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### Authors

Oravecz, Zita

Dirsmith, Jessica

Heshmati, Saeideh

et al.

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## Psychological well-being and personality traits are associated with experiencing love in everyday life

Zita Oravecz<sup>a,\*</sup>, Jessica Dirsmith<sup>b</sup>, Saeideh Heshmati<sup>c</sup>, Joachim Vandekerckhove<sup>d</sup>, Timothy R. Brick<sup>a</sup>

<sup>a</sup> Pennsylvania State University, University Park, PA 16802, United States

<sup>b</sup> Duquesne University, Pittsburgh, PA 15282, United States

<sup>c</sup> Claremont Graduate University, Claremont, CA 91711, United States

<sup>d</sup> University of California, Irvine, Irvine, CA 92697, United States



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### ABSTRACT

Everyday life presents many experiences that can make people feel connected to another and leave them feeling loved. We conducted two ecological momentary assessment studies ( $N = 52$  and  $N = 160$ ) to examine people's subjective perceptions of the impact of these experiences by capturing the extent to which they felt loved at several randomly sampled times during their daily life. Individual differences in loving feelings were characterized by baseline levels, within-person variabilities, and slow and fast time scale indicators of change. Results showed that there were considerable individual differences in these characteristics and these individual differences related systematically to both psychological well-being and personality: across two studies, higher felt love baseline levels were related to greater psychological well-being as well as to higher Extraversion personality scores, while people scoring high on Neuroticism showed lower baseline levels.

### 1. Introduction

A friendly chat with a neighbor, a co-worker offering to help out on a project, and a welcoming smile from a teacher. All of these are small but potentially profound momentary experiences that can make one person feel temporarily connected to another, and leave them feeling loved. It has long been established that humans thrive on social connectedness (see e.g., Baumeister & Leary, 1995), and languish in its absence. A lack of affiliation with others can lead to a rise in feelings of loneliness and social isolation, which has been linked to poorer health behaviors (i.e., smoking, physical inactivity, and poorer sleep) and problematic health outcomes such as higher blood pressure and poorer immune functioning (Cacioppo & Hawkley, 2009; Grant, Hamer, & Steptoe, 2009) as well as increased risk of early mortality (Holt-Lunstad, Smith, & Layton, 2010). In contrast, when people express mutual care and concern for one another (in a romantic or non-romantic context), these daily interpersonal interactions might result in the experience of momentary increases in feelings of love. We conceptualize love broadly in this paper and assume that it emerges from positivity resonance (Fredrickson, 2016). According to this framework, people experience positivity resonance in their daily lives via biobehavioral synchrony, shared momentary experiences of positive emotion, and mutual care. Positivity resonance has already been shown to

have an important impact on well-being (Major, Le Nguyen, Lundberg, & Fredrickson, 2018).

Researchers have long sought out ways to operationally define love and to ascertain different types of love. In what follows, we review how love has been studied in scientific research. We argue that while most of the empirical work has centered on romantic love, non-romantic love has also been considered in several studies. Moreover, in recent studies, the importance of an ecologically valid way of studying love has been brought into focus. Following this new perspective, our research presented below delves more deeply into everyday life love experiences that are not limited to romantic love, by analyzing individual differences in love experiences via ecological momentary assessment (EMA; Stone & Shiffman, 1994) studies. By frequently assessing the degree to which people feel loved (i.e., their levels of *felt love*) in natural settings and deriving individual differences in key characteristics of these experiences over time, we aim to create a useful tool to capture the effect of positivity resonances.

Results obtained in the two EMA studies described below indicate considerable individual differences in daily love experiences (e.g., in baseline levels and within-person variability). These interindividual differences appear to relate systematically to psychological well-being. To further position daily felt love experiences in existing theoretical frameworks, we examined links to personality traits and gratitude –

\* Corresponding author at: 232 Health and Human Development Building, University Park, PA 16802, United States.

interindividual differences in daily experiences of felt love were systematically related to both.

### 1.1. How to conceptualize love

Discussions of the characteristics of romantic and non-romantic love date back at least as far as Aristotle (*Nicomachean Ethics*) and Plato (*Symposium*), who distinguished *philia* (broadly, nonromantic love) from *eros* (sexual or romantic love). Research in the modern field of psychology has primarily focused on romantic love, mostly either from an evolutionary or biological perspective (e.g., Baumeister & Finkel, 2010) or by considering its social aspects (e.g., Gottman, 1979; Hendrick & Hendrick, 1986; Lee, 1977, 1988). A social psychology perspective also emerged with Kelley et al. (1983), who focused on interdependence and attribution in intimate relationships. The resulting interest in romantic love has continued to dominate the literature.

While empirical research on non-romantic love is scarce, some researchers have construed love sufficiently broadly to include non-romantic relationships as well. For example, Sternberg (1986) defined three basic components of love: intimacy, passion, and commitment; this is a definition broad enough to include non-romantic love relationships such as among family members and between friends. Others have returned to Plato's approach and sought to identify types of love (e.g., Berscheid, 2006) or have characterized love based on behavioral observations of "love acts" (Hazan & Shaver, 1987) or loving acts (Buss, 1988) or through biological assessments of people who are "in love" (e.g., Young, 2009). In each case, however, the construct remains largely focused on romantic love, with other types modeled as a means of contrasting other social relationships with that common focal state.

At its core, however, the construct of love is also recognized in the literature as an emotion or as a combination of emotion with a sense of social connectedness. In fact, Izard (1977) noted that love is the combination of the emotion joy with the interest that people feel in connection with others, which again reinforces the idea that love is multifaceted and not limited to just romantic love. This broader understanding of love, as stemming generally from positive emotion and social connectedness, and not only from romantic relationships, can be seen as a synthesis of findings in the relationship and emotion science.

