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Informing the Classification and Assessment of Positive Emotional Experiences:

A Multisample Examination of Hierarchical Positive Emotionality Models

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Abstract

Despite being multifaceted in nature, positive emotional (PE) experiences often are studied using only global PE ratings, and measures assessing more specific PE facets do not converge in their assessment approaches. To address these issues, we examined hierarchical factor structures of ratings of positive emotionality, which reflect propensities toward experiencing PE, in both online community adult ($N = 375$) and undergraduate ($N = 447$) samples. Preregistered analyses indicated (a) a broad distinction between tendencies to experience social affection and other PE types, and that (b) PE ratings can be differentiated by as many as four replicable factors of *Joviality*, *Social Affection*, *Serenity*, and *Attentiveness*. These PE dimensions were associated with distinct personality and psychopathology profiles. Examples of these distinctive associations included Joviality displaying robust positive associations with grandiosity and exhibitionism; conversely, although Social Affection and Joviality were strongly correlated, Social Affection showed associations in the opposite direction with grandiosity and exhibitionism. Other notable results include Serenity (e.g., feeling relaxed) showing negative associations with negative emotionality at a magnitude indicating that Serenity may reflect low levels of negative emotionality to a considerable degree. Collectively, these results highlight the need to consider distinct PE facets in addition to global PE ratings when assessing PE, as important nuance may be lost otherwise. Furthermore, our results indicate the need for additional research clarifying PE structure at different levels of abstraction to inform future measure development efforts and assessment approaches.

KEYWORDS: positive emotionality; positive emotion; hierarchical factor structures; exploratory factor analysis; preregistration

PUBLIC SIGNIFICANCE STATEMENT: Our results inform how tendencies toward having different types of positive emotional experiences such as feeling energetic, compassionate, and determined are interrelated. These results can be used to guide comprehensive assessment of emotional experiences in future research studies, particularly in research focused on how different emotional experiences are linked to personality and mental health symptoms.

Informing the Classification and Assessment of Positive Emotional Experiences:

A Multisample Examination of Hierarchical Positive Emotionality Models

Positive emotional (PE) experiences have been studied widely in connection to psychopathology, well-being, and personality over the last several decades (Gruber, 2011; Watson et al., 2015b). As the body of research on PE experiences has expanded, so have definitions of the PE domain. Traditionally, PE research has focused on experiences such as joy and excitement that are linked to individual differences in extraversion (Cowen et al., 2019; Shiota et al., 2006; Watson et al., 2015a). However, conceptualizations of the PE domain now also include a broader range of experiences that are associated most strongly with five-factor model (FFM) traits other than extraversion. Examples of this include PE experiences of compassion that are most strongly associated with agreeableness of any FFM trait, as well as feelings of determination and attentiveness aligning with FFM conscientiousness (Fredrickson, 2013; Shiota et al., 2006; Watson & Clark, 1999). Upon careful consideration, some PE dimensions may represent a blend of affective, cognitive, and behavioral components rather than being purely emotional in nature. For example, a term such as “attentiveness” may bring to mind aspects of thought or behavior rather than or in addition to affect (e.g., thinking that a conversation is interesting and then displaying interest/attentiveness with specific behaviors). However, attentiveness (e.g., being attentive, interested) is described as a PE facet dimension in some models because such a term may reflect positively-valenced feeling states of curiosity or motivation (Fredrickson, 2013; Watson & Clark, 1999). Supporting this, experiences of attentiveness frequently co-occur with other PE experiences, and attentiveness ratings load strongly onto a general latent factor with ratings of joy and excitement that have long been deemed central to PE descriptions as reviewed.

Although PE can be assessed across different temporal timeframes, the current study focuses on improving the classification and assessment of dispositional, trait tendencies toward experiencing PE. Shorter term, state assessments of PE experiences often are described using terminology such as “positive emotion” or “positive affect.” Dispositional tendencies often are referred to as “positive emotionality” or “positive affectivity” (Shiota et al., 2006; Watson & Clark, 1999), which we emphasize here given that many multidimensional measures have become widely used in PE research. Table 1 provides an overview of these measures, and scales from specific measures are organized rationally into clusters representing facets of the broader PE domain in this table. These measures include the Dispositional Positive Emotion Scales (DPES; Shiota et al., 2006), the Positive and Negative Affect Schedule-Expanded Form (PANAS-X; Watson & Clark, 1999), and the modified Differential Emotions Scale (mDES; Fredrickson et al., 2003), among other commonly used measures (e.g., the Gratitude Adjective Checklist [McCullough et al., 2002]; the Multiple Affect Adjective Check List-Revised [MAACL-R; Lubin & Zuckerman, 1999]; the Multidimensional Mood-State Inventory [MMSI; Boyle et al., 2015]; the Temperament and Affectivity Inventory [TAI; Watson et al., 2015a). The list of scales shown in Table 1 is not exhaustive, but it illustrates that these scales collectively assess a wide range of dimensions, including dimensions linked most strongly to FFM traits other than extraversion (e.g., at least six existing scales include item content assessing attentiveness, which may be more strongly linked to conscientiousness than extraversion).

Issues Resulting from Nonspecific and Inconsistent Assessment Approaches

Although most measures shown in Table 1 assesses multiple dimensions, researchers often aggregate PE ratings into composite scores when using brief measures such as the mDES and the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988); unlike Watson and

Clark's (1999) more recently developed PANAS-X, the PANAS does not provide assessment of facet dimensions. Although these assessment approaches are efficient (e.g., the PANAS assesses general PE with 10 items), they do not allow distinctive associations for different PE facet dimensions to be identified.

Examples of distinctive PE facet associations that would be masked by focusing analyses solely on global PE composite ratings include those for PE facets with different FFM traits. As discussed, extraversion and high-arousal PE experiences are linked closely (Boyle et al., 2015; Heuchert & McNair, 2012; Watson et al., 2015a). Indeed, factor analytic research indicates that a specific PE factor representing individual differences in cheerfulness and energy is a core facet of the extraversion domain (Watson et al., 2015b). Watson et al. (2015b) also identified an extraversion facet labeled excitement seeking in their analyses of extraversion structure, which has clear parallels with some PE facet scales shown in Table 1 (e.g., MAACL-R Sensation Seeking). However, other PE facet scales assessing compassion correlate more strongly with agreeableness than with extraversion (Shiota et al., 2006), which is not surprising because agreeableness measures also assess tendencies toward being kind and sympathetic. These specific PE experiences that are linked to agreeableness may serve a different function than other types of PE by helping to maintain social bonds (Fredrickson et al., 2013; Robinson, 2007). As another example of PE facet level distinctiveness, scales assessing serenity, which also are used widely in PE research (e.g., Tsai et al., 2017), show strong negative associations with measures of negative emotionality (NE; Watson & Clark, 1999; Payne & Schnapp, 2014). Thus, serenity may be less distinct from NE than other PE facets and may represent a blend of low NE and high levels of low-arousal PE.

In addition to distinctive PE facet associations being obscured by focusing analyses only on PE composite ratings, careful review of Table 1 indicates that different measures vary in the specific PE dimensions they assess. Thus, even if researchers assess PE at the facet level, study results could vary depending on the measure used. For example, use of the DPES (Shiota et al., 2006) provides assessment of seven different facet dimensions, several of which are interpersonally-oriented (e.g., Love and Compassion). However, other measures shown in Table 1 do not assess these dimensions (e.g., the MAACL-R; PANAS-X), which may be important to consider in research focused on social relationships for example. This lack of coherence represents a longstanding issue leading to inconsistencies in measurement approaches, which may hinder PE research across contexts (e.g., scores on some PE facet measures may change more than others with treatment; Cowen et al., 2019; Stanton & Watson, 2015).

Current Study Goals: Informing Positive Emotionality Assessment

To inform how PE can be classified and assessed comprehensively and consistently across studies, we aimed to identify a replicable factor analytic model of PE. Specifically, we examined hierarchical factor structures of PE across two samples (i.e., 447 undergraduates; 375 community adults). We examined these hierarchical structures using exploratory factor analysis (EFA) due to a lack of clarity regarding how PE ratings should be organized at various levels of abstraction. As noted, we focused here on assessing emotionality, or dispositions toward experiencing PE. We recognize the importance of examining the consistency of PE factor structures across different temporal frames (e.g., when also assessing state experiences), but examining factor structures across multiple samples and administration instructions was beyond our study scope.

Existing PE research aimed at informing measure development and assessment often has focused on a single level of specificity (e.g., identifying how many PE facets should be assessed

with a specific measure), and existing measures vary in their content and format. Some research has directly examined the factor structure of PE experiences outside of the context of measure development (e.g., Stanton & Watson, 2015), but included limited or no coverage of PE variants such as compassion and awe. Thus, the current study extends prior work by informing our understanding of the classification of a wide range of PE experiences at broad (i.e., a general PE factor), intermediary (e.g., differentiating high- and low-arousal PE), and specific levels (e.g., distinguishing more specific, interpersonally-oriented PEs such as compassion and gratitude). As a related secondary aim, we examined associations for both general and specific PE dimensions identified in our EFAs to demonstrate that specific PE facets show distinctive associations that are masked by focusing analyses solely on composite PE ratings.

Study Predictions

Timestamped predictions were made prior to conducting analyses, as described on the first-author's Open Science Framework page (see <https://osf.io/u8apz>) and in Online Supplemental Appendix 1. These predictions were made after data collection already had been completed (timestamped date of April 22, 2020), such that these registered analyses represent a “postregistration” (Benning et al., 2019). As outlined in Table 1, we predicted that we would be able to identify as many as eight replicable factors representing different PE facets (also see Online Supplemental Table S1 and <https://osf.io/u8apz> for a summary of these same predictions made for our preregistered analyses). Each predicted PE facet appeared to be reflected in the content of several or more existing scales (e.g., the DPES, PANAS-X); in most cases, five or more existing scales assess content relevant to each predicted facet (e.g., five scales include content relevant to social affection/compassion; again, see Table 1).

Prior research indicates that some types of PE experiences may be challenging to differentiate (e.g., feelings of joy and energy; Fredrickson, 2013), and our analyses involved factor analyzing scores from many items across samples. Therefore, we realized that it may not be possible to identify as many as eight well-defined, replicable factors. We generally had more confidence in our predictions for factor solutions with relatively few factors and less confidence in our predictions for factor solutions with larger numbers of factors representing nuanced PE differentiations. As shown in Online Supplemental Figure S1, we predicted that we would be able to identify at least five factors of Joviality, Self-Assurance (e.g., feeling bold), Attentiveness, Serenity, and Social Affection given that many of these distinctions are made in existing multifaceted measures (e.g., the DPES, PANAS-X, and TAI).

