100 in cash compensation for their involvement, plus chances to win a $100 Visa gift card based on the number of nightly reports completed.

Procedure

The institutional review board of the University of North Carolina at Chapel Hill approved all procedures for the study (Study 18–2810). Participants were invited to complete a preintervention online survey, 35 consecutive brief nightly online self-reports, a postintervention online survey, and a postintervention in-person laboratory testing session to collect behavioral and implicit dependent measures. Data were collected between March and November of 2019. Here, we present results based on the nightly reports. Data from the pre- and postintervention online survey and/or the laboratory testing session may be used for subsequent articles.

Behavioral Interventions

Participants were randomized to one of four conditions: either of the two experimental groups (social connectedness-general, social connectedness-weak ties) or either of the two control groups (monitoring passive control, mindfulness active control). Participants assigned to the two social connectedness groups were asked, via email, to view a short TEDx video (11 min, 38 s) that conveyed the value of day-to-day positive connections with others (https://www.youtube.com/watch?v=fHoEWUTYnSo). Beginning

the next morning, they received daily email reminders to try to experience more moments of connections with people. For the social connectedness-general group, additional instructions read, "This could be a shared smile with another person, a laugh with a friend or acquaintance, or a simple act of kindness." For the social connectedness-weak ties group, additional instructions placed emphasis on people "outside your close circle of friends and family." Participants randomized to the mindfulness active control group were asked, via email, to view a different short TED video (9 min, 24 s) that conveyed the value of mindful awareness (https://www.youtube.com/watch?v=qzR62JJCMBQ). Beginning the next morning, they received daily email reminders to "try to experience more moments of mindfulness, taking time to pay attention to the present moment, throughout your day. You could practice mindfulness during routine activities, while you wait in line or are stuck in traffic, or during short breaks at work."

Nightly Online Self-Reports

Emotions. Each evening, participants indicated the degree to which they experienced pleasant and unpleasant emotions that day. Patterning the modified Differential Emotions Scale (Fredrickson, 2013), participants were informed that "pleasant emotions may include amusement, awe, gratitude, hope, inspiration, interest, joy, love, pride, or serenity" and that "unpleasant emotions may include anger, shame, contempt, disgust, embarrassment, guilt, hate, sadness, fear, or stress." Participants used a 5-point Likert scale (1 = *not at all*, 5 = *extremely*) to indicate the greatest degree to which they experienced pleasant and unpleasant emotions that day. The method asking respondents to report on peak emotions within a time-limited period (i.e., "today") capitalizes on the empirically established superiority of memory for affective peaks (and ends) relative to global reports that implicitly require the integration of affect duration, which tends not to be encoded (Fredrickson, 2000; Fredrickson & Kahneman, 1993).

Positivity Resonance. Participants reported the affective quality of specific episodes of interpersonal interaction each day using the Perceived Positivity Resonance Scale (Major et al., 2018). These episodic self-reports followed the event reconstruction method (Grube et al., 2008; Schwarz et al., 2009), which has been empirically established to approximate the psychometric properties of ecological momentary assessment by attenuating reporting biases related to social desirability, self-presentation, and reliance on semantic memory (Robinson & Clore, 2002; Schwarz et al., 2009). First, respondents were asked to "think back to the single longest interaction you had with one or more strangers or acquaintances [close others] today. Take a moment to recall and mentally relive this event, including how the event unfolded, what time of day it was, and what it was like." Then, the quality of coexperienced affect was captured with the seven items of the Perceived Positivity Resonance Scale (Major et al., 2018). Sample items included "For what proportion of time during this episode (from 0 to 100%) did you experience a mutual sense of warmth and concern toward one another?" and "For what proportion of time during this episode (from 0 to 100%) did you feel 'in sync' with the other(s)?"[3] Omega's coefficients were calculated at both between- and within-persons levels using Mplus: between-persons $\omega = .998$; within-persons $\omega = .875$ (Geldhof et al., 2014).

Prosocial Tendencies. We assessed participants' enacted and experienced prosocial tendencies (i.e., spirituality, altruism, humility) by assessing their degrees of agreement or disagreement with various statements about their day on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items for spirituality were "Today, I set aside time for an activity that I consider spiritual" (enacted) and "Today I had a feeling of strong connection to all life" (experienced; based on Underwood & Teresi, 2002). Items for altruism were "Whether it was big or small, I went out of my way to help someone today" (enacted) and "I felt compassion for others today" (experienced; based on Rushton et al., 1981). Items for humility were "Today I let others take the credit or enjoy the spotlight" (enacted) and "Today I felt that I have both many strengths and flaws" (experienced; based on Kruse et al., 2017).

Self-Centered Tendencies. Using a similar format, participants indicated their degrees of agreement or disagreement (1 = *strongly disagree*; 7 = *strongly agree*) with various statements about their day that described enacted and experienced self-centered tendencies. Items for materialism were "Today I bought things that I do not really need" (enacted) and "Today I felt admiration or envy for people who own expensive homes, cars, and clothes" (experienced; based on Richins, 2004). Items for hostility were "Today I got into arguments with people" (enacted) and "Today I felt very bitter about things" (experienced; based on Bryant & Smith, 2001). Items for entitlement were "Today I demanded the best because I'm worth it" (enacted) and "Today I felt that I deserve more things in my life" (experienced; based on Campbell et al., 2004).

Other items in the nightly reports referred to diet and physical activity, perceived stress, loneliness, depressive symptoms, and perceived incivility. These are beyond the scope of the current study but may contribute to subsequent articles.

Data Analytic Plan

We used multilevel dynamic structual equation models throughout. These are comparable to multilevel structural equation models but with the additional capacity to estimate autoregressive effects common in intensive longitudinal data (which cannot be accommodated in the multilevel structural equation model framework). For model estimation, due to the potential convergence and intractable issues with traditional methods like maximum likelihood, we used Bayesian Markov chain Monte Carlo estimator in Mplus (MCMC; Asparouhov et al., 2018; Muthén & Muthén, 1998–2017) for all models (Asparouhov et al., 2018; McNeish & Hamaker, 2020). Compared to a traditional frequentist method like maximum likelihood, Bayesian MCMC provides an entire distribution of possible values for each parameter of interest based on information from the observed data (or posterior distributions) rather than a single point estimate. For convenience of reporting results, each posterior distribution is summarized by its median, akin to a point estimate for a given parameter. With Bayesian estimation, we relied on whether zero was within the 95% credible interval [CI] to determine whether

[3] Preliminary analyses revealed similar patterns of results across all hypotheses when positivity resonance with strangers/acquaintances was analyzed separately from positivity resonance with close others. For parsimony, all analyses reported below reflect the mean score across both categories of social partners.

an estimate is null in the population (McNeish & Hamaker, 2020). Accordingly, *p* values reported in the "Results" section provided by Mplus are analogous to one-tailed *p* values yet do not reflect the common interpretation of significance by a traditional frequentist *p* value. Instead, from a Bayesian estimator, a *p* value of .05 for a positive estimate of a target parameter suggests that 5% of the posterior distribution is below zero (McNeish & Hamaker, 2020). Similar to full information maximum likelihood, the Kalman filter used in these dynamic models compensated for missing data by making predictions for the next observation based on the lagged entries (McNeish & Hamaker, 2020); thus, the autoregressive effects of positivity resonance and latent prosocial and self-centered tendencies were also evaluated at the within-persons level.

