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The Ratio between Positive and Negative Affect and Flourishing Mental Health across Adulthood

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Abstract

Using data from a 30-day diary study with 239 adults (81 young, 81 middle-aged, and 77 older adults) this study examined whether a specific ratio between positive and negative affect distinguished individuals with different mental health status and especially flourishing from non-flourishing individuals. In addition, the study addressed whether there were age differences in the positivity ratio when daily affect data were used, and whether the proposed critical positivity ratio of 2.9 discriminated equally well between individuals with different mental health status across the adult lifespan. Findings showed that the ratio of positive to negative affect differed across adulthood such that age was associated with an increasing preponderance of positive to negative affect. The positivity ratio was also associated with mental health status in the hypothesized direction; higher positivity ratios were associated with better mental health. Finally, although the data supported the notion of a positivity ratio of 2.9 as a “critical value” in young adulthood, this value did not equally well discriminate the mental health status of middle-aged and older adults.

Keywords

adulthood; positive and negative affect; positivity ratio; mental health

Researchers have long suggested that the balance of positive to negative affect is critically relevant to well-being and adjustment (Bradburn, 1969; Kahneman, 1999). Recently, Larsen and Prizmic (2008) argued that the balance of positive to negative affect (hereafter referred to as the positivity ratio) is a key factor in subjective well-being and in defining whether a person flourishes. Larsen and Prizmic discussed work by several authors (e.g., Fredrickson & Losada, 2005; Gottman, 1994; Schwartz, 1997; Schwartz et al., 2002) which suggests that to maintain an optimal level of emotional well-being and positive mental health, individuals need to experience approximately three times more positive than negative affect. Given this background, the present study addressed three questions. First, is there evidence that a specific positivity ratio distinguishes individuals with different mental health status and especially flourishing from non-flourishing individuals? Second, are there age differences in the positivity ratio when daily affect data are used? Third, does the proposed critical positivity ratio of 2.9 discriminate individuals with different mental health status equally well across the adult lifespan?

The Critical Ratio of Positive to Negative Affect

The argument that the ratio of positive to negative affect distinguishes well-functioning individuals from others has been well articulated by Fredrickson and Losada (2005). Drawing on a variety of research, Fredrickson and Losada demonstrated that a positivity ratio of about 3:1 could distinguish between high- and low-performing work teams. Testing the generalizability of their model, these authors also examined the positivity ratios and mental health status of college students, using Keyes' (2002, 20005) definition of flourishing and non-flourishing mental health. Their data showed that a critical ratio of 2.9 distinguished young adults with flourishing mental health from those with non-flourishing mental health.

To date, however, examinations of the positivity ratio have not included adults of all ages. Yet, research suggests that positive and negative affect do not necessarily exhibit stable, or parallel, trajectories across adulthood. Regarding positive affect, studies conflict as to whether age is associated with slightly increased (Gross et al., 1997; Mroczek & Kolarz, 1998), slightly decreased (Charles, Reynolds, & Gatz, 2001; Griffin, Mroczek, & Spiro, 2006; Kunzmann, 2008), or unchanged positive affect (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Indeed, Kessler and Staudinger (2009) found that age was associated with increased levels of low arousal positive affect, but that levels of high arousal positive affect were stable across adulthood. Overall, age differences in positive affect appear to be small and are primarily evident when studies contrast very young and very old adults. In contrast, older adults experience decreased low and high arousal negative affect compared to younger adults (Charles et al., 2001; Diener, Sandvik, & Larson, 1985; Kessler & Staudinger, 2009). This decrease is most evident from young adulthood to middle-age, at which point age differences seem to stabilize (Carstensen et al., 2000; Charles et al., 2001) or slightly reverse (Griffin et al., 2006).

Such age differences in negative and positive affect suggest that older adults should exhibit higher positivity ratios than younger adults. Indeed, such a scenario fits with extant theory and empirical evidence suggesting that age is associated with improved emotion regulation (cf. Scheibe & Carstensen, 2010). We expected, therefore, that older adults would, on average, have higher positivity ratios than younger adults and that such age differences would primarily reflect age differences in negative affect.