Finally, predicted associations for these five PE factors with symptom and personality ratings are shown in Online Supplemental Table S2, which also was included in our data analytic preregistration document (<https://osf.io/u8apz>). We predicted that Joviality and Self-Assurance would associate strongly with extraversion, Attentiveness with conscientiousness, and Social Affection with agreeableness (all predicted $r_s = .50$). We also hypothesized that Serenity would associate strongly and negatively with NE based on prior research (Payne & Schnapp, 2014; Stanton et al., 2016). These predictions for PE facet associations with FFM traits were made based on the literature reviewed (e.g., Shiota et al., 2006; Watson et al., 2000) as well as alignment between the content of specific PE facet measures and FFM traits (e.g., Social Affection and agreeableness measures both reflect tendencies toward being compassionate). Consequently, given these aspects of alignment across PE and FFM measures, demonstrating these patterns of associations would not be surprising; however, examining them enabled us to contextualize our factor analytic findings by showing that distinct PE facets represent

meaningfully different trait tendencies. Lastly, we predicted that most PE facets would associate negatively with personality pathology and internalizing symptoms, but that PE ratings of boldness subsumed within Self-Assurance would show positive associations with some aspects of personality pathology (e.g., attention seeking) and some symptoms (e.g., euphoric mood).

Method

Description of Undergraduate and Online Community Samples

As discussed, we recruited both community adult and undergraduate participants (see Online Appendix S1 and <https://osf.io/u8apz> for description of issues related to validity checks and missing data). Institutional research ethics board approval was granted for all data collection and research procedures. Undergraduates ($N = 447$) were recruited through the psychology department participant pool at a Canadian university. Average participant age was 18.6 years ($SD\ 1.6$), and most participants identified as cisgender women ($n = 303$; 67.8%). Demographic information was collected in a manner consistent with university ethics board guidelines, with 40.9% of participants identifying as being of White or European descent (e.g., Western European descent); 28.2% as of East Asian descent (e.g., Chinese descent); 16.6% as of South Asian descent (e.g., Indian descent); and 4.5% as of Middle Eastern or North African descent; remaining participants (9.8%) specified other identities.

Community adults ($N = 375$) were recruited using Amazon Mechanical Turk. Average participant age was 39.1 years ($SD = 12.1$), with a slight majority of participants identifying as cisgender men ($n = 201$; 53.6%). Most participants identified as White or European American (73.3%), 10.1% as Black or African American, and 8.0% as Asian American, with the remaining percentage of the sample endorsing other identities. In regard to highest level of education obtained, 41.6% of the sample reported having a bachelor's degree; 32.3% reported having a

vocational degree, an associate's degree, or some college; 15.2% reported having a high school diploma or less education, and 10.9% reported having a master's degree or higher.

Positive and Negative Emotionality Assessment

Positive Emotionality

To assess PE, participants were asked to indicate “to what extent you generally feel this way” when rating different emotion adjectives using a 5-point rating scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). These instructions and rating scale follow the format of the PANAS-X (Watson & Clark, 1999), which we used here because (a) many of the adjectives used were drawn from the PANAS-X and (b) this format has been widely used in prior research. Specifically, we administered all PE adjectives from the three PANAS-X PE scales: Joviality (8 items; e.g., *cheerful*), Self-Assurance (6 items; e.g., *proud*), and Attentiveness (4 items; e.g., *determined*). The PANAS-X also includes a Serenity scale that is described as assessing a blend of low NE and low-arousal PE. Due to reflecting elements of both PE and NE, the Serenity scale is not identified as a clear PE measure in the PANAS-X manual (Watson & Clark, 1999); however, we also included adjectives from the Serenity scale (e.g., *relaxed*) in our analyses because this item content is included in many other PE measures. Additionally, we included other adjectives not included in the PANAS-X reflecting PE experiences such as love and compassion, which are constructs assessed by other measures such as the Mood Adjective Checklist (MACL; Nowlis, 1965). Like the PANAS-X, the MACL uses adjective-based assessment, and MACL adjectives from the MACL Social Affection scale (e.g., *affectionate*, *warmhearted*) also were included here. Furthermore, as reviewed, some measures (e.g., the mDES, MACL, DPES) include assessment of PE experiences such as liveliness, gratitude, and awe that we were unable to sufficiently assess using only the PANAS-X and MACL adjectives.

Consequently, we administered additional adjectives to assess each of these domains (e.g., adding adjectives such as feeling *thankful* to assess gratitude), which were generated by the first and second study authors based on the review of the content of measures shown in Table 1. As shown in Table 2, we used a total of 48 different adjectives to assess PE experiences, which included at least several adjective ratings anticipated to load on each potential factor.

We also considered alternative assessment approaches (e.g., administering both the DPES and PANAS-X items). However, alternative approaches such as jointly factor analyzing items/scales from different measures shown in Table 1 may have been challenging. For example, the PANAS-X uses adjectives whereas the DPES items are written in sentence form, such that items may have loaded onto factors together based on having a shared administration format rather than on content grounds (see Watson et al., 2015a).

Finally, participants from both samples also were administered the 10 adjectives from the general Negative Affect (NA) scale of the PANAS-X. Participants again were asked to indicate to “what extent you generally feel this way” when rating each adjective using a 5-point rating scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

Other Measures Administered to Online Community Sample Participants

Community participants completed a more extensive battery of measures than did undergraduates, enabling us to examine associations for our emergent PE factors with other measures using data from this sample. Other measures included the second edition of the Big Five Inventory (BFI-2; Soto & John, 2017). Participants rated themselves on all BFI-2 items using a 5-point scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*).

Participants also completed the 18-item Narcissistic Admiration and Rivalry Questionnaire (NARQ; Back et al., 2013), which includes narcissistic (a) Admiration (9 items; e.g., “am

special”) and (b) Rivalry scales (9 items; e.g., “want my rivals to fail”). Participants responded to the NARQ items using a 6-point scale ranging from 1 (*not agree at all*) to 6 (*agree completely*). Additionally, participants were administered the Grandiosity (7 items) and Exhibitionism (6 items) scales from the Comprehensive Assessment of Traits Relevant to Personality Disorder (CAT-PD; Simms et al., 2011). Participants responded to these items using a 5-point scale ranging from 1 (*very untrue of me*) to 5 (*very true of me*). Finally, participants completed select scales from the Expanded Version of the Inventory of Depression and Anxiety Symptoms (IDAS-II; Watson et al., 2012). Symptom scales from the IDAS-II that were administered included Dysphoria (10 items; e.g., “felt depressed”), Social Anxiety (6 items), Euphoria (5 items; e.g., “had so much energy it was hard to sit still”), and Mania (5 items; “thoughts raced”). Participants indicated the extent to which they experienced symptoms over the past 2 weeks using a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*).

Results

Overview

All analyses were conducted using SAS Version 9.4. Descriptive statistics and coefficient alpha estimates for all study measures are provided in Online Supplemental Table S3. Coefficient alpha estimates for all study measures $> .70$, with most estimates $> .80$.

Next, our primary analyses involved conducting hierarchical EFAs of PE ratings as described. All EFAs were conducted using principal factor analyses and were based on polychoric correlation matrices because participants rated PE items using a 5-point response scale. We used both Velicer’s minimum average partial (MAP) test and parallel analysis to help determine the maximum number of factors to extract in our EFAs. Note that we report results from principal factor analyses subsequently. However, we conducted parallel analyses and the

MAP test using principal components analyses (PCAs) because use of principal factor analysis when conducting these procedures can suggest extracting an overly large number of factors (O'Connor, 2000). Furthermore, although we took results from these parallel analyses and MAP tests conducted with PCAs into account for informing our EFAs, we ultimately sought to identify the largest number of well-defined (i.e., factors on which three or more items loaded strongly), replicable PE dimensions. For conducting these EFAs, we began by extracting a general PE factor in both samples and then extracted solutions with an increasingly larger number of factors (Forbes et al., 2017). When extracting two or more factors, factors were rotated to oblique simple structure using promax. We also examined the extent to which factors replicated across samples using comparability coefficients (Everett, 1983), an approach allowing coefficients to be computed using both the undergraduate and community datasets. Comparability coefficients $\geq .90$ indicate strong factor similarity (Everett, 1983).

Additionally, we report Pearson correlations for emergent dimensions from our EFAs with other study variables in the community dataset. We report correlations for both (a) a general PE factor from a single-factor solution and (b) the factor solution with the largest number of well-defined PE factors. Factors identified in our EFAs were modeled using regression-based factor scores. Lastly, we conducted a series of multiple regression analyses in which factor scores reflecting PE facet dimensions were entered simultaneously as independent variables along with PANAS-X NA ratings when examining their associations with other study variables. Unlike all other analyses described, these regression analyses were not preregistered. They were added after further consideration when revising this manuscript given that scores representing some PE dimensions from our EFAs were strongly associated with PANAS-X NA ratings as described subsequently. We considered the statistical significance of all associations at a $p < .001$ level.

Factor Analytic Results

Preliminary Analyses

Parallel analyses conducted in both the community and undergraduate samples indicated that up to four factors could be extracted in our EFAs. However, results from the MAP test indicated that seven- (mean squared partial correlation = .0147) and eight-factor solutions (mean squared partial correlation = .0122) may be optimal in the community and undergraduate datasets, respectively. This lack of convergence across these two procedures may provide evidence for a hierarchical factor structure wherein multiple, meaningful factor solutions are tenable (Forbes et al., 2017).

Factor Solutions with One to Three Factors

First, adjectives assessing high-arousal PE such as feeling enthusiastic, joyful, and cheerful loaded most strongly (i.e., corresponding item factor loadings $> .75$) on a single general factor in each dataset. Across samples, all 48 PE items loaded $> .40$ on this general factor. Comparability coefficients scored in both datasets for this factor exceeded .99.

Next, factor loadings from two-factor solutions across samples are shown in Online Supplemental Table S4. When extracting two factors, item adjective scores such as *confident*, *bold*, and *daring* (factor loadings $\geq .65$ across samples) loaded strongly onto the first factor across samples. A range of other items assessing feeling excited, relaxed, and at ease also marked this first factor. Adjectives such as *sympathetic*, *loving*, and *compassionate* loaded strongly on the second factor (factor loadings $> .75$ across samples). Thus, emergent factors in the two-factor solution represented a distinction between self- and interpersonally-oriented PE. Accordingly, we labeled the first and second factors *Self-Oriented Positive Emotionality* and *Social Affection*, respectively. The average level of communality for items was .58 and .47 in the

community and undergraduate datasets, respectively, indicating an acceptable level of communality (i.e., values $< .40$ may be problematic; Costello & Osborne, 2005). This two-factor solution replicated well across samples (comparability coefficients for each factor $\geq .98$ in all cases). Both factors correlated strongly in each dataset (interfactor $r = .63$ and $.61$ in the community and undergraduate samples, respectively).

As shown in Online Supplemental Table S5, when extracting three factors, adjective scores such as *sympathetic* and *compassionate* again loaded strongly onto a *Social Affection* factor (i.e., Factor II in both datasets). Additionally, adjective scores reflecting lower-arousal PE experiences assessed by items such as *calm* and *relaxed* (loadings $> .80$ across samples) loaded onto a factor labeled *Serenity* (Factor I and Factor III in the community and undergraduate datasets, respectively). Finally, items assessing high-arousal PE (e.g., *bold*, *excited*) loaded $> .65$ onto Factor III in the community data and Factor I in the undergraduate data. We labeled this factor *Joviality*, a term commonly used to label factors reflecting an array of high-arousal PE experiences (e.g., Watson et al., 1999). All PE factors in each dataset again were moderately to strongly positively intercorrelated, with all interfactor correlations $\geq .40$. For these three-factor solutions, the average level of communality was $.63$ and $.51$ in the community and undergraduate datasets, respectively, again indicating acceptable commonality levels.