In a preliminary measurement model, we assessed whether two latent variables would emerge from the six items assessing prosociality and (separately) the six items assessing self-centeredness both at the between-persons and the within-persons levels. To do so, we fit a lag-1 multilevel vector autoregressive model (multilevel VAR[1]) in Mplus Version 8 (Muthén & Muthén, 1998–2017). All factor variances were fixed to 1 to free up the loadings of all items. Covariances between the two latent variables were estimated at both the between-persons and within-persons levels.

Then, we evaluated the effects of randomized group on mean levels and trajectories of positivity resonance (test of H1), as well as latent prosocial and self-centered tendencies (tests of H2) using the measurement models described above as outcome variables. We did so by using two separate multilevel VAR(1) models in Mplus Version 8. Groups (a four-level categorical variable) were added as three dummy variables in both models (the one left out is the reference group = monitoring passive control group).[4] These models estimated main effects of group and time, as well as Group × Time interactions on positivity resonance, prosocial tendencies, and self-centered tendencies, respectively. Because previous studies have shown that people report better moods, more positive emotions, and fewer negative emotions on the weekends (Ryan et al., 2010; Stone et al., 2012), all models controlled for the effects of weekend.

Next, we assessed the between-persons (tests of H3a) and within-persons (tests of H3b) dose-response relations that linked positivity resonance to both prosocial and self-centered tendencies by conducting two multilevel VAR(1) models in Mplus.[5] Due to differences in the numerical range between positivity resonance scores (0–100) and other variables (1–7), we divided positivity resonance scores by 10 before adding this variable to the models. The autoregressive effects of positivity resonance and of the focal latent outcome variable were also estimated in the model. To eliminate Nickell's bias and Lüdtke's bias for the autoregression effect (Asparouhov et al., 2018; Lüdtke et al., 2008; Nickell, 1981), we used the latent centering approach to partition the between-persons and within-persons effects in dose-response relations. In addition to positivity resonance, models also included time (day in the study) and weekend as covariates. To further test the effects of randomized group on the between-persons and within-persons dose-response relations identified above (tests of H4a and H4b, respectively), the interactions between group dummy variables and latent centered positivity resonance were added as predictors at both levels. Finally, to examine whether effects of positivity resonance on prosociality and self-centeredness are independent of positive and negative emotions (tests of H5), we controlled for positive and negative emotions in the models that tested H3 and H4.

Results

Data Cleaning

Among 416 participants who had completed some or all parts of the study, 405 participants completed at least some nightly reports, contributing 11,225 person-days in total. From these, we removed data for dates on which participants completed more than two nightly reports (n = 326 person-days). For dates on which people completed exactly two nightly reports (n = 1,608 person-days), we retained data if they fit one of two patterns. The first was a "night owl" pattern (n = 426 person-days) in which a date with two reports followed a date with missing data and had one entry before 12 p.m. and the other after 6 p.m. Because new survey links were emailed at 6 p.m. each day, we considered the first entry in these cases to be the report for the previous day. The second pattern (n = 453 person-days) did not follow a date with missing data yet had one entry between 12 p.m. and 6 p.m. and one after 6 p.m. In these cases, we simply removed the first entry. The cleaning process left us with a sample size of N = 405, person-days = 10,152.[6]

Descriptive Statistics

Across the usable nightly reports, participants completed on average 25 surveys (SD = 8.75, range = 1–35). For brevity, descriptive statistics are presented in online supplemental materials. Zero-order correlations among study variables are presented in Table S1 in the online supplemental materials. Means, standard deviations, and sample sizes (in person-days) are presented in Table S2 in the online supplemental materials. To infer the frequency of participants' daily interactions with strong and weak ties, respectively, we tallied the number of times, across the daily reporting period, that a respondent viewed the survey item about their longest interaction with a stranger/acquaintance (close other) yet skipped it. This pattern of missingness suggested that most participants interacted with both strong and weak ties each day. Specifically, only 7.65% of participants skipped the item about a strong tie interaction on at least one day, and only 12.59% of participants skipped the weak tie item (reflecting 0.7% and 0.9% of total person-days, respectively).

Measurement Models for Latent Prosociality and Latent Self-Centeredness

We first evaluated whether, as predicted, the six prosociality items (i.e., two each for spirituality, altruism, and humility) and six self-centeredness items (i.e., two each for materialism, hostility, and entitlement) yielded two latent factors, respectively, for prosocial tendencies and self-centered tendencies. Because these

[4] Therefore, in models to test H4a and H4b respectively, we created three product terms (of the dummy variables and positivity resonance) and added them as predictors at Level 2 to test the interaction between the randomized group and positivity resonance.

[5] Due to the complexity of the model, we ran the same model separately for each latent variable (i.e., prosociality, self-centeredness) with the same set of predictors to reduce computational burdens on the software as each model took around at least 10,000 iterations to converge.

[6] This is the total number of usable and observed nightly reports. The Kalman filter used in all dynamic models compensated for missing data and resulted in a higher number of person-days reported for all models.

models estimated 14 parameters for each person (i.e., six factor loadings and one autoregressive effect for each of two latent variables), the final analysis sample only included participants with at least 14 of the 35 days of daily reports (N = 351, n = 11,751). The lag-1 multilevel VAR(1) model with the Bayesian MCMC estimator (Asparouhov et al., 2018; Muthén & Muthén, 1998–2017) indicated that all but one factor loading for prosocial and self-centered tendencies at both between-persons and within-persons levels was positive (ps $< .001$; see Table S3 in online supplemental materials). The one exception was the factor loading for enacted entitlement at the within-persons level ("Today I demanded the best because I'm worth it"), which was negatively loaded (β = −.084, 95% CI [−.118, −.052], $p < .001$). However, the small size of this factor loading, compared to all other factor loadings, suggested that enacted entitlement would contribute little to the within-persons variance in latent self-centered tendencies. Given that the between-persons factor loading for this item was positive, as expected, we decided to retain the item in subsequent models. The correlations between latent prosocial tendencies and latent self-centered tendencies were −.19 at the between-persons level and −.43 at the within-persons level (both ps $< .01$). These small-to-moderate negative correlations suggest that prosociality and self-centeredness are independent constructs rather than opposite ends of a single bipolar construct.