### 1.2. Studying love in everyday life

Studying love, especially studying romantic relationships, has generated new challenges: getting people to fall in love while in the laboratory is difficult (Aron, Melinat, Aron, Vallone, & Bator, 1997), and the timing of relationships is intricate—consider for example how short interactions on dates might merge into more enduring emotions. To better understand the underlying pathways of such processes, researchers brought their work out of the laboratory to study people as they lived their day-to-day lives. For example, Gable and Poore (2008) assessed people's reflections in long-term dating relationships by signaling them several times a day to report their thoughts and feelings about their partners. Emerging from these roots, researchers have begun to place emphasis on *everyday life experiences of love*, while also emphasizing a conceptualization of love that is not limited to romantic relationships. Oravecz, Muth, and Vandekerckhove (2016) and Heshmati et al. (2019) demonstrated that people tend to agree on what makes them feel loved in everyday life, indicating that people's understanding of love does extend beyond strictly romantic love. This is in line with Fredrickson's (2016) description of love as an emotion that crosses both romantic and interpersonal non-romantic relationship boundaries.

At present, empirical research focusing on experiences of love in daily life (and their correlates) remain scarce. To our knowledge, only Major et al. (2018) adopted Fredrickson's (2016) empirical framework for modeling love in everyday life settings, using a daily diary study of love experiences. Their work showed that higher perceived positivity

resonance was correlated with increased flourishing, fewer depression symptoms, decreased loneliness, and fewer illness symptoms.

The research presented below takes a similar direction but uses the method of ecological momentary assessment to gather fine-grained data about everyday-life experiences of positivity resonance. We focus on each individual's subjective perception of the impact of these experiences by measuring what we call *felt love*. This measure is intended to be broad enough to incorporate both romantic and non-romantic experiences of love. In this paper, we show that characteristics derived from frequent self-report ratings of felt love are predictive of people's psychological well-being and exhibit systematic associations with personality characteristics.

### 1.3. Momentary and individual-specific aspects of daily love experiences

Since loving connections occur in everyday life context, an ecologically valid way to assess individuals' feelings of love is critical in planning for meaningful ways to intervene and prevent subjective feelings of loneliness and social isolation. Ecological momentary assessment is an established research design to assess human emotions as individuals they go about with their day-to-day lives. EMA and related methods such as experience sampling (Csikszentmihályi & Larson, 1987) have been shown to yield improved ecological validity and reduce the potential for reporting bias in capturing psychological processes compared to other methods (Shiffman, Stone, & Hufford, 2008).

We conducted two experience sampling studies to gather empirical evidence on the impacts of loving feelings in everyday life. Over the course of two weeks, participants reported several times a day about their experienced level of love by responding to the question: "How much do you feel loved right now?" From this rich within-person (intra-individual) data, three important individual-specific characteristics of daily love experience were derived: person-specific baseline levels, fluctuations or intra-individual (within-person) variability around the baseline, and the inertia of love experiences. We also looked for associations between inter-individual (between-person) differences in these intra-individual characteristics and established measures related to psychological well-being and personality.

We propose that everyday life experiences of love can provide useful insights into people's psychological well-being (captured by measuring emotional well-being and flourishing). We hypothesized that people with higher psychological well-being experience more love in their everyday lives, with less variability in the degree to which they feel loved over the course of the day. Having positive social relationships has been shown to be an integral part of psychological well-being (Diener & Seligman, 2009; Reis & Gable, 2003; Reis, Collins, & Berscheid, 2000), and experiencing positive emotions such as love has been linked to stronger immune systems (Barak, 2006; Pressman & Cohen, 2005), and higher life expectancies (Holt-Lunstad et al., 2010).

We also explored the secondary hypothesis that gratitude is related to daily love experiences as literature suggests that everyday acts of gratitude contribute to positive social exchanges (McCullough, Kimeldorf, & Cohen, 2008) and play an important role in close relationships (Kubacka, Finkenauer, Rusbult, & Keijsers, 2011), potentially affecting daily love experiences. Furthermore, McCullough, Emmons, and Tsang (2002) found that individuals who habitually report experiencing gratitude engage in prosocial behaviors more frequently than those who do not.

Finally, correlates of everyday-life love experiences with the Big Five personality traits were also analyzed. Individual differences in components of love have been connected to Big Five personality dimensions. For example, both Agreeableness and Conscientiousness have been found to be positively associated with intimacy and commitment (Ahmetoglu, Swami, & Chamorro-Premuzic, 2010; Engel, Olson, & Patrick, 2002). Furthermore, Agreeableness along with Conscientiousness and Extraversion predicted various relationship aspects such as

**Table 1**  
Demographic characteristics of the two samples.

Demographics	Community sample	Undergraduate sample
Gender		
% Male	33	32
% Female	67	68
Race		
% White	80	78
% Asian	10	10
% Black	4	6
% Hispanic	6	4
% Other	0	1
Age		
% Minors (< 18)	0	0
% Young adults (18 – 22)	21	100
% Adults (23 – 65)	79	0
% Seniors (> 65)	0	0

conflicts with peers, number of peer relationships, and falling in love (Asendorpf & Wilpers, 1998). Additionally, Heshmati et al. (2019) linked Neuroticism to cultural knowledge about situations in which people might feel loved, and Openness to optimistically assuming love when one is in doubt. However, to our knowledge no study has addressed the connection of daily love experiences and personality traits - the current work is targeted at filling this gap.