Emotions, Mental Health, and Age

Interest in emotional experience across adulthood has grown at the same time that research on psychological well-being and mental health has shifted away from its traditional focus on illness to a consideration of human well-being and flourishing (Keyes, 2002; Ryff & Singer, 1998; Seligman & Csikszentmihalyi, 2000). Keyes (2002, 2007) proposed that normal functioning is best represented as a continuum, with *flourishing* mental health at one end and *languishing* mental health at the other. Such a conceptualization is consistent with the official definition of the World Health Organization (2004), which defines mental health not merely as the absence of mental illness but the presence of “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (p. 12). It also needs to be noted that conceiving flourishing mental health in this way shows a great deal of conceptual overlap with definitions of positive psychological well-being (Jahoda, 1958; Ryff & Singer, 1998). Keyes' (2007) conceptualization, however, extends these definitions by explicating in operational terms the combination of emotional, psychological, and social variables that contribute to flourishing mental health.

Building on this definition, Keyes (2002, 2007) used emotional, psychological, and social criteria and “diagnosed” mental health in much the same way the criteria of the Diagnostic

and Statistical Manual (DSM; American Psychiatric Association, 2000) diagnose mental illness. In doing so, Keyes established that flourishing adults lead meaningful, happy, and productive lives, whereas languishing adults, although free of clinically relevant mental illness, describe their lives as empty and stagnant. Demonstrating that “languishing” is more than a *lack* of positivity, Keyes (2007) found that in terms of emotional health, limitations of daily living, and lost days of work, the costs of languishing were comparable to those of major depression.

Integrating research on affect and mental health with research on age differences in affective experience raises several questions. One key question is whether the experience of positive and negative affect is similarly associated with mental health across adulthood. Notably, Fredrickson and Losada's (2005) theory of positive affect predicts that a positivity ratio of about 3:1 should distinguish equally well between flourishing and non-flourishing individuals of all ages. Yet, as we argued above, research suggests that older adults are likely to have higher average positivity ratios than younger adults. Frederickson and Losada's theory, therefore, leads to the hypothesis that a greater proportion of older versus younger adults should fit the criteria of flourishing mental health.

This hypothesis is consistent with research indicating that the prevalence of many DSM-IV disorders is greatest in young and middle adulthood and substantially lower by age 60 (Kessler et al., 2005). When mental health is characterized in terms of more than the absence of pathology, however, research on age differences is mixed. For instance, research on age differences in Ryff's (1989) scales of psychological well-being (SPWB) suggests that older adults report greater environmental mastery but lower personal growth and purpose in life than younger adults (Clark, Marshall, Ryff, & Rosenthal, 2000; Ryff, Keyes & Hughes, 2003). In addition, some studies using the SPWB have found that older adults exhibit scores indicating greater well-being than younger adults, whereas others have found the reverse (Clark et al., 2000; Ryff et al., 2003; Pudrovskaya, Springer, & Hauser, 2005). Finally, despite research showing that positive and negative affect are highly relevant to subjective well-being (Arthaud-Day, Rode, Mooney, Near, & Baldwin, 2005), subjective well-being is relatively stable across adulthood (Diener & Suh, 1997; Horley & Lavery, 1995).

Overall, therefore, although research on mental disorders (Kessler et al., 2005) and positive and negative affect (Scheibe & Carstensen, 2010) suggest that a greater proportion of older versus younger adults should fit the criteria of flourishing mental health, findings from studies on psychological and subjective well-being are not as unequivocal. Nonetheless, given how affect was assessed in the present study, we hypothesized that more older than younger adults should fit the criteria of flourishing mental health.