All three factors replicated across samples (all comparability coefficients for parallel factors $\geq .93$), but it is worth noting that the Serenity factor was broader in nature in the community than undergraduate data. Specifically, only four items (i.e., *calm*, *relaxed*, *at ease*, *peaceful*) loaded $> .50$ on the Serenity factor in the undergraduate data. These same items loaded strongly on Serenity in the community data. However, adjectives such as *determined* and *attentive* also loaded strongly onto Serenity in the community data (both loadings $\geq .50$), but

instead loaded most strongly Joviality in the undergraduate data (loadings again $\geq .50$).

Although some items showed differential loading patterns, overall factor comparability still may have been strong due to the same core item sets loading most strongly on Serenity as well as other items having similar loadings across samples (e.g., adjectives such as *daring*, *excited*, *in awe* all loaded very weakly on Serenity across samples).

Factor Solutions with Four Factors

Next, four-factor solutions from the community and undergraduate datasets are shown in Table 3 and Table 4, respectively. Items assessing high-arousal PE (e.g., *excited*, *playful*, *energetic*, *daring*) loaded strongly onto Factor I in the community data and Factor II in the undergraduate data. We again labeled these factors *Joviality*. Adjectives assessing approach-oriented PE experiences such as *bold* and *daring* tended to load more strongly on this Joviality factor in the community than undergraduate dataset, whereas adjectives such as *energetic*, *enthusiastic*, and *lively* showed comparatively stronger loadings on this factor in the undergraduate dataset. Still, many of the same items loaded strongly on these factors, which our comparability coefficient analyses indicated were similar (both coefficients $\geq .93$). Next, a *Social Affection* factor again emerged (Factor II in the community dataset; Factor I in the undergraduate dataset), and comparability coefficients scored in either dataset indicated strong factor similarity (both coefficients $\geq .98$).

Adjectives such as *relaxed* and *peaceful* again loaded strongly onto a *Serenity* factor (Factor III in the community dataset; Factor IV in the undergraduate dataset). A larger number of adjectives loaded strongly onto Serenity in the community than undergraduate results (i.e., only four items with loadings $> .50$ in the undergraduate data), though this factor was comparable across samples overall (both comparability coefficients $\geq .94$). Lastly, adjectives

such as *determined*, *alert*, and *attentive* loaded strongly onto an *Attentiveness* factor that was not identified in previous factor solutions (Factor IV in the community dataset; Factor III in the undergraduate dataset). Both comparability coefficients for this fourth factor were $\geq .90$. The average level of communality was .67 and .54 for the four-factor solutions in the community and undergraduate datasets, respectively, once again indicative of acceptable communality levels.

A hierarchical depiction of solutions ranging from one to four factors is shown in Figure 1, which depicts the “unfolding” of factor structures across samples. As shown in Figure 1, these hierarchies closely parallel each other, with the exception of *Attentiveness* from the four-factor solutions having its strongest path coefficient with different factors from the three-factor solutions (i.e., .72 with *Serenity* in the community data; .87 with *Joviality* in the undergraduate data). This difference likely emerged due to item content reflecting *Attentiveness* (e.g., *attentive*, *determined*) loading most strongly on different factors across datasets in the three-factor solutions as reviewed. Acknowledging this difference, all factors from the four-factor solutions were well-defined, psychologically meaningful, and generally replicable as reviewed.

Solutions with Five or More Factors

Although we found evidence for four replicable factors, convergence in results was poorer when extracting five factors in each dataset. The fourth factor in the community data, on which items such as *alert* and *determined* loaded strongly, had no clear parallel in the undergraduate data when extracting five factors; specifically, all comparability coefficients for this community dataset factor were $< .80$ with all undergraduate dataset factors. Moreover, the fifth factor in the community dataset on which adjectives such as *grateful* and *thankful* loaded strongly did not have a strong parallel factor (i.e., highest comparability coefficient = .87 when using the community dataset for scoring; no coefficients $> .83$ when scoring in the undergraduate data).

Similar issues regarding poor cross-sample factor comparability arose for six-factor solutions. When extracting six factors, adjectives such as *alert* and *attentive* loaded strongly onto the fifth factor in the community dataset, but this factor did not appear to replicate in the undergraduate dataset (i.e., no comparability coefficient $\geq .75$). We also identified a Heywood case in the community dataset, as the adjective *relaxed* loaded 1.02 on the first factor in this dataset. Heywood cases may emerge due to overfactoring and factors being narrowly defined, among other reasons (de Winter & Dodou, 2012). Therefore, we did not consider these factor solutions or solutions with greater numbers of factors further, as we focused on examining associations subsequently for factor scores representing the four replicable factors described.

Online Community Sample Factor Associations

We first examined correlates for emergent PE dimensions with PANAS-X NA scores. Correlations with PANAS-X NA for Joviality, Social Affection, Serenity, and Attentiveness were $-.06$ ($p = .22$), $-.14$ ($p = .006$), $-.57$ ($p < .001$), and $-.22$ ($p < .001$), respectively; thus, Serenity's correlation was much stronger than the correlations for other PE dimensions.

Next, Table 5 presents correlations for emotionality dimensions with other study variables. As predicted, PANAS-X NA was associated robustly with BFI-2 Negative Emotionality and internalizing symptoms. The general PE dimension displayed its strongest correlation with BFI-2 Extraversion ($r = .67$), correlated at least moderately with all FFM domain ratings, and showed some other robust associations (e.g., $r = .50$ with IDAS-II Euphoria).

At a general level, all four PE dimensions displayed robust correlates with BFI-2 Extraversion (all r s $> .40$). However, there was notable variation in the magnitude of these correlates; for example, Joviality correlated $.66$ with extraversion, whereas Social Affection correlated $.41$ with this same trait dimension (z estimate for correlation comparison = 6.60 ; $p <$

.001). Furthermore, Joviality correlated significantly more strongly with IDAS-II Euphoria, NARQ Admiration, and CAT-PD Exhibitionism than other PE facets (all correlations significantly stronger than correlates for all other facets at $p < .001$).

Social Affection's most distinctive correlates were with BFI-2 Agreeableness ($r = .64$; correlation significantly different from those for other PE facets at $p < .001$) and with NARQ Rivalry scores ($r = -.40$). Next, Attentiveness showed the strongest correlation with BFI-2 Conscientiousness of any PE facet ($r = .54$; association was not significantly different than that for Serenity, $r = .48$). Attentiveness also correlated strongly with BFI-2 Open-Mindedness ($r = .53$; correlation significantly different than those for other PE facets at $p < .001$). Finally, Serenity correlated very strongly and negatively with BFI-2 Negative Emotionality ($r = -.77$; $p < .001$ for comparisons with correlations for other PE facets). Unlike other PE facets, Serenity scores also were associated strongly and negatively with IDAS-II Dysphoria and Social Anxiety scores ($r_s \geq .50$; $p < .001$ for all comparisons with other PE facet correlations).

Multiple Regression Analyses Controlling for Negative Emotionality

Follow-up multiple regression analyses were conducted to examine the extent to which PE facet dimensions—and Serenity in particular—continued to show robust associations even when accounting for the overlap (a) amongst PE scores and (b) for PE scores with PANAS-X NA. Examination of the variance inflation factor (VIF) to detect issues related to multicollinearity indicated that no independent variable had a VIF estimate ≥ 4.0 , a benchmark often used for identifying problematic multicollinearity levels (Fox, 1991).

Table 6 presents standardized beta weights from these regressions. These results reinforce several aspects of the correlational analyses, including Joviality being tied closely to extraversion ($\beta = .55$; $\beta_s < .15$ for other PE facets). For example, Social Affection again showed specificity in

its associations with BFI-2 Agreeableness ($\beta = .69$), and high-arousal PE reflected by Joviality also associated strongly with specific externalizing measures (e.g., CAT-PD Exhibitionism). Joviality also was very strongly associated with IDAS-II Euphoria (e.g., “had so much energy”; $\beta = .75$), likely due to both measures assessing energy and excitement.

Perhaps most notably, Serenity showed few robust associations after controlling for its overlap with other PE facets and PANAS-X NA scores, including showing only weak associations with internalizing symptoms (e.g., IDAS-II Dysphoria). However, Serenity still associated strongly with BFI-2 Negative Emotionality ($\beta = -.61$). This association was noteworthy given that it was *stronger in magnitude* than PANAS-X NA’s association ($\beta = .34$) with BFI-2 Negative Emotionality, despite both PANAS-X NA and BFI-2 Negative Emotionality being directly used to assess tendencies toward experiencing negative mood states.

Discussion

Summary of Hierarchical Structures and Implications for Assessing Positive Emotionality

Overview and Implications of Factor Analytic Findings

Our primary goal was to articulate a hierarchical structure of dispositional PE ratings to inform assessment approaches in future research. We predicted that as many as eight, and at least five, replicable PE facets would emerge when examining hierarchical PE structures. However, factor solutions with five or more factors were problematic, as they were challenging to interpret and yielded one or more non-replicable dimensions. At the lowest level of our PE factor hierarchy, we identified four factors of Joviality, Attentiveness, Serenity, and Social Affection, consistent with our timestamped predictions for a four-factor structure (again, see <https://osf.io/u8apz>). These factors generally were replicable across samples, although some specific adjectives loaded most strongly onto different factors in some cases.

The four replicable factors we identified represented four of the five hypothesized factors from the five-factor solution (i.e., Joviality, Self-Assurance, Attentiveness, Serenity, Social Affection), with the exception of a distinct Self-Assurance factor failing to emerge when examining five-factor structures. We also hypothesized that other distinct factors reflecting dimensions such as gratitude would be identified in solutions with six or more factors, but factors representing these dimensions also failed to emerge in more complex factor solutions.

The Importance of Assessing Distinct Positive Emotionality Facets

Although we were not able to identify as many meaningful PE facets as predicted, results from the community data indicated that the replicable PE dimensions from the four-factor solutions still showed distinctive associations that would be masked by focusing analyses solely on composite PE ratings. For example, Joviality showed the clearest links with extraversion (hypothesized $r = .60$, actual $r = .66$), consistent with prior research. In contrast, PE experiences reflected by Social Affection (e.g., *affectionate*) associated robustly with agreeableness (hypothesized $r = .55$, actual $r = .64$) but were unrelated to extraversion in our regression analyses. This is notable given that extraversion facet scales assessing high-arousal PE (e.g., liveliness) from many omnibus personality inventories often are given general labels such as “Positive Emotions” (see Watson et al., 2015b for review), which might suggest a neat correspondence between PE and extraversion. However, both our results and broadened PE conceptualizations indicate that other FFM traits should be considered in addition to extraversion when evaluating alignment for PE dimensions with broader trait frameworks such as the FFM.

This was predicted given the content parallels for item adjectives used in our factor analyses with measures of specific FFM traits (e.g., Social Affection items such as *sympathetic* with agreeableness item content). Although these examples of PE overlap with FFM traits other

than extraversion are not surprising then, they illustrate *exactly why* researchers should be interested in advancing understanding of hierarchical models and assessing PE at the facet level when possible. For example, focusing analyses only on a general PE dimension when studying how PE is associated with personality pathology may mask distinctive relations for Social Affection item content, which is not included in many existing PE measures (again, see Table 1).