## 2. Methods

### 2.1. Study settings

#### 2.1.1. Community sample

The first EMA study (Study 1), focusing on daily emotional and well-being experiences, was conducted at a northeastern university. The sample consisted of 52 individuals, and its demographics are displayed in Table 1. The sample was collected during summer time and mainly consisted of university staff and international students. Because of the relatively diverse age range, we refer to this sample as the *community sample*. Participants were asked to complete a battery of personality tests and demographics items during each of two laboratory sessions, and to complete short web-based surveys via their own smartphones, six times daily over the four weeks of the study. In the introductory session, the participants provided informed consent and their respective phone numbers were registered with the text messaging service SurveySignal (SurveySignal, LLC, 2015). Text messages to complete the web-surveys were sent to the participants' smartphones six times a day. Survey timing was determined by dividing participants' self-reported usual waking hours into six equal-length intervals, and survey prompts were delivered at a random timing within each time interval, constrained so that no two prompts were less than 30 min apart. This sampling scheme was chosen to reduce expectation biases in reporting while providing a representative sampling of the individuals' context. Web-based surveys were designed in and delivered by the Qualtrics survey system (Qualtrics, Provo, UT, 2017). Over the course of the four weeks, participants received and responded to up to 168 text-message prompted web-based surveys. Each survey contained approximately 10–12 questions (including items related to the level of accomplishment, engagement etc.), but only data coming from the felt love intensity question is analyzed here. Compliance was high, with participants completing an average of 157 (SD = 15) of the surveys. Participants were paid proportional to their response rate, with a maximum payment of \$200.

#### 2.1.2. Undergraduate sample

In the second study, the sample consisted of 160 undergraduate students, recruited at the same location; we refer to these participants as the *undergraduate sample* (see demographics in Table 1). They were

enrolled in an eight-week long study examining the effects of mobile interventions on well-being, results of which are not discussed here. The intervention was delivered at the beginning of week three, and the data examined in the present study comprise only the first two weeks before any intervention occurred. With these first two weeks of data collection, we aimed to run a replication of Study 1. Self-report surveys were delivered six times daily following the same protocol as Study 1, and participants also completed a battery of personality assessments and provided demographic information during biweekly lab sessions. Compliance was high in these first two weeks of the study, with participants completing an average of 75 (SD = 6) of the 84 surveys. Participants were proportionally compensated, contingent on response rate, with a maximum payment of \$65 for this portion of the study. The complete eight-week long study was registered on the Open Science Framework (OSF) website<sup>1</sup>. All participant interactions for both studies were overseen by the University's Institutional Review Board.

### 2.2. Materials

Materials used in the analyses, namely the ecological momentary assessment of felt love item and the battery of personality assessments, were consistent across the two studies and the exact forms are available via the above referenced OSF link (see Undergraduate Sample section). Data coming from the ecological momentary assessment of felt love are analyzed in detail later, therefore summary statistics are not provided here. For the rest of the indicators, means, standard deviations and reliability measures (Cronbach's alpha; Cronbach, 1951) are reported below.

#### 2.2.1. Ecological momentary assessment of felt love

The primary modeled outcomes are participant ratings regarding the degree to which they felt loved at a given moment, as measured by the question "How much do you feel loved right now?". Participants responded using a visual digital sliding scale, with the two extremes labeled as "Not at all" and "Extremely." Location on the visual slider was mapped to integers between 0 and 100 respectively.

#### 2.2.2. Flourishing

One measure used to capture psychological well-being was the Flourishing Scale (Diener et al., 2010). This brief, eight-item scale measures an individual's perception of success in several domains, including relationships, self-esteem, purpose, and optimism. The final flourishing score ranges between 1 and 7, with higher values indicating better psychological well-being (Study1:  $M = 5.68$ ,  $SD = 1.11$ ,  $\alpha = 0.93$ ; Study2:  $M = 5.86$ ,  $SD = 0.75$ ,  $\alpha = 0.88$ ).

#### 2.2.3. Emotional well-being

The other measure used to capture psychological well-being was the emotional well-being subscale of the 36-Item Short Form Health Survey (SF-36; Ware & Sherbourne, 1992). The emotional well-being sub-scale ranged from 0 to 100, with higher values indicating better well-being (Study1:  $M = 71.79$ ,  $SD = 18.59$ ,  $\alpha = 0.83$ ; Study 2:  $M = 70.05$ ,  $SD = 17.44$ ,  $\alpha = 0.80$ ).

#### 2.2.4. Gratitude

Trait-level gratitude was assessed using the Gratitude Questionnaire (McCullough et al., 2002). This six-item self-report questionnaire is designed to assess individual differences in the disposition for experiencing gratitude in daily life, scores ranging between 1 and 7 (Study1:  $M = 3.04$ ,  $SD = 1.23$ ,  $\alpha = 0.73$ ; Study2:  $M = 6.15$ ,  $SD = 0.79$ ,  $\alpha = 0.84$ ).

<sup>1</sup> [https://osf.io/rxd2p/?view\\_only=552dfa691bfa40e2a34b961f3e0ad098](https://osf.io/rxd2p/?view_only=552dfa691bfa40e2a34b961f3e0ad098).