Advantage of Assessing Affect on a Daily Basis

Aside from examining the association between the positivity ratio and mental health status across the entire adult lifespan, the present study also has the advantage that adults' positive and negative affect was assessed on a daily basis. Examining affect with daily diary methods (Bolger, Davis, & Rafaeli, 2003) has several advantages over the one-time, retrospective assessments that are commonly used in affect research. First, as Bolger et al. (2003) have pointed out, by asking individuals to report on their affect on a daily basis, the likelihood of retrospection bias is minimized and more reliable person-level data are obtained. Notably, by assessing individuals' affect repeatedly over many days or time periods, one gets data that more accurately account for within-person variability in affect. Research has shown that individuals differ in how variable they are from day to day and some individuals are highly variable (e.g., Eizenman, Nesselroade, Featherman, & Rowe, 1997). Obtaining detailed daily assessments, especially over longer periods of time, therefore provides more reliable estimates of within-person mean levels of affect. Indeed, theory regarding the positivity ratio

seems to emphasize the notion that it is the *general* balance of positive to negative affect that a person experiences across different contexts and periods of time that is linked to favorable outcomes (cf. Larsen & Prizmic, 2008). When assessing a person's positivity ratio, therefore, it would seem to be particularly important to obtain multiple assessments over longer time periods in order to estimate their *general* balance of positive to negative affect with accuracy and reliability. More reliable estimates, in turn, can be expected to have greater predictive validity than simple, one-time assessments. In summary, using daily affect data results in more reliable within-person information and, hence, is ideally suited to examine the association of the positivity ratio with distinct categories of mental health.

Method

Participants

Participants were 239 adult men and women from north central Florida who were part of a study on daily stress. Participants did not have any major cognitive or sensory impairments, concurrent depression, or a history of severe mental illness. Twenty-five percent of participants were recruited through random digit dialing, 25% through letters of invitation to University of Florida alumni, 45% through convenience methods (e.g., flyers) and 5% through a retirement community.

Participants were recruited in 3 age groups: young adults ($n = 81$, M age = 26.1 years, SD age = 5.9 years, range: 18-39 years), middle-aged adults ($n = 81$, M age = 52.4 years, SD = 4.6 years, range: 40-59 years), and older adults ($n = 77$; M age = 71.4 years, SD = 7.8 years, range: 60 – 89 years). To achieve a balanced distribution of gender within age groups, it was necessary for us to oversample middle-aged and older men. Most participants were Caucasian (88%) and well educated with 49% possessing an undergraduate degree and 8% a post-graduate degree. Most young adults (73%) were single; most middle-aged (65%) and older adults (62 %) were married. Forty-five percent of young adults were employed and 55% were students; 90% of middle-aged adults were employed and 68% of older adults were retired. The median reported annual income was \$35,000-50,000.

Procedure

The study protocol began with a 2-hour individual testing session composed of self-report questionnaires administered by a trained tester. The day following this session, participants began 30 consecutive days of daily assessments that included self-administered diaries. Participants were paid \$20 for the baseline session and \$8 per completed diary, for a possible maximum of \$260. The 239 participants were in the study for 7,170 days (30 days each).

Measures

Sociodemographic Variables and General Indicators of Well-being

Sociodemographic information: During the baseline interview, participants reported their date of birth, which was used to calculate their age (in years). Participants also reported their gender, race (coded as *White/non-White* for this study), marital status (coded as *married/non-married* for this study), and education (in years). Participants also indicated their yearly income on a scale ranging from less than \$5,000 to \$150,000 and more.

Life satisfaction: Participants indicated how satisfied they were with their lives on a scale of 1 (*extremely unhappy*) to 6 (*extremely happy*).

Self-rated health: Participants rated their health, compared to other people their age, on a scale of 1 (*very good*) to 6 (*very poor*). Responses were reversed so higher scores indicate better health.

Physical symptoms: During the baseline, participants completed a short version of Larsen and Kasimatis' (1991) comprehensive symptom checklist (see Almeida, Wethington, & Kessler, 2002). Participants indicated how frequently they experienced 11 symptoms (e.g., headaches, nausea) in the previous week on a scale of 0 (*none of the time*) to 4 (*all of the time*). The number of symptoms participants rated a 1 (*a little of the time*) or more was summed to create a total score.

Frequency of Positive and Negative Affect and the Positivity Ratio—Each day, participants' rated their affect in a diary using the Positive Affect and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988). The PANAS consists of 10 positive and 10 negative affect items (e.g., excited, upset); participants indicated how much they experienced each affect in the preceding 24 hours on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*).