Hypothesis 1: Intervention Effects on Positivity Resonance

We predicted that, relative to the monitoring passive control group, the two social connectedness groups would show increases in perceived positivity resonance, evident as higher mean scores (i.e., a main effect of group), increasing scores over time (i.e., a Group × Time interaction), or both (Figure 1a, Path H1). We tested this hypothesis by first fitting a lag-1 multilevel vector autoregressive (multilevel VAR[1]) model for participants' positivity resonance scores over the 35 days. Time was included as a Level-1 predictor, and intervention groups were dummy-coded as three variables (reference group = monitoring passive control) and included as Level-2 predictors, while controlling for the effect of weekend on Level 1. Because three parameters (time, weekend, and autoregressive effects) were estimated at the within-persons level, the final analyses only used data from participants with at least three nightly reports (N = 390, n = 12,472 person-days). Results indicated a significant and positive autoregressive effect (B = .156, 95% CI [.128, .185], β = .156, $p < .001$) but no significant main effects of randomized group, time, or weekend on mean levels of positivity resonance (see Figure 2a). The autoregressive effect suggests that a 1-unit increase in positivity resonance on the previous day is associated with a .156-unit increase in positivity resonance on the current day. However, a significant Group × Time interaction on levels of positivity resonance did emerge, specifically for the social connectedness-weak ties group (B = .149, 95% CI [.043, .254], β = .184, p = .003) and the mindfulness active control group (B = .114, 95% CI [.012, .218], β = .143, p = .015), which is illustrated in Figure 2b. We used computational tools for probing interaction effects in multilevel models, developed by Preacher et al. (2006). From this, we discovered that the simple slopes of time (reported in parentheses below) were significant for participants randomized to the social connectedness-weak ties group (b = .158, $p < .001$, 95% CI [.088, .233]), the social connectedness-general group (b = .087, p = .010, 95% CI [.012, .162]), and (unexpectedly) the mindfulness active control group (b = .124, $p < .001$, 95% CI [.053, .196]). Plus, these three simple slopes did not differ significantly from each other. By contrast, the simple slope of time was not significant for those randomized to the monitoring passive control group (b = .009, p = .398, 95% CI [−.062, .081]). This pattern of results supports H1, which predicted that the two variants of the social connectedness intervention would show elevations in nightly reports of positivity resonance, whereas those in the no-intervention monitoring passive control group would not. The model explained 3.24% of the variance in positivity resonance, suggesting a small effect size of intervention groups (Cohen, 1992; Snijders & Bosker, 2012).

Hypothesis 2: Intervention Effects on Prosociality and Self-Centeredness

Effects on Prosociality

We predicted that, relative to the monitoring passive control group, the two social connectedness groups would show increases in latent prosocial tendencies, evident as higher mean scores (i.e., a main effect of group), increasing scores over time (i.e., a Group × Time interaction), or both (Figure 1a, Path H2). To test this hypothesis, we fit a lag-1 multilevel vector autoregressive (multilevel VAR[1]) dynamic structural equation model with the Bayesian MCMC estimator (Asparouhov et al., 2018; Muthén & Muthén, 1998–2017) including group, time, and the Group × Time interaction as predictors of latent prosocial tendencies. Because 18 parameters were estimated at the within-persons level, the final analyses only used data from participants with at least 18 nightly reports (N = 329, n = 11,000 person-days).[7] Results indicated a significant and positive autoregressive effect (B = .256, 95% CI [.210, .300], β = .256, $p < .001$), plus a significant main effect of group (B = .410, 95% CI [.075, .824], β = .123, p = .009). The autoregressive effects revealed that prosocial tendencies at time t-1 can positively predict prosocial tendencies at time t. Compared to the monitoring passive control group, only participants randomized to the social connectedness-weak ties group reported higher mean levels of prosocial tendencies. No main effect of time or Group × Time interaction emerged, suggesting no effect of randomized group on the trajectory of prosocial tendencies over time. In addition, the results suggested a main effect of weekend on prosocial tendencies such that people showed lower levels of prosocial tendencies on weekends compared to weekdays (B = −.065, 95% CI [−.132, −.001], β = .026, p = .024). This pattern of results provides initial support for H2, which was theory based.

Effects on Self-Centeredness

We also predicted that, relative to the monitoring passive control group, the two social connectedness groups would show decreases in

[7] For each person (within-persons level), 18 parameters included six loading estimates for prosocial tendencies, the estimated autoregressive effect for prosocial tendencies, and the estimated effects of time and weekend on prosocial tendencies. These parameters were also estimated for self-centeredness, creating a total of 18 parameters.

Figure 2

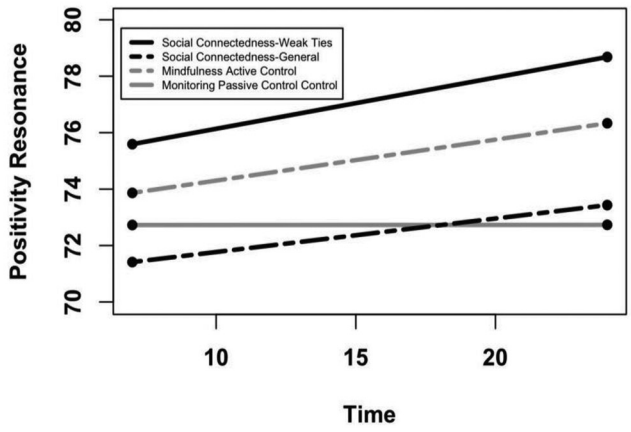
H1 Model Estimates and Illustration of the Group × Time Interaction Across 35 Nightly Reports of Positivity Resonance

a

Dependent Variable: Positivity Resonance (H1)