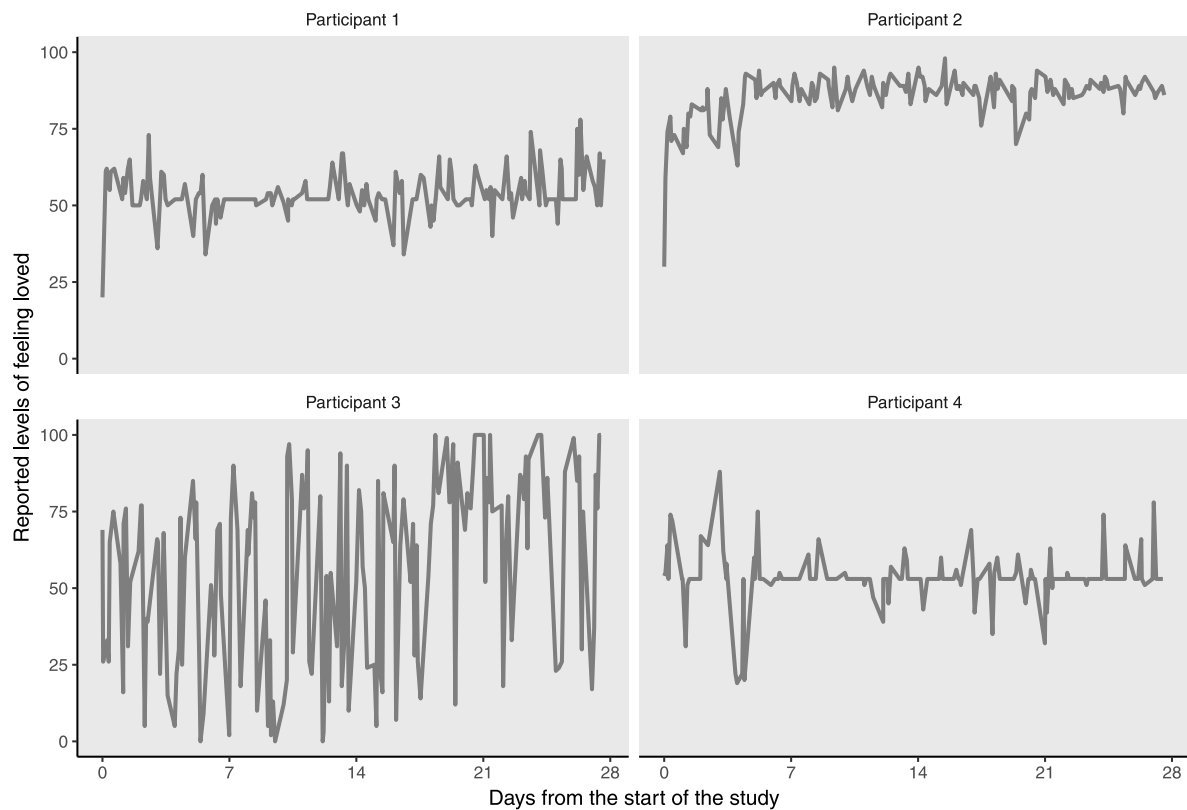


Fig. 1. Self-reported levels of love from 4 participants over the course of Study 1. Participants reported their momentary levels of felt love on a scale from 0 (Not at all) to 100 (Extremely). Individual differences in terms of baselines, change in baseline, variance around baselines and inertia (see explanation in text) are apparent.

### 2.2.5. Personality

Personality was captured via the Big Five model of personality, using the Big Five Inventory-2 (BFI-2) scale (Soto & John, 2017). The BFI-2 assesses personality in terms of five domains (scores range between 1 and 5): extraversion (Study1:  $M = 3.43$ ,  $SD = 0.62$ ,  $\alpha = 0.83$ ; Study2:  $M = 3.69$ ,  $SD = 0.74$ ,  $\alpha = 0.87$ ), agreeableness (Study1:  $M = 3.91$ ,  $SD = 0.61$ ,  $\alpha = 0.85$ ; Study2:  $M = 3.84$ ,  $SD = 0.56$ ,  $\alpha = 0.78$ ), conscientiousness (Study1:  $M = 4.03$ ,  $SD = 0.59$ ,  $\alpha = 0.84$ ; Study2:  $M = 3.70$ ,  $SD = 0.66$ ,  $\alpha = 0.85$ ), negative emotionality (Study1:  $M = 2.72$ ,  $SD = 0.84$ ,  $\alpha = 0.90$ ; Study2:  $M = 2.65$ ,  $SD = 0.89$ ,  $\alpha = 0.91$ ), and open-mindedness (Study1:  $M = 3.84$ ,  $SD = 0.66$ ,  $\alpha = 0.85$ ; Study2:  $M = 3.78$ ,  $SD = 0.67$ ,  $\alpha = 0.84$ ).

### 2.3. Data analysis

We illustrate the modeling framework for capturing individual differences in the self-reports of how loved people feel by considering four weeks of data from four participants in Study 1, as shown in Fig. 1. Ratings are conveyed on a 0–100 scale, with endpoints ranging from *Not at all* to *Extremely*. Individual differences are visually apparent, and we propose four substantively motivated characteristics to describe them. First, Participant 1 (top left) differs from Participant 2 (top right) because the majority of the self-reports is centered on different areas of the graph. More specifically, on average, Participant 1's felt love level is in the middle between the *Not at all* and *Extremely* endpoints, fluctuating around score 54, while Participant 2's indicates more intense love experiences, fluctuating around score 86. These are differences in the *baseline* levels. A second important characteristic is the degree of fluctuation of self-reported levels of felt love. This characteristic is often referred to as *intra-individual* (or *within-person*) *variability* and quantified as a variance or standard deviation parameter; individual differences in this are very pronounced when comparing Participant 1 (top left) and

Participant 3's data (bottom left). Third, even for a given level of intra-individual variance, some people return quickly to their baseline levels, while others linger longer in a given felt love state. This is a difference in the *inertia* of love experiences and is noticeable when comparing Participant 1 (top left) and Participant 4's (lower right) data. These differences play out on the hour-to-hour time-scale: we can see that Participant 1 returns quickly to their baseline, showing a peaked pattern in the data graph, while for Participant 4 the changes in the felt love levels are slower, showing a smoother pattern. In other words, Participant 4 lingers longer in a given love state, with love intensities changing more slowly than for Participant 1. These three characteristics have been argued to sufficiently describe individual differences in affective experiences in everyday life (Kuppens, Oravecz, & Tuerlinckx, 2010) and have been found to be related to personality type (see, e.g., Oravecz, Tuerlinckx, & Vandekerckhove, 2011), affect dynamics in psychiatric disorders (see, e.g., Westerman et al., 2017) and age-related differences in affect dynamics (Wood et al., 2017).