The frequency of positive and negative affect and the positivity ratio were calculated following the method described by Fredrickson and Losada (2005). Specifically, we summed the number of positive and negative affects experienced over the 30 days. Research has shown that adults' tend to report experiencing at least mild positive affect most of the time and that negative affect is more potent than positive affect (Cacioppo, Gardner, & Bernsten, 1999). In keeping with Fredrickson and Losada's approach, therefore, we counted positive affect items when ratings were ≥ 3 and negative affect items when ratings were ≥ 2 . The positivity ratio was computed for each participant by dividing the total number of positive affects by the total number of negative affects. ¹ The intercorrelation between mean positive daily affect and mean negative daily affect was $r(239) = -.13, p > .05$; the correlations of mean positive daily affect and mean negative daily affect with the positivity ratio were $r(239) = .26$ and $r(239) = -.38$, both $ps < .01$, respectively.

Keyes' Index of Mental Health Status—Following Keyes (2002, 2005), we constructed an index of mental health status based on adults' characteristics of positive functioning. In formulating his measure, Keyes attempted to capture multiple aspects of mental health, including psychological (Ryff, 1989), social (Keyes, 1998), and emotional well-being. The data in the present study were originally collected for a different purpose, thus, we could not exactly replicate Keyes' measure. Notably, we did not have measures of participants' social well-being. Furthermore, like Fredrickson and Losada (2005), we eliminated indicators of emotional well-being from our measure of mental health to avoid the circularity inherent in using affect as both an indicator and predictor of mental health. Thus, our index of mental health was based on Ryff's scales of psychological well-being (Ryff, 1989) that assessed meaningfulness and self-actualization as well as dispositional indicators of well-being (e.g., optimism, self-esteem). All measures used in the calculation of the mental health index were collected at baseline, i.e., prior to the daily affect data. Specifically, the mental health index included the following measures:

Dispositional optimism: The revised Life Orientation Test (LOT-R; Scheier, Carver, & Bridges, 1994) assessed each participant's tendency to behave positively and optimistically

¹Based on a reviewer's suggestion, we also computed participants' positivity ratios on a daily basis and then summed the number of days each participant had positivity ratios in excess of 2.9. The pattern of findings was unchanged when we used this alternative method of capturing participants' balance of positive to negative affect and examined whether there was evidence to support the existence of a critical value of 2.9.

when faced with challenges. Respondents indicated their agreement with 6 scorable items and 4 filler items on a 5-point scale (0 = *strongly disagree*, 4 = *strongly agree*). Higher scores indicate greater optimism. Research supports the reliability and validity of the LOT-R (Scheier et al.); here the coefficient of internal consistency (i.e., Cronbach's α) was .74.

Self-esteem: Participants completed the Rosenberg Self-Esteem Scale (SES; Rosenberg, 1989), a 10-item questionnaire measuring an individual's degree of positive self-regard. Participants rated items on a 4-point scale (1 = *strongly disagree*, 4 = *strongly agree*); higher scores indicate higher self-esteem. The reliability and validity of the SES has been extensively documented (Blascovich & Tomaka, 1991). The coefficient of internal consistency in the present study was .85.

Scales of psychological well-being: The mental health index included all six subscales of Ryff's Scales of Psychological Well-Being Scale (SPWB, Ryff, 1989; i.e., Self-Acceptance, Environmental Mastery, Purpose in Life, Positive Relations with Others, Personal Growth, and Autonomy). Each subscale includes 14 items and participants respond on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*). The SPWB has good internal consistency (all α 's $\geq .80$) and test-retest reliability (Ryff, 1989). In this study Cronbach's α ranged from .83 for the Autonomy subscale to .92 for the Self-Acceptance subscale.

Extraversion and Neuroticism: Both the extraversion and neuroticism subscales of the NEO-FFI (Costa & McCrae, 1992) were included in the mental health index. Each scale has 12 items and participants respond using a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). The NEO-FFI has high internal consistency, test-retest reliability, and convergent and discriminant validity (Costa & McCrae). In this sample, Cronbach's α was .86 for the neuroticism scale and .83 for the extraversion scale.