	β	*Posterior SD*
PosRes_t+1	0.156	0.013
Weekend	-0.012	0.010
Time	0.065	0.009
SC_Weak Ties	0.032	0.047
Mindfulness	0.006	0.047
SC_General	-0.037	0.055
SC_General X Time	0.096	0.064
SC_Weak Ties X Time	0.184*	0.063
Mindfulness X Time	0.143*	0.064
Intercept	5.054*	0.232

b



Note. 2a: Model estimates. 2b: Group × Time interaction. Analysis sample size n = 12,472 person-days. PosRes_t + 1 = positivity resonance reported at the next day; SC_general = social connectedness-general group; SC_Weak Ties = social connectedness-weak ties group. Simple slopes and simple intercepts were estimated from the model summarized in Figure 2a (test of H1). All slopes were significant except the slope of the monitoring passive control group. The results suggested that compared to the monitoring passive control group, all the other groups showed significant increases in positivity resonance over time.
* Indicates significant results (95% credible interval does not include zero).

latent self-centered tendencies, evident as lower mean scores (i.e., a main effect of group), decreasing scores over time (i.e., a Group × Time interaction), or both (Figure 1a, Path H2). Using the same model as above, results indicated a significant and positive autoregressive effect for latent self-centered tendencies (B = .280, 95% CI [.230, .330], β = .278, $p < .001$). The autoregressive effects again suggested that levels of self-centered tendencies on one day can be positively predicted by previous-day self-centered tendencies. Yet no main effect of time, group, or Group × Time interaction emerged, suggesting no effect of randomized group on self-centered tendencies. The results offer no additional support for H2 and instead underscore the independence of prosociality and self-centeredness.

Hypotheses 3a and 3b: Dose-Response Relations

We also predicted person-level associations while controlling for randomized group. H3a predicted a between-persons dose-response relation such that individuals who, on average, reported more positivity resonance (relative to average individuals) would manifest more prosocial and fewer self-centered tendencies (Figure 1a, Path H3a). H3b predicted an analogous within-persons dose-response relation such that on days in which individuals reported more positivity resonance (relative to their own average across days), they would manifest more prosocial and fewer self-centered tendencies (Figure 1a, Path H3b). Two separate multilevel VAR(1) models with Bayesian MCMC estimator (Asparouhov et al., 2018; Muthén & Muthén, 1998–2017) were conducted to test for between-persons and within-persons effects of positivity resonance on the latent variables for prosocial tendencies and self-centered tendencies, respectively. By the model default in Mplus, positivity resonance was latent centered to distinguish within-persons effects from between-persons effects. On the within-persons level, 11 parameters were estimated for each

individual.[8] Therefore, for the current model, only participants who had at least 11 nightly reports were retained, which left a sample size of $N = 359$ participants ($n = 11955$ person-days).

Between-Persons Effects

We conducted two separate multilevel VAR(1) models with positivity resonance as the predictor, the same set of covariates (group and weekend), and different outcomes variables (prosocial tendencies or self-centered tendencies). Time was also included as a random effect to model the varying trends across 35 days for each participant. In addition, the model included the autoregressive effects for both positivity resonance (i.e., positivity resonance regressed on lag-1 positivity resonance) and the focal outcome variable, which were also allowed to vary across individuals. In the first model, the latent variable of prosocial tendencies was the outcome variable. Figure 3 presents the model estimates (for both H3 and H4 when the outcome variable is prosocial tendencies). Results indicated that the between-persons effect ($B = .193$, 95% CI [.086, .311], $\beta = .152$, $p < .001$) was statistically significant and positive for a "dose" of positivity resonance on the "response" of prosocial tendencies. To illustrate the between-persons effect, individuals who scored 1 unit higher on positivity resonance, relative to the average of other individuals, were .152 units higher on latent prosocial tendencies (supporting Path H3a). In the second model, the latent variable of self-centered tendencies was the outcome variable. Figure S1 in the online supplemental materials presents the model estimates. Results indicated that the between-persons effect ($B = -.244$, 95% CI [−.415, −.069], $\beta = -.247$, $p = .002$) was negative and statistically significant for a "dose" of positivity resonance on the "response" of self-centered tendencies. To illustrate the between-persons effect, individuals who scored 1 unit higher on positivity resonance, relative to the average of other individuals, were .247 units lower on latent self-centered tendencies (also supporting Path H3a). Thus, considering prosociality as well as self-centeredness, H3a was fully supported.

Within-Persons Effects

The same models described above also tested the within-persons effects of positivity resonance on latent prosociality and self-centeredness, respectively. The findings revealed a statistically significant and positive within-persons effect of positivity resonance on prosocial tendencies ($B = .310$, 95% CI [.266, .354], $\beta = .393$, $p < .001$), which reflected that days characterized as 1 unit higher on positivity resonance, relative to this individual's average day, were .393 units higher on latent prosocial tendencies (supporting Path H3b). In addition, the within-persons effect was also statistically significant and negative for self-centered tendencies ($B = -.344$, 95% CI [−.345, −.251], $\beta = -.295$, $p < .001$), which reflected that days characterized as 1 unit higher on positivity resonance, relative to one's average day, were .295 units lower on latent self-centered tendencies (also supporting Path H3b). Thus, considering prosociality as well as self-centeredness, H3b was fully supported.

Hypotheses 4a and 4b: Intervention Effects on Dose-Response Relations

Between-Persons Effects

We predicted that, relative to the monitoring passive control group, the two social connectedness groups would show stronger between-persons dose-response relations from positivity resonance to the latent indices of prosociality and self-centeredness, respectively (Figure 1a, Path H4a). To test this hypothesis, we extended the models used to test H3a above to include the experimental group interaction effects with latent positivity resonance. Results showed a significant interaction between randomized group and latent positivity resonance. Specifically, the mindfulness active control group, but neither of the social connectedness groups, showed a stronger between-persons effect of positivity resonance on prosocial tendencies ($B = .224$, 95% CI [.028, .426], $\beta = .380$, $p = .012$) compared to the monitoring passive control group, an unexpected effect. When the outcome variable was latent self-centered tendencies, results showed no interactions between randomized group and the latent centered positivity resonance variable. H4a therefore received no support.