While less visible than the above three characteristics, we can also observe an upward shift in baseline love levels in Participant 2 and 3's data over the course of the study. This phenomenon might be due to reactivity to the experience sampling (e.g., Conner and Reid, 2012; Barta, Tennen, & Litt, 2012), which suggests that simply asking people about their daily experiences raises their awareness, which in turn might influence the measured experience. If this is true in the context of feeling loved, then the experience sampling design itself may work as an intervention and elicit change in felt love levels. To account for this possibility, we also compute and analyze the *change in the baseline* (or *baseline drift*) as an additional person-specific characteristic. We note that baseline drift and inertia (described in the previous paragraph) capture two conceptually different phenomena: inertia captures the hour-to-hour perseveration of events of felt love, while baseline drift captures the aggregated effects of those events across days. We can think of inertia as an indicator of *fast time-scale* change in felt love and



baseline drift over the course of the study as a *slow time-scale* indicator.

A multilevel latent stochastic differential equation model (MLSDEM, based on the Ornstein-Uhlenbeck process model; see, e.g., Oravecz, Tuerlinckx, & Vandekerckhove, 2016) was used to fit the self-reported data on felt love. This approach captures the individual differences described above, modeling differences in the baseline, intra-individual variability, inertia, and change in baseline over the course of the study, and is robust to the intricate characteristics of the data that stem from the EMA design. Specifically, in order to reduce effects due to the anticipation of the prompt, our prompts are unequally spaced throughout the day, and each participant follows a different (randomized) data collection schedule. This violates the assumptions of many traditional modeling approaches, such as repeated measures analysis of variance or autoregressive models. Self-reports about experienced felt love might also be perturbed with measurement error, which needs to be separated from meaningful within-person variance (intra-individual variability measure). This can be done by estimating the four described individual specific characteristics as latent model parameters (dynamical process) and allowing it to be perturbed by error variance (measurement part). Third, self-reports are naturally nested within participants, which calls for a multilevel model (Raudenbush & Bryk, 2002) that jointly analyzes differences at the within and between person levels. MLSDEM conforms to all these requirements. Given at least 50 observations per person, MLSDEMs can reliably estimate the substantively meaningful characteristics of the individual (Oravecz et al., 2011). Our data meet this criterion; the average number of responses was 157 (SD = 15) in the community sample and 75 (SD = 6) in the undergraduate sample.

### 3. Results

The MLSDEM was fitted in the Bayesian framework (Gelman et al., 2013), which allows for intuitive interpretation of the results by providing posterior probability distributions on the quantities of interest. In the Bayesian framework, prior probability distributions on the model parameters need to be set, which were chosen to be non-informative in the current analysis. Data analysis was carried out in JAGS (Plummer, 2003) and R (R Core Team, 2017), with rjags (Plummer, 2016) to interface R with JAGS. Correlations between the three person-specific love characteristics and the trait level measures were calculated in JASP (version 0.7.5; JASP Team, 2016). Code, data and full results are available on the OSF page<sup>2</sup> for the project.

#### 3.1. Overview of the group-level trends and individual differences in everyday life experiences of love across the two experience sampling studies

We define four key individual differences characteristics, shown in Table 2, which summarize the group-level trends in every day felt love. Point estimates of the corresponding model parameters and their 95% Credible Intervals (CIs) are displayed. In the Bayesian framework, the Credible Interval plays a similar role to the Confidence Interval in the classical framework. By definition, the probability that the true parameter falls within the 95% Credible Interval is 95%. We remind the reader that the scale for love experiences was between 0 and 100.

As seen in Table 2, the mean level of felt love across people is above the midpoint of the scale in both studies ( $M = 63.24$  and  $70.46$ , corresponding 95% CIs exclude the midpoint 50), with the baseline about 7 points higher in the undergraduate sample than in the community sample. At the same time, there is a considerable span of individual differences in these baselines, measured by the group-level standard deviation estimate ( $M = 15.07$  and  $15.49$ ), indicating that some people do have baseline felt love levels that fall below the midpoint in both studies.

**Table 2**

Group level results on love experiences from two community and undergraduate samples. Regulation is reported on a log-scale.

Characteristic	Sample	Point estimate	95% Credible Interval	
Average baseline	Community	63.24	58.84	67.41
	Undergraduate	70.46	68.00	72.93
Individual differences in baselines (SD)	Community	15.07	12.51	18.26
	Undergraduate	15.49	13.87	17.31
Baseline drift per day	Community	0.14	0.08	0.21
	Undergraduate	0.16	0.07	0.26
Individual differences in average change in baseline per day (SD)	Community	0.21	0.15	0.29
	Undergraduate	0.51	0.43	0.60
Average intra-individual variability (SD)	Community	14.33	12.21	17.30
	Undergraduate	11.89	11.05	12.86
Individual differences in intra-individual variability (SD)	Community	8.22	5.84	12.36
	Undergraduate	5.59	4.73	6.67
Average inertia	Community	0.71	-0.36	1.82
	Undergraduate	1.53	0.80	1.94
Individual differences in inertia (SD)	Community	2.12	1.40	3.01
	Undergraduate	1.97	1.57	2.34

The baseline level of loving feelings can change during the course of the study. Statistically, this was captured by allowing the baseline to vary as a linear<sup>3</sup> function of how long a participant has been in the study; this is a *slow time-scale* indicator of change in felt love, referred to as *baseline drift*. The posterior mean estimate for the group-level baseline drift was positive and credibly different from 0 (95% Credible Interval excludes 0) in both samples (Community  $M = 0.14$ ; Undergraduate  $M = 0.16$ ), implying an overall gradual increase in felt love over the course of the study. This value represents a 3.92-point ( $28 \text{ days} \times 0.14$ ) increase in love baseline during the course of the study for the community sample, and a 2.24-point increase for the undergraduate sample ( $14 \times 0.16 = 2.24$ ); a relatively small effect size in each case. Individual differences in the baseline changes were remarkable, with a standard deviation of 0.21 across the community sample and more than double this value in the college sample (0.51). These results indicate that the overall linear increase across the study in experienced love was not apparent for every participant; for example for some participants it was much larger (maximum was around 0.60 in Study 1, and around 1.47 in Study 2, corresponding to an overall increase of 16.80 and 20.58 points in felt love levels, respectively).