Profile of Mood States: Participants completed the short form of the Profile of Mood States (POMS-SF; Curran, Andrykowski, & Studts, 1995; McNair, Lorr, & Droppleman, 1981). Participants indicated how much they felt a particular way (e.g., energetic, confused) during the past 2 weeks on a 5-point scale (0 = *not at all*, 4 = *extremely*). The POMS-SF has excellent psychometric properties (Curran et al.). For the purpose of the present study, we used the tension, vigor, fatigue, and confusion subscales; Cronbach's α for these subscales was .85, .90, .91, and .77, respectively.

Item Overlap between the Mental Health Index and the Daily Affect Ratings—It should be noted that there is some item overlap between the PANAS (Watson et al., 1988), used to collect the daily affect ratings and the measures used to create the mental health index. Specifically, some of the items on the PANAS are identical to items on the POMS-SF (e.g., both include the item “active”; Curran et al., 1995), whereas others are similar (e.g., the PANAS includes the item “nervous,” whereas the POMS includes the item “uneasy”). As well, some of items on the neuroticism subscale of the NEO-FFI (Costa & McCrae, 1992) assess similar types of affect as assessed by the PANAS (e.g., the PANAS includes the item “jittery,” whereas the NEO-FFI asks participants to rate how often they feel “tense and jittery”). It should be emphasized, however, that the measures used to create the mental health index were collected at *baseline*, and preceded the collection of the daily affect data. In addition, the measures used to create the mental health index were worded to assess participants' dispositional or trait-like ways of being, whereas the PANAS was used to assess participants' day-to-day affect (i.e., over the past 24 hours). Finally, the items on the remaining measures used to create the mental health index (e.g., Ryff's scales of psychological well-being, etc.) show little, if any, item overlap with the PANAS.

Results

Assignment to Mental Health Categories

As outlined in the methods section, 14 scales were used to create the mental health index. Table 1 shows the descriptive statistics and correlations among these measures. Of the 91 correlations, 84 were significant at the $p < .01$ level. Neuroticism scores and POMS confusion, fatigue, and tension scores were negatively correlated with the remaining measures and were, therefore, reversed. Following Keyes' (2002) approach, we standardized participants' scale scores and classified them into the upper, middle, or lower tertile for each scale. Participants having 8 or more subscales in the upper tertile were classified as having *flourishing* mental health ($n = 61$). Participants with 8 or more subscales in the lower tertile were classified as having *languishing* mental health ($n = 65$). The remaining participants were assigned to the *moderately mentally healthy* category ($n = 113$). The percentage of flourishing adults in our sample was similar to that found in Keyes' (2005; 2007) work using nationally representative samples although our sample had a lower percentage of moderately mentally healthy adults and a somewhat higher percentage of languishing adults.²

Table 2 presents sociodemographic and well-being data by the three mental health categories. Chi-square tests found no significant gender, race (white versus non-white), or marital status (married versus not married) differences across mental health categories. Univariate analyses of variance (ANOVAs) found no significant age or income differences between the mental health groups.

ANOVAs, however, revealed that languishing and moderately mentally healthy individuals reported fewer years of education than flourishing individuals, $F(2,236) = 5.3$, $\eta^2 = .04$, $p < .01$. In addition, there were significant differences on self-rated health, $F(2,236) = 15.2$, $\eta^2 = .11$, life satisfaction, $F(2,236) = 13.2$, $\eta^2 = .21$, and physical symptoms, $F(2,236) = 20.1$, $\eta^2 = .15$, all p 's $< .001$. All three groups differed from one another such that languishing adults had scores indicative of the poorest well-being (i.e., poorest self-rated health, lowest life satisfaction, and highest physical symptoms) and flourishing adults had scores indicative of the highest well-being, with moderately mentally healthy adults falling in between.

Age Group, Mental Health Status, and Daily Affect

Across the sample, the mean frequency of daily negative affects endorsed with a rating of 2 (*a little*) or higher was $M = 2.0$ ($SD = 1.6$, range = 0.1-8.8), the mean frequency of daily positive affects with a rating of 3 (*moderately*) or higher was $M = 5.7$ ($SD = 2.6$, range = 0.1-10.0), and the mean positivity ratio was $M = 8.9$ ($SD = 20.0$; range = 0.2-154).³ Table 3 presents the mean daily affective experience by age group and mental health status.