Further research is needed to build on our findings to reach consensus on how to optimally assess PE at different levels of breadth. However, in the meantime, we encourage researchers to use measures that were created explicitly to assess PE at the facet level when possible. Examples of such measures reviewed include the TAI and DPES, which through their facet scales assess many of the emotional experiences reflected by our emergent factors, albeit in somewhat different ways (e.g., the TAI includes a separate scale assessing vigor/energy, which the DPES does not). In making these recommendations, we are not advising that measure scores reflecting general PE should not ever be included in study analyses, but rather, that consideration of distinctive facet dimensions represents another important level of analysis.

It also is important to recognize that although the direction and magnitude of most associations aligned with our predictions, some associations were stronger than anticipated. This was the case for Serenity especially given its very strong associations with NE. Next, we review the implications of these findings for PE classification by discussing the substantive nature of each PE dimension, giving emphasis to discussing findings for Serenity in light of these results.

Serenity

Serenity was moderately to strongly intercorrelated with other PE facets (e.g., $r = .62$ with Joviality in the community data), indicating that it overlaps strongly with other aspects of the broader PE domain. We predicted that Serenity also would associate strongly with NE ratings.

However, the magnitude of the Serenity-NE associations were even stronger than predicted, particularly the $-.77$ correlation between Serenity with BFI-2 Negative Emotionality; Serenity also correlated $-.57$ with PANAS-X NA, though this correlation is more in line with prior research (e.g., Payne & Schnapp, 2014). Placing this association for Serenity with BFI-2 Negative Emotionality in context, correlations of this magnitude often are observed between *different measures of the same construct* (e.g., different measures of negative emotionality correlate $.75$ -. $.80$; Watson et al., 2015a). Furthermore, Serenity continued to be strongly associated with BFI-2 Negative Emotionality even in our regression analyses when controlling for PANAS-X NA, which is noteworthy given that both BFI-2 Negative Emotionality and PANAS-X were used to assess tendencies toward experiencing NE.

Why then were these associations so strong in magnitude? When considering post hoc explanations, this Serenity association with BFI-2 Negative Emotionality may have resulted from similar administration procedures for both our emotionality adjectives and the BFI-2. Specifically, the BFI-2 items are written as short phrases or lists of adjectives (e.g., “is outgoing, sociable”), with many of the BFI-2 Negative Emotionality items consisting of content that is very similar in nature to the item content that loaded strongly on Serenity. For example, the BFI-2 Negative Emotionality scale includes items such as “can be tense” as well as reverse-keyed items assessing emotional stability (e.g., “handle stress well”) aligning closely with items that loaded strongly onto Serenity (e.g., *relaxed*, *calm*). In contrast, all PANAS-X NA items directly assess NE experiences and do not require reverse-keying for scoring, which may explain in part why Serenity associated more strongly with BFI-2 Negative Emotionality than PANAS-X NA. Going forward, it will be important to directly compare the extent to which Serenity associates more strongly with NE assessed via the BFI-2 than other trait measures. For example, the

HEXACO Personality Inventory-Revised (HEXACO PI-R; Lee & Ashton, 2018) assesses NE using longer sentence statements than those provided in the BFI-2, and many HEXACO PI-R items focus on NE experienced in specific circumstances (e.g., “get anxious about making important decisions”).

Acknowledging these differences across measures, different models provide similar descriptions of emotional stability (or low NE) as reflecting tendencies toward being relaxed and calm across situations (Lee & Ashton, 2018; Soto & John, 2017; Watson et al., 2015b). Item content related to this definition loaded strongly onto Serenity here as reviewed, highlighting possible “jingle-jangle” issues (i.e., content assessing tendencies toward feeling calm being given different labels). Taken together, the strong associations for Serenity and NE likely are due to a combination of construct overlap and methodological factors (i.e., similarities in item content and wording). At a minimum, our results and consideration of these issues indicates that unlike other PE variants that are more distinct from NE, Serenity may represent a blend of low NE and high PE, as identified previously (Payne & Schnapp, 2014; Watson & Clark, 1999).

However, our results are not conclusive, and we hope that future research will investigate the degree to which specific aspects of Serenity are distinct from NE to inform affective assessment. Low-arousal affective experiences (e.g., feeling peaceful, relaxed) reflecting Serenity are described as core to the broader PE domain across many models (e.g., Cowen et al. 2019; Fredrickson, 2013). Important cross-cultural differences in experiencing and valuing low-arousal experiences of PE also have been consistently identified, and PE experiences may vary according to other factors such as age (e.g., older adults may experience less high-arousal PE; Tsai et al., 2017). Furthermore, other research indicates a meaningful distinction between experiences of contentment (e.g., feeling content, satisfied) and tranquility (e.g., feeling calm,

serene; Berenbaum et al., 2019), but only five adjectives broadly related to these constructs were included in our study to model a potential Serenity facet. Therefore, it will be important to determine the degree to which different types of low-arousal PE identified in previous research such as contentment and tranquility appear distinct from NE across contexts and when using different assessment approaches (e.g., assessing PE experiences in specific situations).

Social Affection

Item content reflecting Social Affection emerged as distinguishable from other aspects of PE even when extracting two factors across samples, highlighting its distinctiveness. Social Affection's robust associations with agreeableness were predicted as reviewed but demonstrate—perhaps more than any other facet—the importance of considering distinct dimensions when assessing PE. For example, in addition to Social Affection and Joviality showing differential associations with extraversion as discussed, they had markedly different associations with grandiosity and exhibitionism. These findings demonstrate clearly that specific PE ratings are associated meaningfully with traits other than extraversion, with emotional experiences represented by Social Affection being important for building social bonds and for self-regulation in social contexts based on prior research (e.g., Robinson, 2007).

Joviality

Joviality (e.g., feeling excited) seems most differentiable from other PE facets identified in that it reflects high-arousal PE, though some specific items that loaded strongly onto Attentiveness (e.g., *determined*) also may capture high-arousal PE to an extent. In addition to Joviality associating robustly with extraversion as predicted, other associations for Joviality with grandiosity, exhibitionism, and IDAS-II Euphoria (e.g., “had so much energy”) support this interpretation. These associations indicate distinctive connections for Joviality's unique variance

with specific aspects of externalizing psychopathology and hypomania, consistent with other recent research (e.g., Gruber, 2011; Stanton et al., 2019; Watson et al., 2015b).

Attentiveness

Lastly, consistent with our predictions and prior research, Attentiveness displayed specificity in its associations with conscientiousness. Again, this is not surprising based on content grounds (i.e., conscientiousness measures assess motivation and persistence), but it provides another example of how specific PE facets are associated with different trait profiles. One aspect of our findings that was not anticipated centers on Attentiveness's positive associations with open-mindedness, a trait typically weakly linked with emotionality ratings (e.g., Watson et al., 2000). When considering post hoc explanations, these associations may have been identified due to the Attentiveness factor being represented by item content such as *reflective* that was not predicted to load strongly onto Attentiveness in our analyses. Some items used to rate open-mindedness here assess tendencies toward being intellectually curious and interested in ideas, which someone describing themselves as reflective may be likely to strongly endorse. Given that these associations with open-mindedness are novel in some ways, it will be interesting to explore connections for this FFM domain with specific PE facets going forward.

The emergence of the Attentiveness factor and these associations also reflect expanded definitions of the PE domain as reviewed. For example, some of the items loading strongly onto Attentiveness (e.g., *concentrating, alert*) appear to include cognitive or thought-based elements. This may raise concerns about the relevance of content assessed by these items to the PE domain; however, Attentiveness was moderately to strongly correlated with other emergent PE factors when examining four-factor solutions. Furthermore, all Attentiveness items—and all PE items included in our factor analyses more generally—loaded strongly onto a common factor

when examining single-factor solutions. Taken together, this provides some basic evidence that all items included here reflect the same broad domain.

Future Directions and Limitations

Our results inform PE classification and assessment in the ways noted, but analyses of PE state ratings could provide different results. Relatedly, we were unable to examine how different functional and contextual factors may serve to differentiate various PE experiences (e.g., Attentiveness may facilitate goal pursuit more than some other PE types). It also would have been interesting to examine PE facet associations with other psychopathology commonly studied in relation to PE not assessed here (e.g., substance use). Thus, we hope future work will advance research in this area using other study designs (e.g., using intensive longitudinal designs).

Additionally, we included many adjectives in our factor analyses, yet we still may have failed to include a sufficient number of adjectives reflecting specific PE types that would have enabled us to identify more than four replicable dimensions in our hierarchical EFAs. This potentially could be important for making finer-grained distinctions amongst different types of low-arousal PE for example (e.g., tranquility versus contentment; Berenbaum et al., 2019). Related to this consideration, it will be important to evaluate low-arousal PE and NE overlap going forward as discussed, including determining if Serenity item content aligns more closely with some specific measures of NE than others (e.g., NE assessed via the BFI-2 versus HEXACO PI-R). Finally, views of what constitutes PE have expanded over time (e.g., by including attentiveness, compassion), but researchers continue to disagree about the boundaries of the PE domain. Acknowledging these issues, we hope that future research will build on these results in the ways described to sharpen understanding of hierarchical PE structures to promote consistency in assessment approaches across studies.

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Figure 1*Hierarchical Models of Positive Emotionality in the Community and Undergraduate Samples*

Note. The first hierarchy in Panel A ($N = 375$) is from the community sample, and Panel B ($N = 447$) is from the undergraduate sample. These two hierarchies mirror one another with the exception of the Attentiveness factors from the four-factor solutions having different primary path coefficients with factors from the three-factor solutions across these datasets. Only the strongest path coefficients for each factor with factors from the previous level are shown.

Table 1*Positive Emotionality Content Coverage of Existing Measures*

Positive Emotionality Facet	Example Scales
Joviality	PANAS-X Joviality, DPES Joy, mDES Amusement, mDES Joy, DPES Amusement, MAACL-R Positive Affect, TAI Geniality
Energy/Vigor	PANAS-X Joviality, MACL Surgency, MACL Vigor, MAACL-R Sensation Seeking, TAI Vigor
Self-Assurance/Boldness	PANAS-X Self-Assurance, DPES Pride, mDES Pride, MAACL-R Sensation Seeking, TAI Experience Seeking
Attentiveness	PANAS-X Attentiveness, mDES Interest, mDES Inspiration, MACL Concentration, MMSI Arousal-Alertness, TAI Attentiveness
Serenity	PANAS-X Serenity, DPES Contentment, mDES Serenity
Gratitude	mDES Gratitude, DPES Contentment, Gratitude Adjective Checklist
Social Affection/Compassion	DPES Love, DPES Compassion, mDES Love, MACL Social Affection, TAI Geniality
Awe	DPES Awe, mDES Awe, MMSI Curiosity

Note. Not every scale from each measure listed is shown above (e.g., the mDES includes adjectives assessing hope that were not clearly represented in most other measures). Some scales with different labels are listed together because they include at least some content relevant to the predicted positive emotionality facet (e.g., various amusement scales include content related to cheerfulness). Additionally, some scales are listed twice because they include content potentially relevant to multiple facets (e.g., PANAS-X Joviality includes adjectives such as *cheerful* but also adjectives such as *energetic*). DPES = Dispositional Positive Emotion Scales; MAACL-R = Multiple Affect Adjective Check List-Revised; MACL = Mood Adjective Checklist; mDES = Modified Differential Emotions Scale; MMSI = Multidimensional Mood-State Inventory; PANAS-X = Positive and Negative Affect Schedule-Expanded Form. TAI = Temperament and Affectivity Inventory.