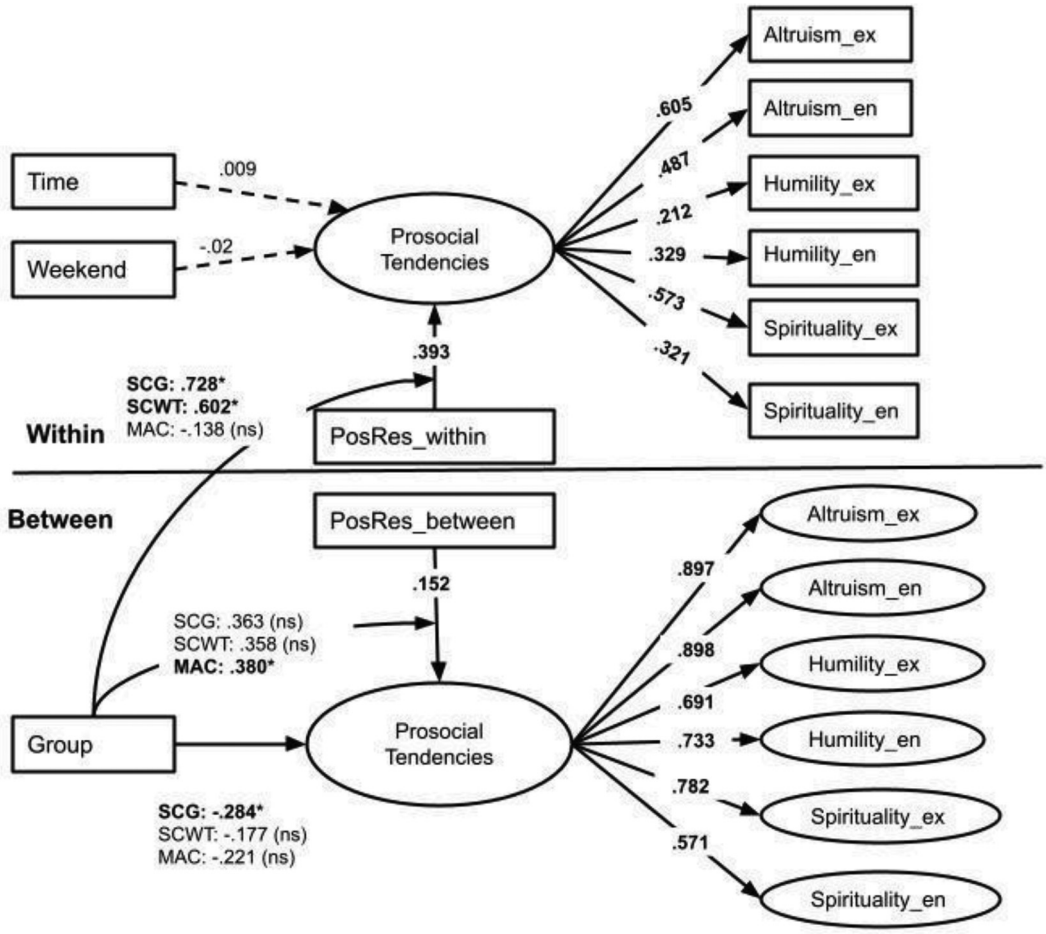
Within-Persons Effects

Analogously, we predicted that, relative to the monitoring passive control group, the two social connectedness groups would show stronger within-persons dose-response relations from positivity resonance to the latent indices of prosociality and self-centeredness, respectively (Figure 1a, Path 4b). Patterning the analysis above, to test this hypothesis, we extended the models used to test H3b to include the randomized group interaction effects with the latent centered positivity resonance. In the model that used latent prosocial tendencies as the outcome variable, results showed that randomized group significantly interacted with the latent centered positivity resonance. Specifically, both social connectedness groups showed significantly stronger within-persons effects of positivity resonance on prosocial tendencies compared to the monitoring passive control group (see Figure 4; weak ties: $B = .068$, 95% CI [.019, .146], $\beta = .602$, $p = .015$; general: $B = .083$, 95% CI [.004, .131], $\beta = .728$, $p = .005$). The simple-slope analyses suggested that although all simple slopes for the within-persons effects of positivity resonance on latent prosociality were significantly different from zero for all groups, the effects were stronger in both social connectedness groups compared to the monitoring passive control group (general: $b = .393$, 95% CI [.345, .441]; weak ties: $b = .378$, 95% CI [.330, .426]; $ps < .001$), whereas the within-persons effects of positivity resonance on prosocial tendencies were not distinguishable between the two control groups (mindfulness active control: $b = .295$, [.250, .341]; monitoring passive control: $b = .310$, [.266, .354]; both $ps < .001$; further comparison of the simple slopes between the experimental groups were later tested in RQ1). In the analogous model that used latent self-centered tendencies as the outcome variable, no significant interactions between randomized group and the latent centered positivity resonance emerged (see Figure S1 in online supplemental materials). This pattern of results provides support for the theory-guided aspect of H4b that the social connectedness interventions would increase the within-persons dose-response relation between positivity resonance to prosociality. However, the analogous effect of the interventions

[8] In each model for each person (within-persons level), the 11 parameters included six loading estimates for prosocial tendencies (or self-centered tendencies), the estimated autoregressive effects for both prosocial tendencies (or self-centered tendencies) and positivity resonance, and the estimated effects of time, weekend, and positivity resonance on prosocial tendencies (or self-centered tendencies).

Figure 3

The Lag-1 VAR(1) Model Estimates of the Dose-Response Relations Linking Positivity Resonance to Prosocial Tendencies (for Both H3 and H4)



Note. The group variables were dummy coded with the monitoring passive control group as the reference group; therefore, three estimates are presented for each main effect and interaction that involve groups, indicating the difference between one group versus the reference group. Solid lines indicate significant effects (or at least one for group variables), and dashed lines indicate nonsignificant effects (or all nonsignificant for group variables; the Bayesian estimator does not rely on one-tailed p values but rather 95% credible intervals). _ex = experienced; _en = enacted; PosRes_within = latent centered positivity resonance at within-persons level; PosRes_between = latent centered positivity resonance at between-persons level; SCG = social connectedness-general group; SCWT = social connectedness-weak ties group; MAC = mindfulness active control group. For group variables with at least one significant result, we used "ns = nonsignificant, * = significant" to distinguish group differences.