In both samples, participants also showed a considerable amount of intra-individual variability in their experience of felt love across days. The intra-individual variability measure captures how much a given person's felt love intensity fluctuates around the baseline from day to day and is displayed in Table 2. The group-level intra-individual variability estimate quantifies how much on average felt love levels fluctuate within-person: the community sample showed an average within-person standard deviation of 14.33 points. Considering the 0–100 scale and the 63.24 average baseline, this value indicates that on average people experienced considerable ups and downs in how much they felt loved. The average within-person felt love fluctuations is only slightly smaller for the college-age participants ( $M_{SD} = 11.89$ ). However, when compared to this group's 70.46 baseline, it was much less likely for the undergraduates to fall below the midpoint of the scale, indicative of more intense love experiences overall.

Finally, the inertia for momentary love states was computed to capture the fast-time-scale changes in felt love. Inertia was assessed by analyzing how quickly felt-love states return to the baseline after being moved away (higher values in Table 2 correspond to less inertia). Looking at the average inertia estimates in Table 2, the community

<sup>3</sup> A more complex model allowing for quadratic curves was also fitted to the data but no credible quadratic trends were found.

<sup>2</sup> [https://osf.io/rxd2p/?view\\_only=552dfa691bfa40e2a34b961f3e0ad098](https://osf.io/rxd2p/?view_only=552dfa691bfa40e2a34b961f3e0ad098).

sample participants, on average, exhibited somewhat more inertia, that is a slower change in love states than college sample participants ( $M = 0.71$  and  $1.53$  respectively), with comparable amounts of individual differences ( $M = 2.12$  and  $1.97$ ). The scale of these estimates is somewhat difficult to interpret directly: it is measured on a log scale and its influence plays out over time. One way to capture what these numbers represent is to think of them as inducing correlation across time. A participant in the community sample, with comparatively slower changes in felt love time, would show lingering effects of past felt love states after half an hour with a correlation of  $0.36$  (mid-sized correlation by Cohen's criteria). By contrast, a participant in the college sample no longer shows those effects a half hour later—the correlation with their state a half hour before is around  $0.01$ . After 3 h this correlation is negligible (less than  $0.01$ ) for both groups, implying that a participant's current love state is not predictable from more distal past experiences.

### 3.2. Do everyday life love experiences systematically relate to psychological well-being and personality?

We hypothesized that individual differences in daily life experiences of loving feelings are systematically related to psychological well-being. To study these associations, correlations (Pearson's  $r$ ) were calculated between indicators psychological well-being, such as flourishing and emotional well-being; and daily felt love experience characteristics, namely baseline levels, intra-individual variability, and inertia. We also explored how these felt love characteristics relate to gratitude and personality characteristics.

We quantified the evidence for these associations using Bayes Factors (BF; Ly, Verhagen, & Wagenmakers, 2015). The Bayes Factor is a statistical tool for hypothesis testing in the Bayesian statistical framework. With the BF, evidence in favor of no correlation (null hypothesis), is quantified relative to evidence in favor of correlation (alternative hypothesis). BF is computed on a continuous scale, expressing the ratio of evidence between the alternative and the null hypothesis (or vice versa, by taking the reciprocal). In order to summarize BFs in terms of discrete categories for interpretation of evidence strength, a classification scheme was proposed by Jeffreys (1961). According to this classification, a BF in favor of a given hypothesis<sup>4</sup> whose value is below 3 shows anecdotal or no evidence for the alternative, BF between 3 and 10 shows moderate evidence, BF between 10 and 30 shows strong evidence, BF greater than 30 shows very strong evidence and BF greater than 100 shows extreme evidence.

In both samples, psychological well-being measures and gratitude had meaningful medium-size correlations with baseline levels of loving feelings in everyday life ( $r$ 's between  $0.43$  and  $0.64$ ), as shown in Table 3. The corresponding BFs indicated at least strong evidence for these correlations. Between the two samples, the undergraduate sample had somewhat larger effect sizes ( $r$ 's between  $0.5$  and  $0.6$ ) and stronger evidence ('extreme') in favor of these effects. Intra-individual variability (IIV) in felt love yielded small negative correlations with psychological well-being measures and gratitude, but the evidence supporting these effects was weak (BFs are all below 3). Inertia showed a small-size positive correlation with emotional well-being in the community sample, suggesting that participants with higher in emotional well-being experienced a slower change in their love states, but the BF indicated only moderate evidence in favor of this correlation, and this effect was not replicated in the college sample. There was no evidence for any other associations with respect to inertia and the well-being

<sup>4</sup> BF in favor of the alternative hypothesis is conventionally denoted  $BF_{10}$ , although in this paper we denote it simply as BF. This BF ( $BF_{10}$ ) can be converted into  $BF_{01}$ , which quantifies evidence in favor of the null, by taking the inverse:  $BF_{10} = 1/BF_{01}$ , with interpretations identical, mutatis mutandis. We do not refer to  $BF_{01}$ s anywhere in this paper.