Table 2*Adjectives Included to Assess Potential Positive Emotionality Facets*

Joviality	Happy, joyful, playful, silly, delighted, cheerful, amused, excited
Energy/Vigor	Enthusiastic, lively, energetic, active
Self-Assurance	Proud, strong, fearless, confident, bold, daring
Attentiveness	Concentrating, determined, inspired, alert, interested, attentive
Serenity	Relaxed, calm, peaceful, at ease, content
Gratitude	Appreciative, blessed, grateful, thankful
Social Affection	Sympathetic, admiration, forgiving, affectionate, warmhearted, kindhearted, close to others, compassionate, loving
Awe	Meaningful, amazed, fascinated, reflective, in awe, mindful

Note. Each adjective was predicted to have its strongest factor loading on the factor in the same row.

Table 3*Promax Factor Loadings of the Positive Emotionality Adjectives in the Community Sample*

Item Adjective	Joviality	Social Affection	Serenity	Attentiveness
Daring	.86	-.36	.02	.11
Excited	.85	.01	.08	-.06
Amazed	.78	.25	-.14	-.05
Fascinated	.73	.16	-.19	.07
Bold	.72	-.18	.06	.30
In awe	.71	.22	-.06	-.05
Silly	.68	.25	-.24	-.27
Admiration	.63	.32	-.06	.01
Amused	.61	.13	.15	-.06
Inspired	.56	.23	.01	.22
Playful	.55	.22	.21	-.10
Active	.54	-.04	.13	.29
Fearless	.53	-.34	.11	.22
Lively	.52	.08	.31	.11
Energetic	.51	.05	.26	.19
Enthusiastic	.48	.14	.36	.04
Delighted	.47	.27	.32	-.03
Proud	.39	.01	.31	.20
Kindhearted	-.16	.90	.06	.12
Sympathetic	-.10	.86	-.21	.19
Compassionate	-.14	.85	-.03	.20
Warmhearted	.00	.82	-.01	.12
Loving	.05	.76	.25	-.16
Affectionate	.22	.65	.13	-.11
Forgiving	.17	.57	.00	.00
Grateful	.07	.55	.20	.15
Appreciative	.15	.53	.10	.21
Thankful	.16	.47	.25	.11
Close to others	.08	.46	.46	-.12
Blessed	.19	.44	.10	.12
Meaningful	.17	.40	.27	.19
At ease	-.13	-.02	.95	-.01
Relaxed	-.06	-.08	.95	-.05
Calm	-.19	-.03	.94	.08
Peaceful	.08	.11	.72	.04

(table continues)

Table 3 (cont.)

Item Adjective	Joviality	Social Affection	Serenity	Attentiveness
Content	-.07	.15	.72	.07
Happy	.19	.16	.68	-.07
Confident	.22	-.19	.58	.33
Cheerful	.30	.25	.47	.00
Joyful	.41	.26	.46	-.13
Alert	-.11	.05	.03	.73
Attentive	-.11	.12	.17	.71
Determined	.04	.08	.11	.67
Concentrating	.02	.20	-.06	.66
Mindful	.03	.33	.05	.52
Reflective	.27	.28	-.35	.52
Interested	.13	.21	.19	.49
Strong	.29	.00	.28	.45

Note. $N = 375$. Factor loadings $\geq .40$ are **bolded**. Joviality correlated .55, .62, and .52 with Social Affection, Serenity, and Attentiveness, respectively. Social Affection correlated .52 and .44 with Serenity and Attentiveness, respectively. Serenity and Attentiveness correlated .53.

Table 4*Promax Factor Loadings of the Positive Emotionality Adjectives in the Undergraduate Sample*

Item Adjective	Social Affection	Joviality	Attentiveness	Serenity
Sympathetic	.80	-.03	-.07	-.08
Kindhearted	.74	.00	-.11	.21
Appreciative	.73	-.07	.16	-.11
Compassionate	.71	-.02	.09	.02
Warmhearted	.69	.24	-.11	.07
Loving	.69	.25	-.10	.03
Grateful	.67	-.03	.23	.02
Forgiving	.65	-.06	-.02	.08
Affectionate	.64	.19	-.12	-.04
Thankful	.58	.00	.26	.04
Meaningful	.57	.12	.20	.01
Blessed	.48	.08	.33	-.05
Admiration	.44	.20	.27	-.28
Mindful	.43	-.11	.37	.20
Close to others	.35	.25	.06	.17
Lively	-.02	.83	-.07	.12
Energetic	.05	.82	.00	-.03
Excited	.07	.74	.11	-.01
Enthusiastic	.08	.70	.12	-.01
Cheerful	.18	.69	-.09	.17
Playful	.11	.59	-.02	.07
Happy	.25	.58	-.12	.16
Daring	-.23	.54	.36	-.08
Joyful	.37	.53	-.04	.10
Amused	.13	.53	.21	-.02
Silly	.19	.43	.01	-.15
Active	-.03	.40	.25	.17
Delighted	.31	.36	.15	.19
In awe	.25	.34	.22	-.05
Determined	.04	-.04	.73	.09
Alert	.14	-.14	.60	.09
Confident	-.25	.26	.55	.29
Concentrating	.14	-.19	.54	.10
Attentive	.17	.06	.54	.10
Bold	-.18	.46	.53	-.03

(table continues)

Table 4 (cont.)

Item Adjective	Social Affection	Joviality	Attentiveness	Serenity
Inspired	.09	.29	.53	-.08
Proud	.07	.19	.44	.14
Fearless	-.31	.28	.43	.17
Reflective	.20	.10	.42	-.11
Strong	.01	.21	.41	.25
Fascinated	.17	.31	.39	-.22
Interested	.09	.37	.38	.04
Amazed	.12	.38	.37	-.19
Calm	.02	-.19	.14	.82
Relaxed	-.04	.15	-.11	.79
At ease	-.01	.09	.08	.75
Peaceful	.10	.02	.13	.63
Content	.25	.12	.26	.31

Note. $N = 447$. Factor loadings $\geq .40$ are **bolded**. Social Affection correlated .55, .44, and .36 with Joviality, Attentiveness, and Serenity, respectively. Joviality correlated .54 and .47 with Attentiveness and Serenity, respectively. Attentiveness and Serenity correlated .39.

Table 5*Correlates for Emotionality Dimensions in the Online Community Sample*

Scale	General NA	General PE	Joviality	Social Affection	Serenity	Attentiveness
<i>Personality</i>						
BFI-2 Negative Emotionality	.68	-.56	-.37	-.27	-.77	-.40
BFI-2 Extraversion	-.33	.67	.66	.41	.59	.49
BFI-2 Agreeableness	-.42	.50	.20	.64	.43	.34
BFI-2 Conscientiousness	-.41	.44	.20	.31	.48	.54
BFI-2 Open-Mindedness	-.21	.44	.33	.36	.27	.53
<i>Psychopathology</i>						
IDAS-II Euphoria	.07	.50	.67	.23	.37	.23
NARQ Admiration	-.11	.47	.57	.20	.36	.36
IDAS-II Dysphoria	.78	-.39	-.17	-.24	-.60	-.31
IDAS-II Social Anxiety	.66	-.33	-.17	-.14	-.50	-.30
CAT-PD Exhibitionism	.02	.30	.46	.06	.24	.14
NARQ Rivalry	.41	-.26	-.01	-.40	-.25	-.22
IDAS-II Mania	.50	-.02	.21	-.06	-.18	-.10
CAT-PD Grandiosity	.19	.00	.20	-.20	.00	-.05

Note. $N = 375$. Correlations $\geq |.40|$ are **bolded**. All correlations shown are Pearson correlations, and all correlations $\geq |.18|$ are significant at $p < .001$. General NA = Negative affectivity scores assessed using the Positive and Negative Affect Schedule-Expanded Form; CAT-PD = Comprehensive Assessment of Traits Relevant to Personality Disorder; IDAS-II = Expanded Version of the Inventory of Depression and Anxiety Symptoms; NARQ = Narcissistic Admiration and Rivalry Questionnaire.

Table 6*Multiple Regression Models Examining Associations for the Emotionality Dimensions in the Online Community Sample*

Scale	General NA	Serenity	Joviality	Social Affection	Attentiveness	Model R^2
<i>Personality</i>						
BFI-2 Agreeableness	-.32*	-.01	-.24*	.69*	.10	.56
BFI-2 Negative Emotionality	.34*	-.61*	-.02	.12*	-.06	.69
BFI-2 Open-Mindedness	-.25*	-.33*	.17	.20*	.48*	.35
BFI-2 Extraversion	-.24*	.05	.55*	-.01	.13	.53
BFI-2 Conscientiousness	-.16	.26*	-.25*	.09	.46*	.42
<i>Psychopathology</i>						
IDAS-II Dysphoria	.64*	-.23*	.07	-.04	-.07	.66
IDAS-II Social Anxiety	.55*	-.16	-.02	.09	-.12	.47
NARQ Rivalry	.41*	.14	.27*	-.52*	-.11	.36
IDAS-II Mania	.46*	-.03	.40*	-.14	-.12	.34
IDAS-II Euphoria	.15	.15	.75*	-.18*	-.12	.50
NARQ Admiration	-.11	-.07	.65*	-.18*	.12	.36
CAT-PD Exhibitionism	.05	.08	.60*	-.26*	-.08	.27
CAT-PD Grandiosity	.21	.13	.42*	-.42*	-.10	.21

Note. $N = 375$. All values are standardized beta weights, and all values $\geq |.30|$ are **bolded**. Standardized beta weights that are significant at $p < .001$ are highlighted with an asterisk. All overall models were significant at $p < .001$. General NA = Negative affectivity scores assessed using the Positive and Negative Affect Schedule-Expanded Form; CAT-PD = Comprehensive Assessment of Traits Relevant to Personality Disorder; IDAS-II = Expanded Version of the Inventory of Depression and Anxiety Symptoms; NARQ = Narcissistic Admiration and Rivalry Questionnaire.

Online Appendix 1: Study Preregistration Information

Time of Preregistration

All preregistration information described subsequently was timestamped on **April 22, 2020**.

Overview of Preregistered Research

The primary goal of this research is to inform how positive emotional experiences should be classified and assessed in future research. As a related secondary aim, we are interested in demonstrating that distinct types of positive emotional experiences (e.g., feeling enthusiastic versus experiencing gratitude) show differential patterns of correlates with well-being, personality, and psychiatric symptoms. The datasets collected for this research (i.e., 447 undergraduates and 375 community adults) represent a cross-sectional, observational study.

Nature of Registration

As described by Benning et al. (2019), registration efforts for data collection and analysis span a continuum ranging from preregistration before data collection begins to postregistration, which involves registering analyses prior to conducting them when using existing datasets. No registration for this study occurred prior to or during data collection, as we are registering analyses of existing datasets as described in more detail subsequently. Consequently, our approach aligns more closely with a **postregistration** rather than preregistration approach.