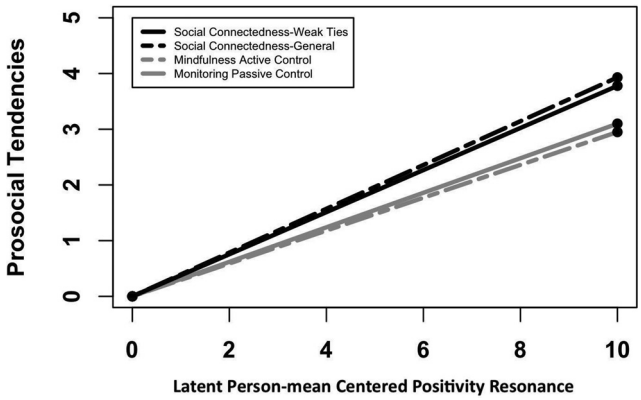
on the link between positivity resonance and self-centeredness was not supported, which again points to the independence of prosociality from self-centeredness.

H5: Independent Effects of Positivity Resonance From Individual-Level Emotions

To explore whether any effects of positivity resonance (i.e., paths H3a and H3b or moderation of them by paths H4a and H4b) were independent from individual-level positive and negative emotions (H5), we added latent-centered positive and negative emotions as additional predictors at between-persons and within-persons levels in the models used to test dose-response relations (see Figures S2 and S3 in the online supplemental materials). The pattern of results supporting paths H3a and H3b remained unchanged when we accounted for the variances explained by positive and negative emotions. Results for prosocial tendencies are presented in Figure S2 in the online supplemental materials), and those for self-centered tendencies are presented in Figure S3 in the online supplemental materials. The two exceptions were that (a) the unexpected effect that the mindfulness active control group produced a stronger (relative to the monitoring passive control group) between-persons dose-response relation linking positivity resonance to prosocial tendencies was reduced to nonsignificance (B = .055, 95% CI [−.168, .290], β = .095, p = .315) and that (b) the expected effect that the social connectedness-general group produced a stronger (relative to the monitoring passive control group) within-persons dose-response relation linking positivity resonance to prosocial tendencies was

Figure 4

Illustration of the Interaction Between Randomized Group and Latent Centered Positivity Resonance at Level 1 Predicting Latent Prosocial Tendencies (i.e., Within-Persons Effect)



Note. Simple slopes and simple intercepts were estimated from the model used to test H4b. All slopes were significant. The results suggested that compared to the monitoring passive control group, both social connectedness groups showed significantly stronger within-persons links from positivity resonance to prosocial tendencies. No differences were found between the mindfulness active control group and the monitoring passive control group.

also reduced to nonsignificance, $B = .064$, 95% CI [−.003, .133], $\beta = .568$, $p = .031$ (see Figure S2).[9] In addition, we found significant between-persons and within-persons effects of both positive and negative emotions. Specifically, regarding within-persons effects, on days when individuals experienced greater positive emotions and less negative emotions (relative to other days), they also reported higher levels of prosocial tendencies (positive emotion: $B = .598$, 95% CI [.551, .647], $\beta = .448$, $p < .001$; negative emotion: $B = -.175$, 95% CI [−.216, −.135], $\beta = -.131$, $p < .001$). Regarding between-persons effects, averaged across the 35 days, individuals who, relative to other individuals, experienced higher levels of positive emotions (unsurprisingly) and higher levels of negative emotions (surprisingly) showed higher levels of prosocial tendencies.

Ancillary Analyses

For brevity, ancillary analyses are only summarized in Table 1, with details provided in the online supplemental materials (Section 2). The bottom line was that, compared to the general variant of the intervention, the weak ties variant tended to show bigger effects on prosocial tendencies (cf., H2), which at times exceeded both active and passive control groups (cf., H4b).

Discussion

We used two variants of a modest behavioral intervention that targeted social connectedness to test the causal prediction, drawn from the positivity resonance theory, that daily experiences of love, the emotion (or positivity resonance), build individual-level resources—namely, prosocial tendencies—that stand to facilitate the flourishing of whole communities. In parallel, we tested whether daily experiences of positivity resonance also reduce individuals' self-centered tendencies, which may detract from community flourishing. We targeted self-centered rather than antisocial tendencies because the latter are rare in daily life. Interestingly, in contrast to behavioral and neurohormonal evidence for prosocial and antisocial behavior being at opposite ends of a single "caring continuum" (Marsh, 2019), our data suggest that prosocial and self-centered tendencies are not strongly negatively correlated (i.e., $r = -.19$ between persons and $r = -.43$ within persons). These and other findings suggest that, in daily life, prosociality and self-centeredness tend to vary independently rather than inversely.

Of the five hypotheses tested, three received full support and two received partial support, with hypothesized relations evident for prosociality but not self-centeredness (see Figure 1b). We underscore that all tests of hypothesized group differences compared participants randomized to the two experimental groups to those randomized to the passive control group. Comparisons to the active control group, which can rule out mere treatment effects, are summarized as ancillary analyses undertaken to address RQ2. Our first prediction, that the social connectedness interventions would elevate positivity resonance (H1), received full support: Significant group differences in trajectories of day-to-day positivity resonance emerged, with each variant of the intervention (general and weak ties) producing increases over time in positivity resonance that were absent in the no-intervention control group (depicted in Figure 2b). Extending past research that showed that even brief social interactions can induce positive emotions (Epley & Schroeder, 2014; Sandstrom & Dunn, 2014a), the current study showed that such interactions also induce perceptions of coexperienced positive emotions. Our second prediction, that the social connectedness interventions would elevate prosociality and reduce self-centeredness (H2), received partial support: Only the weak ties variant of the intervention showed higher mean levels of prosocial tendencies compared to the no-intervention control group. As added evidence that prosociality is not simply the inverse of self-centeredness, no predicted reductions or lower mean levels in self-centered tendencies were evident.

Our third prediction, which received full support, concerned the dose-response relations, both between persons (H3a) and within persons (H3b), that linked positivity resonance to prosociality and self-centeredness, irrespective of randomized group. Whereas between-persons effects reflect individual differences, within-persons effects reflect day-to-day processes, which can provide greater insight into people's prospects for increasing their well-being. Fully supporting H3a, significant between-persons effects emerged for both prosociality and self-centeredness. Specifically, individuals who reported more positivity resonance compared to an average person also reported more prosocial tendencies and fewer self-centered tendencies. Fully supporting H3b, significant within-persons effects also emerged for both prosociality and self-centeredness. Specifically, on days during which people reported more positivity resonance than their own average across days, they also reported more prosocial tendencies and fewer self-centered tendencies.

Our fourth prediction, which received support for prosociality only, concerned whether prioritizing connectedness would tighten the

[9] Recall that the Bayesian estimator does not rely on one-tailed p values but rather 95% credible intervals. If the 95% credible interval includes zero, the result is not significant.