**Table 3**

Results on the associations between psychological well-being and everyday life love experiences, in terms of Pearson's  $r$  correlations and corresponding Bayes Factors quantifying the ratio of evidence in favor of the correlation. IIV stands for intra-individual variability.

Predictor	Sample	Statistic	Baseline	IIV	Inertia
Flourishing	Community	$r$	<b>0.55</b>	-0.26	0.20
		BF	1031.54	0.94	0.45
	Undergraduate	$r$	<b>0.64</b>	-0.17	-0.06
		BF	$1.20 \times 10^{17}$	0.93	0.13
Gratitude	Community	$r$	<b>0.53</b>	-0.28	0.31
		BF	489.53	1.15	2.04
	Undergraduate	$r$	<b>0.55</b>	-0.01	-0.02
		BF	$1.15 \times 10^{11}$	0.21	0.10
Emotional Well-being	Community	$r$	<b>0.43</b>	-0.22	<b>0.33</b>
		BF	24.89	0.56	3.00
	Undergraduate	$r$	<b>0.51</b>	-0.19	-0.06
		BF	$2.26 \times 10^9$	1.90	1.13

measures.

Table 4 shows associations between felt love characteristics and personality traits. In both samples, results indicated that more extraverted participants tended to have higher baseline levels of everyday-life felt love experiences ( $r = 0.35$ ,  $BF = 4.13$  and  $r = 0.30$ ,  $BF = 146.60$  in the community and undergraduate samples, respectively). In contrast, participants who scored higher on the neuroticism scale had lower baselines ( $r = -0.42$ ,  $BF = 16.32$  and  $r = -0.33$ ,  $BF = 829.52$ ). In the community sample, we also found evidence that neurotic individuals had more variability around this baseline ( $r = 0.42$ ,  $BF = 18.94$ ). While there was a small positive correlation suggesting the same tendency in the undergraduate sample, the evidence for this effect was anecdotal. However, in the undergraduate sample neuroticism was weakly associated with higher inertia ( $r = 0.21$ ,  $BF = 3.34$ ), with moderate evidence for this effect. Finally, undergraduate participants with Agreeable personalities tended to have higher baselines ( $r = 0.35$ ,  $BF = 2656.39$ ), indicating more intense love experiences for these participants. Correlations in the same directions were found in the community sample as well, but they were smaller, without sufficient evidence to consider them credible.

## 4. Discussion

The two studies presented here expand upon existing research on love by assessing how loved individuals felt throughout their day and examining correlations with other psychological variables including personality and psychological well-being. In both studies, ecological momentary assessment via smartphone at random times throughout the day was able to capture considerable individual differences in felt love experiences. We used a one item measure of loving feelings, administered six times daily for several weeks to make sure we sample a variety of everyday life experiences. Item conciseness is a useful characteristic in EMA settings as it avoids unnecessary burden on participants, resulting in better compliance and longer periods of measurement. Individual differences based on this concise love measure showed systematic relationships with other well-studied psychological variables, suggesting that the ecological momentary assessment design is a viable and useful method of learning about people's everyday life felt love experiences.

We modeled self-reported levels of felt love in terms of a person-specific baseline level, intra-individual variability around that baseline, slow-timescale change in the baseline and fast-timescale inertia. The results from these models showed a fairly similar picture across the two studies, one with a broad age range (between 19 and 48) and another consisting of undergraduate students (between 18 and 22). While most of the results were consistent, the college-aged sample did exhibit a slightly higher baseline with less intra-individual variability around it,

**Table 4**

Results of the associations between personality traits and everyday life love experiences, in terms of Pearson's  $r$  correlations and corresponding Bayes Factors quantifying the ratio of evidence in favor of the correlation. IIV stands for intra-individual variability.

Predictor	Sample	Statistic	Baseline	IIV	Inertia
Extraversion	Community	$r$	<b>0.35</b>	-0.23	-0.11
		BF	4.13	0.61	0.23
	Undergraduate	$r$	<b>0.30</b>	-0.07	0.12
		BF	146.60	0.15	0.28
Agreeableness	Community	$r$	0.29	-0.02	0.24
		BF	1.32	0.17	0.73
	Undergraduate	$r$	<b>0.35</b>	-0.18	-0.03
		BF	2656.39	0.70	0.11
Conscientiousness	Community	$r$	0.11	-0.05	0.26
		BF	0.23	0.18	0.99
	Undergraduate	$r$	0.20	-0.11	-0.00
		BF	2.49	0.24	0.01
Neuroticism	Community	$r$	<b>-0.42</b>	<b>0.42</b>	-0.09
		BF	16.32	18.94	0.21
	Undergraduate	$r$	<b>-0.33</b>	0.19	<b>0.21</b>
		BF	829.52	1.62	3.34
Openness	Community	$r$	-0.05	0.17	-0.33
		BF	0.19	0.35	2.60
	Undergraduate	$r$	0.09	0.03	0.05
		BF	0.20	0.10	0.12

suggesting more consistently intense love experiences overall in that age group.

Characteristics of everyday-life felt love, parameterized in terms of baseline levels, variability, and inertia, showed credible relationships with indicators of psychological well-being, such as flourishing and emotional well-being, as well as with gratitude and personality traits. Psychological well-being measures showed credible medium-sized correlations with baseline levels of loving feelings in everyday life, with strong evidence supporting these correlations, and this observation replicated across the two studies: people who feel loved seemed to feel happier as well. Similarly, we found evidence that higher trait gratitude is related to higher daily love experiences, most likely via reciprocal mechanisms as in close relationships (Kubacka et al., 2011). While these relationships were evident in both samples, although we found larger effect sizes and more evidence in favor of the effects in the college sample.