The first author of this study cleaned this dataset and thus was aware of some basic features of each sample dataset (e.g., amount of missing data, basic demographic information) prior to completing this data analytic registration. However, no other findings have been published using these datasets, and no primary study analyses were conducted prior to creating this registration. Based on recommendations provided by Benning et al. (2019) for creating registration plans, we

describe each of the following topics subsequently: (a) a brief rationale for this research, (b) study design and sample types (including participant inclusion/exclusion criteria), (c) handling of missing data and an overview of key study variables, (d) an overview of measures used and their scoring, and (e) key predictions for analyses to be conducted.

Background Information and Study Rationale

Measurement of Positive Emotional Experiences

Positive emotional (PE) experiences have been studied widely over the last several decades across the social, personality, and clinical psychology literatures. For example, the broaden-and-build theory of positive emotions has been an influential framework guiding research on how PE experiences both facilitate and result from having meaningful interpersonal interactions (Fredrickson, 2013). Numerous studies also indicate robust associations for positive emotional experiences with increased levels of subjective well-being. In the clinical literature, deficits in PE experiences are identified as criteria of a range of clinical disorders, including major depression, social anxiety, and schizophrenia spectrum disorders.

In most studies spanning these literatures, ratings of PE typically are aggregated into a global composite score using measures such as the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) or the modified Differential Emotions Scale (mDES; Fredrickson et al., 2003). Although this approach is efficient (e.g., assessing PE with the PANAS requires administering only 10 adjectives) and therefore can be applied in many different research designs, focusing only on global PE ratings masks the distinctive nature of specific emotional experiences comprising the broader PE domain (Stanton et al., 2016). For example, even though experiences of both (a) enthusiasm, liveliness, and fearlessness and (b) serenity and contentment both are identified as positively-valenced sets of emotional experiences, they have different

correlates and may serve different functions. Whereas experiences of serenity and contentment may be indicative of consummatory and affiliative needs being met, feelings of enthusiasm, pride, and fearlessness may function to facilitate reward and status seeking (DeYoung, 2013). In fact, although experiences of most PE variants are considered adaptive, experiences of pride and fearlessness have been found to associate positively with grandiose narcissistic traits and risk for hypomania/mania (Gruber, 2011). Thus, focusing assessment strategies solely on general PE scores fails to capture important nuances comprising interrelated but distinct PE experiences.

However, even if researchers wish to assess PEs at finer-grained level in studies, it is unclear which specific facets of PE should be targeted, as the field lacks a consensual, comprehensive taxonomy for classifying and studying different types of PEs. This lack of coherence represents a longstanding issue that has led to inconsistencies in measurement approaches and the interpretation of key findings across literatures, which has hindered research on emotion across contexts (e.g., which types of PE should be assessed when examining change in treatment; Cowen et al., 2019; Stanton & Watson, 2015). A cursory review of measures and models used to study PEs makes this lack of consensus on how PEs should be classified and studied apparent. For instance, the Positive and Negative Affect Schedule-Expanded Form (PANAS-X; Watson & Clark, 1999) includes three PE facet scales of Joviality (e.g., *cheerful*), Self-Assurance (e.g., *proud, strong*), and Attentiveness (e.g., *concentrating, determined*); in contrast, another widely used measure, the Profile of Mood States-Second Edition (Heuchert & McNair, 2012) classifies PEs into Vigor-Activity and Friendliness categories. Therefore, research is needed to clarify which specific aspects of PE experiences should be targeted in future research.

Current Study Goals

To inform how PE experiences can be classified and studied in a more comprehensive, consistent manner in future research, we aim to identify a replicable factor analytic model of PE experiences. We will examine hierarchical factor structures of PE across two samples (447 undergraduates and 375 community adults), with a focus on articulating the nature of PE experiences at both general (e.g., global ratings of PE) and specific levels (e.g., feeling excited versus appreciative). For the purposes of this study, we focused on assessing trait-like tendencies to experience specific mood states (i.e., asking participants the extent to which they generally feel happy, joyful, etc.), which often are referred to as “positive emotionality” (Stanton & Watson, 2015). Although we recognize the importance of examining the consistency of factor structures when using different temporal administration instructions in future research (e.g., asking participants how they generally feel versus how they feel currently), an examination of factor structures across multiple samples using different instruction variations is beyond our current study scope.

As a related secondary aim, we will examine the correlates for both general and specific PE factors with personality, interpersonal issues, and a range of symptoms in our sample of community adults. This will enable us to identify the extent to which distinct PE dimensions showed differential patterns of associations with these other variables. For example, based on prior research, feelings of excitement and energy would be expected to correlate more strongly with extraversion than would other PE experiences such as compassion, which may instead align more closely with individual differences in agreeableness.

Datasets and Data Collection Procedures

Overview of Samples and Data Collection Procedures

We will use data from two samples for our proposed analyses as discussed. Participants from both samples described completed study questionnaires using Qualtrics Survey software. The first is a sample of 447 university undergraduates recruited from a large Canadian university. Data from these participants were collected during the course of the 2018-2019 academic year via the Psychology Department research participant pool. Participants for the second sample were 375 community adults recruited from Amazon Mechanical Turk, with data collection for this sample occurring in the Fall of 2018. For both samples, eligibility requirements included being 18 years or older, able to provide informed research consent, and comfortable reading and writing in English. There were no other inclusion/exclusion criteria for participants from either sample.

Detailed demographic information on both samples is provided in the manuscript associated with this data analytic registration. To provide an overview, for undergraduate participants, average age was 18.6 years (SD 1.6), and the majority of participants identified as women ($n = 303$; 67.8%). The most common ethnicities endorsed by participants were White (40.9%), East Asian (e.g., Chinese descent; 28.2%), and South Asian (e.g., Indian descent; 16.6%). For the community sample, average age was 39.1 years ($SD = 12.1$). Slightly over half of the sample identified as men ($n = 201$; 53.6%), and the majority identified as White (73.3%).

Undergraduate Sample Missing Data

The undergraduate sample originally consisted of 491 participants, but 33 participant cases were removed prior to analyses due to these participants failing to answer all or virtually all study items. Additionally, another 11 participant cases were removed due to failing both of two obvious validity items (e.g., “select agree for this item”), which reduced this sample to the final number of 447 participants.

There were very few missing item responses across study measures after removing these problematic cases. For example, in the final sample of 447 participants, there were only four missing PE and NE item values in the entire dataset. The first author of this study imputed missing item responses using multiple imputation procedures conducted with SAS Version 9.4 prior to computing scale scores in each sample.

Community Sample Missing Data

The community sample originally consisted of 385 participants. However, 10 participant cases were removed due to failing to answer all or nearly all study items, reducing our effective sample size to 375 participants. None of these remaining 375 participants failed to correctly answer any of the study validity “catch” items (e.g., please select “strongly disagree” for this item).

Once again, there were very few missing data points in this second sample after removing cases missing all or nearly all study items. In fact, none of the remaining 375 participants were missing any of the items assessing PE or NE, and there were no more than two missing items total across all participants for any other study measures reported in this research. Once again, the first author of this study imputed missing item responses using multiple imputation procedures conducted with SAS Version 9.4 prior to computing scale scores in each sample.

Study Measures

Measure Scoring and Coding

Participants in both samples (i.e., undergraduate and community) rated themselves on a range of adjectives assessing PE and NE as explained, with community adult participants also completing a more extensive battery of personality and symptom questionnaires that are described in more detail subsequently. Note that undergraduate participants also completed

several other measures not used in this research, such as the Hypomanic Personality Scale; however, we did not include these other few measures in this study to (a) maintain consistency in primary analyses across studies given that community adults did not complete these measures and (b) because we already were planning to use a large number of items and scales in our analyses.

Similarly, community adults completed several other measures (e.g., ratings of vignettes describing individuals who are narcissistic) that were not included in our analyses for these same reasons. We did not transform any item or scale scores, and no other scoring alterations were made for any of the measures described here. For measures including reverse-coded items such as the Big Five Inventory-2 (BFI-2; Soto & John, 2017; <http://www.colby.edu/psych/wp-content/uploads/sites/50/2013/08/bfi2-form.pdf>), we reverse-coded items for scale-scoring consistent with measure scoring guidelines.

Assessment of Positive and Negative Emotional Experiences

Positive Emotionality. Participants from both samples were administered a wide range of adjectives assessing PE and NE experiences. As stated, we focused on assessing general tendencies to experience specific mood states. Thus, when rating themselves on these mood adjectives, participants were asked indicate to “what extent you generally feel this way” using a five-point rating scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

These instructions and rating scale follow the format of the PANAS-X (Watson & Clark, 1999). We used this administration format because it has been used widely when obtaining mood ratings and because many of the adjectives used for this research were drawn from the PANAS-X. Specifically, we administered all positive emotion adjectives from the three PANAS-X scales identified as assessing positive emotion: Joviality (8 items; e.g., *joyful*), Self-

Assurance (6 items; e.g., *proud, strong*), and Attentiveness (4 items; e.g., *determined*). The PANAS-X also includes adjectives in its Serenity (e.g., *at ease*) subscale that were included in analyses due to their relevance to the broader PE domain (Tsai, 2017).

Additionally, we included other adjectives reflecting PE experiences that have been a focus of research on prosocial behavior, interpersonal functioning, and resilience. For example, research on the influential broaden-and-build theory of PE also includes emphasis on socially-oriented emotional experiences such as love and compassion (Fredrickson, 2013), which previously have been identified as PE experiences representing a construct titled “social affection” in prior mood research using measures such as the Mood Adjective Checklist (MACL; Nowlis, 1965). Finally, frameworks such as the broaden-and-build theory and measures such as the PANAS-X also include assessment of PE experiences such as feeling awe or amazement. Therefore, we also included adjectives assessing such experiences in our analyses.

In total, we included 48 different adjectives assessing PE experiences in our analyses, as shown in Online Supplemental Table S1 below (note that we updated table labels here out of convenience for the reader, as table labels in the preregistration document differ and do not include a label as being supplemental). We included at least several adjectives reflecting each possible PE facet, as several or more indicators of each potential facet needed to be included in our factor analyses to enable factors reflecting each facet to be identified. These predictions shown in Online Supplemental Table S1 were made primarily by the study first and second authors, and these predictions and our factor analytic analyses are discussed in more detail subsequently.

Although many of the adjectives shown in Online Supplemental Table S1 were drawn from previous measures such as the PANAS-X and MACL, this also involved us writing some

additional adjectives or phrases not identified by existing measures to ensure that each potential facet was represented by several or more adjective indicators for our data analyses (e.g., we added adjectives such as feeling meaningful, reflective, and in awe, which may be relevant to a dimension such as *Awe*). Although it possible that emotional experiences such as feeling reflective or mindful may not reflect PE, it was necessary to adopt a broad assessment approach to determine the extent to which these emotional experiences are intertwined with other core PE experiences such as feeling joy.

Negative Emotionality. Participants from both samples also were administered the 10 adjectives (e.g., nervous, irritable, distressed) from the general Negative Affect scale of the PANAS-X. Again, participants were asked indicate to “what extent you generally feel this way” using a five-point rating scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Inclusion of these adjectives permitted us to determine the extent to which PE and NE dimensions showed differential patterns of correlates with other study variables.