To test for differences in affective experience due to age and mental health status, we performed a 3 (Age Group) $\times$ 3 (Mental Health Status) MANOVA with positive affect, negative affect, and the positivity ratio as the dependent variables. There was a significant multivariate effect of mental health status, Wilks' $\lambda = .75$, $F(6, 456) = 11.5$, $p < .001$, $\eta^2 = .13$, and age group, Wilks' $\lambda = .84$, $F(6, 456) = 7.06$, $p < .001$, $\eta^2 = .08$. The multivariate interaction of Age Group $\times$ Mental Health Status was not significant. The significant

²Note that Keyes (2009) presents the distribution of adults in the three mental health categories broken down for adults who have had an episode of mental illness in the preceding year (33% of adults) and those who have not (77% of adults). Given our screening procedures, we compared our distribution with adults in the latter group and adjusted the percentages presented by Keyes for this latter group to sum to 100% (rather than 77%).

³Given that there were 30 days of data collection, the maximum possible number of positive or negative affects participants could report experiencing was 300 (i.e., 30 days $\times$ 10 affect items per day). Consequently the possible range of the positivity ratio is .003 to 300 (i.e., 1/300 to 300/1). The actual range was 3 to 300 for the positive affects, 1 to 264 for the negative affects, and 0.2 to 154 for the positivity ratio.

multivariate effects of mental health status and age group were due to significant univariate effects for all dependent variables (all p 's < .001).

Focusing on age group differences, Tukey's HSD post-hoc test showed that young adults had significantly lower mean positive affect and higher mean negative affect than both middle-aged and older adults; the latter two age groups did not differ significantly on these variables (Table 3). Regarding the positivity ratio, Levene's test showed that the homogeneity of variance assumption was violated; thus, we used the Games-Howell post-hoc procedure (Games & Howell, 1976). This comparison showed that older adults had the highest mean positivity ratio, followed by middle-aged adults, then young adults; all 3 age groups were significantly different from one another (Table 3).

Regarding mental health status, Tukey's HSD post-hoc tests showed that languishing adults had the lowest mean positive affect and highest mean negative affect, whereas flourishing adults had the highest mean positive affect and lowest mean negative affect. The means for the moderately mentally healthy group fell in the middle; all 3 mental health groups differed significantly from one another (Table 3). In addition, Games-Howell post-hoc comparisons showed that languishing adults had significantly lower positivity ratios than both the moderately mentally healthy and flourishing adults (Table 3). The mean positivity ratios of flourishing and moderately mentally healthy adults were not significantly different from each other.

The Positivity Ratio as Discriminator of Mental Health Status

Next, we considered whether the positivity ratio was a useful predictor of mental health status using discriminant function analysis. The variables included in this analysis were the positivity ratio and the sociodemographic (i.e., education) and well-being indicators (i.e., self-rated health, life satisfaction, and physical symptoms) that differed by mental health status. Prior probabilities for the three groups were equal (i.e., .33) and all variables were entered simultaneously.

The first discriminant function was statistically significant, accounting for 97.0% of the between-group variability and having a canonical correlation of .60, Wilk's $\lambda = .630$, $\chi^2(10, N = 239) = 108.2$, $p < .001$. Table 4 shows the correlations between the discriminating variables and the canonical discriminant function, which revealed that the variable that contributed most to the overall discrimination between the mental health groups was participants' life satisfaction rating, followed by physical symptoms, self-rated health, and the positivity ratio. The values of the group centroids indicated that this function discriminated the flourishing group from the languishing group.

The two functions correctly classified 74% of the flourishing and 69% of the languishing adults, representing an average improvement of 38.5% over the prior probabilities. In contrast, only 47% of the moderately mentally healthy participants were correctly classified. The overall correct classification rate was 63.3%.

The Critical Value of the Positivity Ratio

Last we examined whether the hypothesized critical ratio (Fredrickson and Losada; 2005) distinguished equally well among flourishing and non-flourishing individuals at all ages. We also examined whether a higher proportion of older adults were classified as flourishing compared to younger adults.