We also hypothesized that lower levels of intra-individual variability in felt love would be associated with higher levels of psychological well-being. While we did find small negative correlations between levels of IIV and the psychological well-being measures and gratitude, suggesting that low variability may have positive effects, the limited evidence supporting these effects leaves us unable to draw any firm conclusions about this relationship. We also explored the relationships between psychological well-being and inertia, without any hypotheses set on these beforehand. The community sample showed a medium-sized positive correlation between inertia and emotional well-being, suggesting that longer-lasting states of felt love are associated with better emotional well-being; however, the evidence supporting this barely reached a moderate level and the effect did not replicate in the undergraduate sample. We conclude that further work is necessary to better understand the relationship between psychological well-being and felt love IIV and inertia measures.

Importantly, both of our studies found credible evidence that feeling loved in daily life is associated with flourishing and emotional well-being. These findings highlight the importance of studying felt love in its natural context and emphasize that for psychological well-being, it is not only romantic relationships that matter, but also other forms of positivity resonance people experience in their everyday life. While our design does not permit causal inference, we theorize that these characteristics demonstrate a mutual, cyclical influence upon one another. If so, nonromantic felt love may provide an avenue for intervention to

improve well-being if applied appropriately. Interestingly, we found evidence of a small but credible drift in participants' baselines of felt love over the duration of the study. While small enough to be unlikely to bias results over the course of a one- to two-month study, the effect implies that raising awareness of felt love in day-to-day life may itself be an intervention that raises levels of felt love over a longer period of time. This suggests there may be merit in developing interventions to improve well-being that are based in raising momentary awareness of felt love using smartphone-based platforms.

Finally, we also explored associations between characteristics of daily-life felt love and personality traits. Across both samples, higher Extroversion individuals tended to have higher baseline levels of every day felt love, while individuals with higher levels of Neuroticism demonstrated opposite patterns. These consistent findings help us further highlight the importance of everyday-life felt love construct and can be used to facilitate the development of individualized intervention strategies.

## 5. Limitations and future directions

The study samples consisted of individuals demonstrating relatively adaptive psychological well-being. Future studies may wish to explore subgroups of individuals who may be in greater need of assessment of day-to-day feelings in order to drive future treatment or intervention. For example, it would be interesting to compare individuals with mental health symptoms or diagnoses such as anxiety or depression to the general population in order to determine if there are differences in their daily experiences felt love. These potential differences could assist in treatment and intervention to improve the health and well-being of these subgroups of individuals. Additionally, these studies consisted of adult participants only; future research may wish to explore the impact of every day felt love in both younger and older populations. Examining child and adolescent populations as well as aging adults could yield meaningful information for both groups.

As mentioned above, one important limitation of the study is that our design does not permit direct causal inference, and all associations are correlational. Therefore more research is needed to determine for example the causal direction and mechanism of the link between personality and felt love. Although our results show that extroverted, outgoing people are more likely to report feeling loved than individuals who are more anxious and neurotic, two possibilities exist. It is possible that people who demonstrate higher neuroticism or anxiety are less likely to interpret a given event as an expression of love, an effect that training may be able to mitigate, and which may have nontrivial impacts on relationship satisfaction and well-being. It seems likely that the opposite effect may be true for people who exhibit high extraversion, and indeed they may be incentivized to engage in social interaction because they are more likely to view interpersonal acts as acts of love.

This heterogeneity across personality scores is underscored by the large amounts of overall interpersonal variability in individual characteristics that define daily felt love. The differences between age groups further underscore this variability, suggesting that like the weightings of feelings in Gable and Poore's (2008) study of relationships, the role and influence of felt love may vary both between individuals and across the lifespan.

Future research may also wish to explore the impact of gratitude interventions on felt love. Gratitude, here defined as a virtue or as an emotional state that involves an interpersonal connection between both the benefactor and beneficiary (Emmons, 2007), has a close relationship with Fredrickson's (2016) conceptualization of love. Gratitude interventions may increase or improve how much love people feel as they go about their day-to-day lives. Liao and Weng (2018) found that gratefulness impacts subjective well-being, mediated by social connectedness and expanding meaning in life. Froh et al. (2009) found that gratitude interventions were moderated by positive affect, with low-positive-affect individuals showing more benefit from these



interactions. Our findings imply that felt love may provide additional pathways to both positive affect and overall well-being, and may, therefore, be a valuable construct in the implementation of gratitude-based interventions. More work is required to determine what role, if any, felt love plays in these relationships.

We predict that many individuals will respond to or benefit from a simple intervention that makes them aware of everyday feelings of love in their lives. In the current study, higher baseline experience of daily felt love was linked to higher well-being, indicating that interventions to increase well-being in adults can be oriented towards increasing awareness of feelings of love. One example includes Loving Kindness Meditation (Hutcherson, Seppala, & Gross, 2008), a meditation intervention focused on increasing social connectedness. Interventions centered on compassion and care through receiving care and expressing care for others, might also be effective ways to increase felt love and consequently increasing well-being (Dvořáková, Greenberg, & Roeser, 2019).

However, the intricate interpersonal differences in our data imply that some individuals may require additional or different support in order to achieve and maintain psychological well-being. Interventions must, therefore, be tailored to their specific needs. We suggest that additional work on the sources and correlates of between-person variability in felt love may be beneficial to researchers hoping to deploy interventions using felt love.

## 6. Conclusions

We presented results from two experience sampling studies on felt love in everyday life. Our results suggest that overall levels of felt love have close relationships with psychological well-being, and may be predictive of personality traits. These results are generally consistent across studies, although some effects are stronger or weaker in the college-student sample than in the broader community sample, suggesting that the role of felt love may vary across the lifespan. We also found substantial between-person variability in felt love. We suggest that the construct of felt love may be useful, and recommend additional research geared towards the development and customization of individualized felt-love interventions to improve well-being at all stages of life.

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