Other Measures

Community adult participants completed a more extensive battery of measures than did undergraduates as described, including additional measures of personality, well-being, and psychopathology. Therefore, we also will examine relations for our emergent PE factors with measures of these other variables using data from the community sample.

Other measures that will be incorporated into in our analyses include the BFI-2 (Soto & John, 2017). The BFI-2 is a 60-item measure assessing both five-factor model domains and facets (e.g., Sociability, Assertiveness, and Energy Level are facet level scales comprising the extraversion domain). Participants rated themselves on all BFI-2 items using a 5-point scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*).

Participants also completed several other measures assessing interpersonal strategies and antagonism. This included the 18-item Narcissistic Admiration and Rivalry Questionnaire (NARQ; Back et al., 2013), which was administered to assess both agentic (i.e., using the 9-item Admiration scale) and antagonistic (i.e., using the 9-item Rivalry scale) interpersonal strategies. Participants responded to all NARQ items using a 6-point scale ranging from 1 (*not agree at all*) to 6 (*agree completely*).

Additionally, participants were administered the Grandiosity (7 items; e.g., “feel others are beneath me”) and Exhibitionism (6 items; “love to be the center of attention”) scales from the Comprehensive Assessment of Traits relevant to Personality Disorder (CAT-PD; Simms et al., 2011). Participants responded to all CAT-PD items using 5-point scale ranging from 1 (*very untrue of me*) to 5 (*very true of me*).

Finally, participants completed select scales from the Expanded Version of the Inventory of Depression and Anxiety Symptoms (IDAS-II; Watson et al., 2012), a measure assessing a range of symptom dimensions and well-being. Scales from the IDAS-II that were administered included Dysphoria (10 items; e.g., “felt depressed”; “blamed myself for things”), Social Anxiety (6 items; e.g. “worried about embarrassing myself”), Euphoria (5 items; e.g., “had so much energy it was hard for me to sit still”), Mania (5 items; “thoughts jumped rapidly from one idea to another”), and Well-Being (8 items; “looked forward to things”). These IDAS-II scales were selected for use in this study given that they were expected to show robust positive (e.g., Euphoria) or negative (e.g., Social Anxiety) associations with PE. Participants were asked to indicate how much they experienced each symptom over the past 2 weeks using a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*).

Study Analyses and Hypotheses

Overview of Hierarchical Factor Analytic Analyses

We plan to conduct two primary series of analyses aligning with our study goals of (a) identifying replicable factor structures of PE and (b) examining the personality and psychopathology correlates of general and specific PE dimensions. For our first series of analyses, we will examine hierarchical factor structures of PE, beginning with extracting a general PE dimension in each sample and then subsequently examining solutions with an increasing number of factors. In both samples, we plan to conduct exploratory, principal factor analyses, rotating factors using promax for solutions with more than a single factor.

To guide us in determining how many factors to extract in each dataset, we will use both parallel analysis and Velicer's minimum average partial (MAP) test. Although results from our hierarchical PE models will be based on principal factor analyses, it is recommended that these two procedures are conducted with principal components rather than principal factor analyses (O'Connor, 2000). Therefore, we will conduct them in this manner.

Although we will take information provided by these procedures into account when determining factor solutions to examine, given our focus on articulating a hierarchical model of PE, our primary objective will be to identify the largest number of interpretable, psychologically meaningful dimensions (i.e., each factor defined by several or more similar item adjectives) that replicate across samples. We plan to compute comparability or congruence coefficients to determine the similarity of factors across samples, with coefficients $\geq .90$ providing evidence that the same basic dimension emerged across samples (Everett, 1983).

Hypotheses for Factor Analytic Models

Maximum Number of Anticipated Factors and Factor Replicability. Online Supplemental Figure S1 shown below provides an overview of how we expected our hierarchical

models across samples to “unfold” when extracting an increasingly large number of factors. Predictions outlined in this model and discussed subsequently were made primarily by the first and second authors when planning data collection for this study. Note that Online Supplemental Figure S1 depicts the *maximum* number of replicable, well-defined factors that we anticipated it would be possible to retain. As this figure shows, we anticipated that at most, we potentially would be able to identify eight distinct, replicable dimensions in our hierarchical factor analyses, which we labeled *Joviality*, *Energy*, *Self-Assurance*, *Attentiveness*, *Serenity*, *Gratitude*, *Social Affection*, and *Awe*. Once again, Online Supplemental Table S1 provides an overview of specific items that we anticipated would define each of these factors.

We decided a priori that we would consider a factor well-defined if it had at least three item markers (a) loading $\geq .40$ on that factor and (b) having cross-loadings $\leq .30$ on other factors. Regarding factor replicability, we will consider an emergent factor replicable if that factor has a cross-sample factor for which a comparability/congruence coefficient $\geq .90$.

Additional Predictions for Other Factor Solutions. Overall, we had more confidence that broader dimensions identified at the top levels of the hierarchy shown in Online Supplemental Table S1 would be well-defined and replicable across samples. This was the case given prior research indicating that (a) respondents may have difficult distinguishing closely related experiences of PE (e.g., feelings of gratitude versus feelings of warmth) and/or (b) some PE experiences may often co-occur (e.g., excitement and high energy levels). Therefore, very specific factors may be difficult to identify in both samples, especially with the high likelihood that at least some items in each sample would not emerge as clear indicators of any factor at various levels of the hierarchy. Acknowledging these issues, we made the following hypotheses

for other specific factor solutions with fewer than eight factors (again, also see Online Supplemental Figure S1):

1. Single-factor solution: We predicted that nearly all PE adjectives would load at least moderately on this general factor across samples (i.e., $\geq .30$) and that this general dimension would be similar in nature across samples.
2. Two-factor solution: We also were confident that we would be able to identify a basic distinction between high (e.g., excitement, joy) and low-arousal PE (e.g., contentment, feelings of social affection) in a two-factor solution in both samples based on prior research (Heuchert & McNair, 2012; Stanton & Watson, 2015). We anticipated that each factor would be defined strongly by many items (i.e., 10+ items with loadings $\geq .40$) across samples.
3. Three-factor solution: Upon extracting three factors in each sample, we expected that we would be able to identify replicable dimensions corresponding with *Joviality* (e.g., feeling cheerful, joyful), *Serenity* (e.g., peaceful, content), and *Social Affection* (e.g., affectionate, compassionate, loving), as we included a significant number of adjectives that seemed to correspond roughly with these three broad dimensions. For all example adjectives listed in this paragraph and subsequently (e.g., “feeling content” as a descriptor for the Serenity factor above), we predicted that these item adjectives would load $\geq .40$ on that specific factor.
4. Four-factor solution: Our predictions for a four-factor solution mirrored those for a three-factor solution, with the exception of the items from the broader Joviality factor from the three-factor solution splitting to define (a) a narrower Joviality factor (e.g., excited, joyful) and a (b) an Attentiveness factor (e.g., feeling determined, alert). We made this

prediction given that Joviality and Attentiveness item content have been shown to be closely related yet distinct in factor analytic research (Watson & Clark, 1999).

5. Five-factor solution: Upon extracting five factors, we predicted that Joviality, Attentiveness, Serenity, and Social Affection factors would continue to emerge. We also predicted that an additional replicable *Self-Assurance* factor (e.g., felt proud, strong, fearless, bold, and daring) would emerge, as this item content seems to capture a reward- and approach-driven variant of PE potentially distinguishable from other PE types.
6. Solutions with six or greater factors: As noted, we were less confident regarding our predictions for solutions with relatively large number of factors. Therefore, although we anticipated that additional *Awe*, *Gratitude*, and *Energy/Vigor* factors may emerge in more complex solutions, we had less confidence in these very specific predictions.

Correlational Analyses

As noted, additional correlational analyses will be conducted only in the community sample. We will model emergent factors from our hierarchical analyses using regression-based factor scores. Specifically, we plan to examine the personality and psychopathology correlates of a general PE factor representing the broad dimension from the single-factor solution. We also plan to examine correlates for factors from the most complex factor solution we can identify (i.e., the factor solution with the largest number of replicable, interpretable dimensions). We chose to adopt this approach given that this specific factor model will represent the most nuanced possible model of PE that we can identify. Thus, we hoped that explicating the correlates of factors from this model would be useful for identifying similarities and differences in the correlates for different facet dimensions (e.g., Joviality versus Serenity) comprising the PE domain.

Although we were unsure of the number and nature of factors that would emerge in our hierarchical factor analyses a priori, we expected that we would be able to identify at least four to five well-defined replicable factors as described. We also will examine correlates for a general NE dimension to enable us to compare patterns of correlates for PE dimensions with those for NE. Note that in examining factor correlates, we will focus primarily on explicating broad patterns of relationships for factors (e.g., identifying the personality and psychopathology profile of individuals who describe themselves as jovial) versus evaluating the significance of individual correlations. Nonetheless, due to reporting many correlations, we will consider the statistical significance of all correlations at a $p < .001$ level.

Online Supplemental Table S2 provides an overview of the predicted correlates for (a) a general PE factor, (b) each factor from the predicted five-factor solution, and (c) a general NE factor. As these predictions illustrate, we anticipate that various PE dimensions will show distinctive patterns of correlates from one another in some ways (e.g., Social Affection will be most strongly correlated with agreeableness) and will show correlates differing in nature from NE. Based on our prior research (e.g., Stanton et al., 2016), we expect that emergent dimensions such as Serenity will show patterns of correlates most similar to those for NE, as NE and Serenity-item content appear to overlap more strongly than NE does with other PE variants.

Potential Deviations from Planned Analyses

Given the complex nature of our factor analyses involving a large number of items across multiple samples, we recognize that there is some possibility that our original data analytic plan for factor analyzing PE adjectives will require alterations after beginning primary study analyses. For example, if we are unable to identify replicable sets of dimensions when examining factor solutions with three or greater factors, then we may consider rerunning analyses with reduced

sets of PE items to see if clearer sets of factors then can be identified. We will note all deviations from the data analytic approach described here should they occur.

Finally, given the complexity of our data analytic approach, note that we will not focus here on examining how demographic variables such as gender and ethnicity might influence factor analytic models and patterns of factor correlates. Although these variables may have potentially important influences on some findings, we lack sufficient sample sizes to adequately examine these issues. For example, less than 150 participants in the undergraduate sample identified as men, a subsample size that is insufficient for examining the factor structure of 48 PE items. However, it is possible that we may conduct additional analyses based on feedback provided from journal reviewers.

Online Supplemental Figure S1*Preregistered, Predicted Hierarchical Model of Positive Emotionality*

Note. A hierarchical model of positive emotionality depicting the maximum number of replicable factors that we anticipate being able to identify. We will view a factor as well-defined and psychologically meaningful if it has at least three item markers (a) loading $\geq .40$ on that factor and (b) having cross-loadings $\leq .30$. We will consider a factor replicable if it has a parallel factor in each sample indicated by a comparability/congruence coefficient $\geq .90$. Attentive = Attentiveness; Self-Assur = Self-Assurance; Social Affect = Social Affection. This figure and all other preregistration information was timestamped on April 22, 2020.