To determine whether 2.9 was a critical threshold, we classified individuals into two groups: those with positivity ratios below 2.9 and those with positivity ratios above 2.9. Of the 239 participants, 129 had positivity ratios over 2.9 (i.e., 54% of the total sample). Considering

the age groups separately, 33% of young adults ($n = 27$), 54% of the middle-aged adults ($n = 43$), and 77% of the older adults ($n = 59$) had positivity ratios in excess of the hypothesized critical value. Then we performed a 2 (Above vs. Below 2.9) $\times$ 3 (Mental Health Status) chi-square test to assess whether having a positivity ratio above or below the hypothesized critical value differed by mental health group. This test was significant, $\chi^2(2, 239) = 41.8$, $p < .001$ and confirmed that a disproportionate number of languishing individuals had positivity ratios below 2.9 and a disproportionate number of flourishing individuals had positivity ratios above 2.9.

Next, we conducted a 3 (Age Group) $\times$ 3 (Mental Health Status) chi-square analysis to test whether a greater proportion of older than younger adults were assigned to the flourishing mental health group. The results of this chi-square test were not significant, indicating a similar distribution of young, middle-aged, and older adults across the mental health groups.

Last, we examined the mean positivity ratios presented in Table 3. Among young adults the mean positivity ratios for the languishing and flourishing groups flanked the hypothesized critical value of 2.9. Indeed, the mean positivity ratio for young adults categorized as being moderately mentally healthy was 3.0. Notably, however, middle-aged and older adults in all three mental health groups had mean positivity ratios in excess of 2.9 (see Table 3). Furthermore, the relatively large standard deviations in the mean positivity ratios of moderately mentally healthy and flourishing middle-aged and older adults suggested that among middle-aged and older adults there was high variability in positivity ratios even within mental health categories.

Discussion

This study addressed the association between the positivity ratio, age, and mental health status. Drawing on research on adult development and emotional experience (e.g., Carstensen et al., 2000; Charles et al., 2001) and Fredrickson and Losada's (2005) work on the positivity ratio, we examined whether our data supported the existence of an age universal critical positivity ratio. In synthesizing our findings, we focus first on the general issue of whether the positivity ratio is systematically associated with mental health status. Then, we turn our attention to whether there is a critical value of the positivity ratio that is equally discriminating of mental health status across adulthood.

The Ratio of Positive to Negative Affect and Mental Health

Scholars have long discussed the importance of the balance of positive and negative affect (Bradburn, 1969). Recently, Larsen and Prizmic (2008) reviewed the subjective well-being literature and concluded that to experience a minimum level of positive mental health, adults need to experience approximately three times more positive to negative affect. This conclusion is in keeping with Fredrickson and Losada's (2005) theory of the positivity ratio, which posits that a 2.9 ratio of positive to negative affect represents a critical threshold that can distinguish adults with flourishing mental health from those with non-flourishing mental health.

The data presented here clearly support the view that the ratio of positive to negative affect is associated with individuals' mental health status. Consistent with Keyes' (2002; 2007) proposition, we considered mental health to be more than the absence of mental illness and classified individuals into three different categories that represent a continuum of mental health, including *flourishing*, *moderately mentally healthy*, and *languishing* states. Our data showed that adults who were, at baseline, categorized as having flourishing rather than languishing mental health experienced a higher ratio of positive to negative affect on subsequent days. This finding is in keeping with extant research suggesting that the ratio of

positive to negative affect is an important predictor of mental health (cf. Larsen & Prizmic, 2008) and that both positive and negative affect are relevant to subjective well-being (Arthaud-Day et al., 2005).

Also in keeping with Fredrickson and Losada's (2005) theory and our expectations, we found that adults with positivity ratios lower than the 2.9 were significantly more likely than adults with positivity ratios above 2.9 to be classified as having languishing mental health. Indeed, our analyses revealed that in combination with physical symptoms, self-rated health, and life satisfaction – all well established indicators of subjective well-being (Eid & Larsen, 2008) – the positivity ratio contributed significantly to the discrimination of mental health status. Notably, these variables primarily distinguished languishing and flourishing adults, whereas adults in the moderately mentally healthy group were less accurately identified. This pattern, whereby the groups on the extreme of the mental health spectrum were easier to identify, is consistent with the interpretation that low positivity ratios (i.e., under 2.9) are a strong indicator of poor mental health.