Table 1
Summarized Results for RQ1 and RQ2

Hypothesis	Analyzed outcome variable	Result
	RQ1: SC-general vs. SC-weak ties (ref)	
H1: Positivity resonance	Mean levels	*ns*
	Growth trajectory	*ns*
H2: Prosocial	Mean levels	Weak ties > general
	Growth trajectory	*ns*
H2: Self-centered	Mean levels	*ns*
	Growth trajectory	*ns*
H4a: Between-persons effects of PosRes	Prosocial	Weak ties < general[a] (neither was different from MPC)
	Self-centered	*ns*
H4b: Within-persons effects of PosRes	Prosocial	*ns*
	Self-centered	*ns*
	RQ2: SC-general vs. MAC (ref); SC-weak ties vs. MAC (ref)	
H1: Positivity resonance	Mean levels	*ns*
	Growth trajectory	*ns*
H2: Prosocial	Mean levels	MAC ≈ weak ties; MAC > general
	Growth trajectory	*ns*
H2: Self-centered	Mean levels	*ns*
	Growth trajectory	*ns*
H4a: Between-persons effects of PosRes	Prosocial	*ns*
	Self-centered	*ns*
H4b: Within-persons effects of PosRes	Prosocial	MAC < weak ties[b]; MAC < general[b]
	Self-centered	*ns*

Note. H = hypothesis; RQ = research question; ref = reference group; PosRes = positivity resonance; MPC = monitoring passive control group; MAC = mindfulness active control group; SC-General = social connectedness-general group; SC-Weak Ties = social connectedness - weak ties group; *ns* = nonsignificant. > indicates stronger effects, and < indicates weaker effects. ≈ indicates no differences. Details can be found in the online supplemental materials
[a] The group difference was reduced to nonsignificant when we controlled for individual-level emotions to test H5. [b] The group difference remained significant when we controlled for individual-level emotions to test H5.

coupling of these dose-response relations, which may reflect an underlying upward spiral dynamic of mutual influence between positivity resonance and prosocial tendencies. Compared to the no-intervention control group, neither variant of the intervention had an impact on the between-persons dose-response relations (failing to support H4a; but see discussion of RQ2 below). By contrast, both variants of the intervention (general and weak ties), compared to both control groups (monitoring passive control [H4b] and mindfulness active control [RQ2]), produced stronger positive within-persons dose-response relations linking positivity resonance on a given day to prosociality on that same day (depicted in Figure 4). Specifically, participants who made efforts to increase their social connectedness showed the strongest coupling of positivity resonance with prosocial tendencies on a given day. That is, for them, days with greater success in elevating positivity resonance above their average level were days with greater prosociality. H4b only received partial support, however, because the intervention had no evident impact on the significant negative within-persons dose-response relation that linked positivity resonance to self-centeredness. This pattern of support suggests that whereas the social connectedness interventions did not alter existing individual differences in dose-response relations, the interventions did function to amplify the cascading prosociality that followed from people's varying success in forging positive connections. Metaphorically, this represents a greater return on investment with plausible community-level benefits: On successful days, participants in the intervention groups got "more bang" in prosociality "for their buck" of positivity resonance, an effect likely to have benefited participants' communities.

Finally, regarding the fifth and last hypothesis, we learned that, as in past research on positivity resonance (Brown et al., 2021; Major et al., 2018; Otero et al., 2020; Prinzing et al., 2020; West et al., 2021), all dose-response relations for positivity resonance, irrespective of experimental group (i.e., H3a and H3b), remained independent of any associated increases in individual-level positive emotions (controlling for negative emotions). Independence from individual-level emotions was also established for the weak ties (yet not the general) variant of the social connectedness intervention (i.e., H4b for weak ties). This latter finding joins the evidence for H2 in suggesting that the weak ties variant of the connectedness intervention is more effective (than the general variant) in elevating prosocial tendencies. We speculate that this pattern of results may reflect that the affective quality of interactions with strangers and acquaintances (vs. close others) most contributes to people's overall beliefs about the goodness of community and humanity. On the whole, evidence for H5 helps to establish the unique contributions of the collective-level construct of positivity resonance as distinct from the individual-level construct of positive emotions. Given that positive affect is one feature of positivity resonance (albeit, when shared) and is well established as a precursor to prosocial behavior (Carlson et al., 1988; Isen, 1987), these data cleared a high bar for establishing independence of constructs.

Ancillary analyses addressed two research questions. With RQ1, we directly tested for differences between the two variants of the social connectedness intervention, suspecting that the weak ties variant would be more effective. That appears to be the case for prosocial tendencies (i.e., partial support for H2 was only evident for the weak ties variant). Yet the reverse difference emerged for the causal effect on the between-persons dose-response relation linking positivity resonance to prosociality (i.e., the general variant

of the intervention strengthened that dose-response link more than the weak ties variant), although we hasten to add that neither variant was distinguishable from the no-intervention control group (i.e., *ns* for H4a), and this difference between intervention variants did not survive when we controlled for individual-level emotions (test of H5). Regarding RQ2, the two variants of the social connectedness intervention rarely differed from the mindfulness active control group. The one exception was that both variants, relative to both control groups, significantly strengthened the within-persons dose-response relation that linked positivity resonance to prosociality (full support for H4b for prosocial tendencies). Plus, these stronger experimental effects remained significant when we controlled for individual-level emotions (test of H5). This suggests that, although mindful awareness may also elevate positivity resonance, the cascade of broader impacts may be greater for interventions focused directly on creating social connectedness. A priori, we did not anticipate that mindfulness, as an asocial intervention, would increase positivity resonance. In hindsight, however, we note that past research has found increases in trait mindfulness to be linked, indirectly, to increases in perceived social connection, as mediated by improvements in decentering, that is, identifying less with the contents of consciousness (Adair et al., 2018). We thus suggest that future researchers who test this or similar social connectedness behavioral interventions seek out a different active control comparison group.