Online Supplemental Table S1*Adjectives Predicted in our Preregistration to Define Each Factor in an Eight-Factor Model*

Factor	Item
Joviality	Happy, joyful, playful, silly, delighted, cheerful, amused, excited
Energy/Vigor	Enthusiastic, lively, energetic, active
Self-Assurance	Proud, strong, fearless, confident, bold, daring
Attentiveness	Concentrating, determined, inspired, alert, interested, attentive
Serenity	Relaxed, calm, peaceful, at ease, content
Gratitude	Appreciative, blessed, grateful, thankful
Social Affection	Sympathetic, admiration, forgiving, affectionate, warmhearted, kindhearted, close to others, compassionate, loving
Awe	Meaningful, amazed, fascinated, reflective, in awe, mindful

Note. Each adjective is predicted to have its strongest factor loading on the factor in the same row. Should each of these factors emerge, we predicted that each item would load $\geq .40$ on each factor. This table information and all other preregistration information was timestamped on April 22, 2020.

Online Supplemental Table S2*Preregistered General Estimates of Correlation Values for Emotionality Dimensions*

Scale	General NE	General PE	Joviality	Self-Assurance	Attentiveness	Serenity	Social Affection
<i>Personality</i>							
BFI-2 Negative Emotionality	.75	-.30	-.35	-	-	-.50	-
BFI-2 Extraversion	-	.70	.60	.50	.35	-	-
BFI-2 Agreeableness	-	.35	-	-	-	.35	.55
BFI-2 Conscientiousness	-	.35	.35	.35	.50	-	-
BFI-2 Open-Mindedness	-	-	-	-	-	-	-
<i>Psychopathology</i>							
IDAS-II Dysphoria	.70	-.50	-.50	-	-.40	-.55	-
IDAS-II Mania	.60	-	-	-	-	-.50	-
IDAS-II Social Anxiety	.55	-.40	-.40	-.40	-.35	-.40	-.40
IDAS-II Euphoria	-	.45	.45	.55	-	-	-
NARQ Admiration	-	.35	.45	.60	-	-	-
CAT-PD Exhibitionism	-	.35	.35	.40	-	-	-.40
CAT-PD Grandiosity	-	.35	.35	.40	-	-	-.50
NARQ Rivalry	-	-	-	.35	-	-.35	-.40

Note. All correlations computed will be Pearson correlations, and all correlations shown are rough estimates for each dimension with each of the other study variables shown. Only correlations that are predicted to be $\geq .35$ were shown; we focused on this relatively high cutoff given the monomethod assessment approach used for this research. Correlations $\geq .50$ are **bolded**. CAT-PD = Comprehensive Assessment of Traits Relevant to Personality Disorder; IDAS-II = Expanded Version of the Inventory of Depression and Anxiety Symptoms; NARQ = Narcissistic Admiration and Rivalry Questionnaire. This table information and all other preregistration information was timestamped on April 22, 2020.

Online Supplemental Table S3*Descriptive Statistics and Coefficient Alpha Estimates for Community Sample Measures*

Measure	<i>M</i>	<i>SD</i>	α
<i>Emotionality</i>			
PANAS-X Negative Affect	17.5	7.1	.92
<i>Personality</i>			
Extraversion	35.9	11.2	.91
Sociability	10.7	4.9	.90
Assertiveness	11.8	4.2	.82
Energy Level	13.3	4.1	.82
Agreeableness	46.4	8.6	.87
Compassion	15.8	3.4	.74
Respectfulness	16.9	2.9	.76
Trust	13.7	4.0	.80
Conscientiousness	47.4	9.7	.92
Organization	15.5	3.9	.88
Productiveness	16.0	3.6	.84
Responsibility	15.9	3.4	.81
Negative Emotionality	30.2	11.8	.93
Anxiety	11.3	4.5	.84
Depression	9.7	4.5	.89
Emotional Volatility	9.2	4.0	.86
Open-Mindedness	46.0	10.0	.91
Intellectual Curiosity	15.7	3.7	.81
Aesthetic Sensitivity	14.9	4.0	.82
Creative Imagination	15.4	3.7	.83

(table continues)

Online Supplemental Table S3 (contd.)

Measure	<i>M</i>	<i>SD</i>	α
<i>Personality Pathology</i>			
CAT-PD Exhibitionism	11.7	5.7	.87
CAT-PD Grandiosity	11.5	5.5	.91
NARQ Admiration	25.1	10.0	.89
NARQ Rivalry	18.7	8.5	.86
<i>Current Symptoms</i>			
IDAS-II Dysphoria	19.0	8.3	.91
IDAS-II Mania	8.7	4.2	.86
IDAS-II Euphoria	9.0	3.8	.76
IDAS-II Social Anxiety	11.5	5.9	.91

Note. $N = 375$ all measures shown above, which are from the community sample. For the PANAS-X Negative Affect scale in the undergraduate sample ($N = 447$), $M = 25.5$, $SD = 6.9$, and $\alpha = .84$. All personality measures shown are from the Big Five Inventory-2. CAT-PD = Comprehensive Assessment of Traits Relevant to Personality Disorder; IDAS-II = Expanded Version of the Inventory of Depression and Anxiety Symptoms; NARQ = Narcissistic Admiration and Rivalry Questionnaire; PANAS-X = Positive and Negative Affect Schedule-Expanded Form.

Online Supplemental Table S4*Promax Factor Loadings from the Two-Factor Solutions Across Samples*

Item Adjective	Community Sample		Undergraduate Sample	
	Self-Oriented PE	Social Affection	Self-Oriented PE	Social Affection
Confident	.87	-.05	.88	-.22
Daring	.85	-.27	.65	-.10
Bold	.83	-.04	.76	-.06
Excited	.74	.08	.61	.26
Lively	.74	.19	.62	.17
Energetic	.73	.17	.56	.26
Active	.72	.10	.62	.06
Relaxed	.72	-.04	.61	-.08
Fearless	.70	-.25	.72	-.26
Strong	.70	.16	.67	.06
Enthusiastic	.70	.23	.58	.26
Proud	.69	.12	.58	.12
At ease	.68	.03	.69	-.05
Calm	.67	.04	.59	-.09
Peaceful	.67	.18	.57	.07
Happy	.66	.22	.39	.40
Joyful	.62	.32	.37	.52
Cheerful	.61	.33	.51	.34
Delighted	.61	.35	.48	.41
Amused	.59	.20	.52	.28
Playful	.56	.27	.44	.25
Content	.55	.23	.49	.28
Inspired	.55	.36	.56	.19
In awe	.49	.28	.34	.36
Interested	.49	.38	.59	.20
Amazed	.48	.32	.41	.25

(table continues)

Online Supplemental Table S4 (cont.)

Item Adjective	Community Sample		Undergraduate Sample	
	Self-Oriented PE	Social Affection	Self-Oriented PE	Social Affection
Fascinated	.47	.25	.34	.28
Determined	.46	.28	.63	.04
Admiration	.44	.41	.08	.56
Attentive	.40	.32	.53	.21
Alert	.30	.24	.43	.12
Kindhearted	-.16	.99	-.05	.78
Compassionate	-.17	.96	-.04	.77
Sympathetic	-.28	.96	-.27	.87
Warmhearted	-.07	.91	.02	.80
Loving	.05	.80	.01	.80
Affectionate	.13	.70	-.10	.73
Appreciative	.24	.65	-.12	.79
Grateful	.23	.65	.08	.72
Forgiving	.07	.63	-.10	.68
Thankful	.33	.57	.15	.63
Blessed	.24	.53	.21	.55
Meaningful	.40	.52	.17	.65
Mindful	.28	.50	.31	.43
Close to others	.32	.50	.30	.43
Reflective	.16	.44	.30	.27
Concentrating	.27	.39	.35	.11
Silly	.21	.25	.18	.32

Note. $N = 375$ and 447 in the community and undergraduate samples, respectively. Factor loadings $\geq .40$ are **bolded**.

Online Supplemental Table S5*Promax Factor Loadings from the Three-Factor Solutions Across Samples*

Item Adjective	Community Sample			Undergraduate Sample		
	Serenity	Social Affection	Joviality	Joviality	Social Affection	Serenity
Calm	.96	-.02	-.18	-.08	-.02	.85
At ease	.92	-.03	-.12	.09	.00	.78
Relaxed	.89	-.10	-.06	-.04	-.01	.82
Confident	.76	-.13	.24	.70	-.26	.31
Content	.73	.16	-.06	.28	.27	.33
Peaceful	.72	.11	.08	.07	.11	.65
Happy	.61	.14	.19	.31	.37	.18
Attentive	.57	.27	-.07	.50	.16	.11
Strong	.53	.08	.31	.51	.02	.27
Determined	.50	.22	.07	.62	-.01	.09
Interested	.46	.31	.15	.62	.13	.06
Alert	.45	.20	-.07	.41	.08	.09
Cheerful	.45	.25	.30	.42	.30	.20
Proud	.42	.05	.40	.52	.08	.16
Kindhearted	.08	.94	-.15	-.19	.78	.22
Sympathetic	-.13	.92	-.09	-.16	.85	-.08
Compassionate	.04	.91	-.13	-.01	.74	.02
Warmhearted	.01	.86	.00	.01	.78	.08
Loving	.11	.74	.04	.03	.77	.04
Affectionate	.02	.64	.21	-.02	.71	-.04
Grateful	.26	.59	.08	.12	.69	.03
Appreciative	.20	.59	.16	.02	.75	-.12
Forgiving	-.02	.58	.17	-.14	.68	.08
Thankful	.29	.50	.17	.18	.60	.04
Blessed	.14	.47	.20	.32	.50	-.05
Meaningful	.36	.45	.18	.21	.60	.02

(table continues)

Online Supplemental Table S5 (cont.)

Item Adjective	Community Sample			Undergraduate Sample		
	Serenity	Social Affection	Joviality	Joviality	Social Affection	Serenity
Mindful	.33	.44	.05	.19	.41	.21
Close to others	.36	.44	.08	.20	.40	.18
Reflective	-.05	.39	.29	.44	.20	-.11
Concentrating	.31	.34	.05	.31	.08	.10
Daring	.11	-.34	.86	.77	-.18	-.07
Excited	.05	-.01	.84	.67	.18	.02
Amazed	-.17	.24	.77	.63	.16	-.18
Fascinated	-.14	.18	.73	.59	.20	-.22
Bold	.25	-.13	.73	.85	-.15	-.01
In awe	-.09	.21	.70	.44	.30	-.04
Silly	-.39	.20	.67	.34	.27	-.14
Admiration	-.06	.33	.62	.37	.48	-.28
Amused	.11	.12	.60	.59	.21	.00
Inspired	.13	.27	.56	.69	.11	-.07
Active	.31	.02	.56	.53	.02	.20
Playful	.14	.19	.55	.43	.21	.09
Fearless	.26	-.31	.54	.62	-.31	.19
Lively	.37	.10	.52	.57	.12	.15
Energetic	.36	.08	.51	.64	.18	.00
Enthusiastic	.37	.15	.48	.65	.19	.02
Delighted	.28	.26	.47	.38	.37	.21
Joyful	.36	.23	.41	.33	.48	.12

Note. $N = 375$ and 447 in the community and undergraduate samples, respectively. Factor loadings $\geq .40$ are **bolded**.