The findings reported here provide proof of principle that a modest behavioral intervention that nudges people to create more positive social connections can, over time, cause increases in the collective affective state known as positivity resonance. Plus, when that intervention encourages people to focus their behavioral change efforts on those outside their circle of close others, this intervention also causes increases in a suite of prosocial tendencies indexed by people's engagement in spiritual, helpful, and humble behaviors and experiences of oneness, compassion, and humility. Results also showcase the positive links—evident both as differences between persons as well as day-to-day fluctuations within persons—between positivity resonance and this same suite of prosocial tendencies, alongside parallel negative links between positivity resonance and a suite of self-centered tendencies indexed by people's engagement in materialistic, argumentative, and demanding behaviors and experiences of envy, bitterness, and entitlement. Results reported here also provide proof of principle that both variants of the social connectedness intervention can strengthen the positive link, across days, between positivity resonance and the suite of prosocial tendencies described above, a consequential finding that emerged relative to the active control group as well as the passive control group. Importantly, the mechanisms by which the interventions translate into positivity resonance remain unknown. Future research is needed to test whether increases in positivity resonance reflect increases in the frequency or duration of day-to-day social episodes, increases in the affective quality of day-to-day social episodes, or both. Future research is also needed to assess whether increases in positivity resonance reported by individuals are also noted by, and beneficial to, those with whom these individuals interact.

Strengths of the current study include randomization to test causal effects, densely repeated measures over 35 days, and the relatively large sample size. Although reliance on self-report is often associated with reporting biases (e.g., related to memory distortion, experimenter demand, and social desirability), a strength of this study is the use of time-limited (i.e., targeting "today") and episodic assessments (i.e., the event reconstruction method for perceived positivity resonance; peak affect for emotion reports), which are known to attenuate such biases (Robinson & Clore, 2002; Schwarz et al., 2009). One limitation of this study concerns the conceptual closeness of "simple acts of kindness," mentioned briefly in the connectedness intervention, and altruism, one of the three prosocial tendencies assessed as an outcome of the intervention. Although we conceptualize simple kindness as effortless and cost-free (e.g., being friendly and respectful) and altruism as requiring greater engagement and costs (e.g., "I went out of my way"), we acknowledge that we do not know whether participants themselves saw this distinction. To explore whether this conceptual closeness may have accounted for the reported findings, we reran all models that used the index of latent prosocial tendencies with the two items for altruism removed. The overall pattern of results remained largely unchanged (for details, see Section 3 of online supplemental materials). Nevertheless, future tests of the connectedness intervention could thus be strengthened by omitting reference to "acts of kindness." Another limitation of this study is the inability of the sample to support tests of differences by gender or ethnicity. We also acknowledge that we assessed collective affective experiences by inquiring about only one individual's perspective. Future work could strengthen the evidence for claims made here by gathering data from the social collective.

We also note that the evidence for dose-response relations presented here does not support causal claims. Although randomization to either connectedness intervention strengthened a subset of these relations, the "dosage" of positivity resonance was self-selected by participants and not experimentally manipulated. Relatedly, although theory guides us to interpret positivity resonance as the "dose" and elevations in prosociality as the "response," because the evidence is correlational, we cannot rule out the possibility that prosociality is the "dose" and positivity resonance is the "response." We speculate, however, as stated in our motivation for H4, that reciprocal causality exists between positivity resonance and prosociality, reflecting upward spiral dynamics commonplace in positive psychological processes (Fredrickson & Joiner, 2018). If so, prosocial tendencies (which vary across both persons and days) may function as vantage resources that amplify subsequent experiences of positivity resonance (Van Cappellen et al., 2018). Nevertheless, future research could randomize participants to gradated frequencies of positivity resonance and/or prosocial acts to test causal claims directly.

Future research is also needed to identify the mechanisms through which experiences of positivity resonance may build prosocial tendencies. Candidate mediators include increases in self-transcendent emotions (Stellar et al., 2017; Van Cappellen et al., 2013), physiological down-regulation of negative affect (Fredrickson & Levenson, 1998; Yuan et al., 2010), an expanded breadth of attentional scope (Schmitz et al., 2009), and/or neural shifts in dynamic functional connectivity (Cohen, 2018).

The results of the experiment reported here have several theoretical implications. Most notably, evidence for H1 and H4b (in combination) supports the causal claim, drawn from the positivity resonance theory, that when people seek to raise the affective quality of their day-to-day social connections, they create positivity resonance (H1, supported relative to the passive control group), and as they do so, they strengthen the day-to-day coupling between positivity resonance and prosocial tendencies (H4b, supported relative

to both passive and active control groups for both variants of the intervention, effects that were independent of individual emotions for the weak ties variant). In plain terms, as individuals strove for more positive moments of connections with weak ties, they produced more everyday love, which came with more virtue—that is, more enacted and experienced spirituality, altruism, and humility. Consistent with theories of collective affect (Barsade & Gibson, 2012; Brown & Fredrickson, 2021; Goldenberg et al., 2020), positivity resonance sets off a rising tide of prosociality that stands to benefit whole communities. Moreover, evidence for H3a and H3b provide evidence consistent with the positivity resonance theory, that this form of collective positive affect, which varies across individuals and (within individuals) across days, rises and falls in step with variation in prosociality and self-centeredness.

This study also opens several avenues for future research. One unknown is whether increases in self-reported prosociality that follow from efforts to increase social connectedness indeed create behavioral shifts that benefit communities. Initial evidence consistent with community benefit comes from data our team collected early in the COVID-19 pandemic. Specifically, we found that perceived positivity resonance on a typical day in April of 2020 had an indirect effect, both cross-sectionally and longitudinally, on behaviors known to limit viral spread (e.g., handwashing, wearing face coverings) as well as on pandemic-related charitable behaviors, with each effect mediated by latent prosocial tendencies (West et al., 2021). These behaviors were self-reported, however. Future investigations can be strengthened by incorporating implicit and behavioral measures of targeted constructs.

Finally, the results presented here hold practical implications. A Gallup (2020) poll suggests that 40% of Americans rate morals in the United States as poor, and most (68%) see them as getting worse. Although the modest behavioral intervention tested here produced small effects for boosting levels of positivity resonance, future research could be undertaken to optimize intervention effectiveness by incorporating evidence-based design features established by communication science to raise the effectiveness of health communications. For instance, our postintervention user experience interviews revealed that study participants tended to "tune out" the daily email reminders because they were too frequent and did not change. In hindsight, our approach to reminders may have inadvertently reinforced impressions that the intervention was delivered by machines and not by humans. Communication scientists have discovered a range of design features, such as human imagery and testimonials, that increase the perception of being together with others (i.e., social presence), which in turn is known to increase the effectiveness of digital health interventions (Lazard et al., 2020). If deployed here, our modest intervention, for which the current study provides proof of principle, might pave the way for a scalable and low-cost digital wellness campaign that targets the affective quality of everyday interactions with strangers and acquaintances to raise prosocial virtues at a time when many Americans feel them to be lacking or waning.

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Received August 31, 2020
Revision received July 31, 2021
Accepted August 10, 2021 ■