Age and the Critical Ratio of Positive to Negative Affect

As hypothesized, data from the present study showed that the positivity ratio differed with age such that younger adults had the lowest mean positivity ratios, followed by middle-aged adults, and then older adults. This pattern is consistent with a growing body of research suggesting that age is associated with a better ability to maintain positive affect (Scheibe & Carstensen, 2010). This research includes studies on socioemotional selectivity theory (Carstensen, Issacowitz, & Charles, 1999) and adults' tendency to preemptively manage their emotions by managing their environment and social interactions (Aspinwall & Taylor, 1997), as well as studies suggesting that older adults are more flexible and selective in their use of coping strategies than younger adults (Blanchard-Fields, Mienaltowski, & Seay, 2007; Diehl, Coyle, & Labouvie-Vief, 1996).

Given that the positivity ratio reflects both positive and negative affect, we also examined age differences in these affect systems separately. Age differences in the positivity ratio appear to reflect differences in both the positive and negative affect systems. Regarding negative affect, our data were consistent with studies that show small, but significant, decreases in negative affect with age (e.g., Charles et al., 2001; Diener et al., 1985). Also conforming with research suggesting that age differences in negative affect stabilize around middle-age (Carstensen et al., 2000; Charles et al., 2001), we found the age differences in negative affect were most apparent when younger adults were compared with middle-aged and older adults.

In terms of positive affect, our data showed the reverse pattern of age differences. Specifically, consistent with previous research (Gross et al., 2007; Mroczek & Kolarz, 1998), younger adults reported lower positive affect than middle-aged and older adults. These findings are in keeping with research by Kessler and Staudinger (2009) indicating that age is associated with increased low-arousal positive affect (and stability in high-arousal positive affect). In addition, although the middle-aged and older adults did not report significantly different levels of positive or negative affect, a trend was present that favored the older adults. Thus, when combined in the positivity ratio, the total effect was that young adults had the lowest positivity ratios, followed by middle-aged adults, and then older adults who had the highest ratios of positive to negative affect.

Age, Mental Health Status, and the Universality of the Critical Positivity Ratio

Given the age differences in affect and the resulting positivity ratio, one might expect that older adults would be more likely to have flourishing mental health than younger and

middle-aged adults. Existing research does not support such a view, however, and indeed we did not find any age differences in the distribution of adults across the three mental health status groups. Rather, research suggests that when mental health is characterized in terms of positive mental health, rather than the absence of pathology, age differences are small (Pudrovska et al., 2005) and not necessarily consistent across studies. For instance, although older adults tend to report greater environmental mastery than younger adults, they also have been shown to report lower personal growth and purpose in life (Clark et al., 2000; Ryff et al., 2003). The lack of significant age differences in the likelihood of being categorized into the different mental health groups, therefore, fits within the body of research suggesting that although older adults are less likely than younger adults to meet the criteria for diagnosable mental health problems (Kessler et al., 2005), they do not necessarily possess better positive well-being.

Together, the lack of age differences across the mental health groups and the age differences in the positivity ratio suggest that the hypothesized critical ratio of 2.9 does not possess similar meaning across adulthood. Notably, Fredrickson and Losada's (2005) work on the critical ratio was done on young adult samples, which is the age group within which our data suggest the critical ratio is most applicable. Indeed, in our sample, the value of 2.9 sat exactly on the cusp between languishing and flourishing mental health among young adults, with moderately mentally healthy young adults having a mean positivity ratio of 3. Among middle-aged and older adults, however, our data indicated that even adults with languishing mental health had mean positivity ratios above 2.9. Furthermore, the variability in the critical ratios was particularly large among middle-aged and older adults. Overall, therefore, the proposed critical value of 2.9 appears to be less discriminating of mental health status in middle and later adulthood.

The critical ratio may be less meaningful in middle-aged and older adulthood because of differences in the social contexts that adults of different ages inhabit on a daily basis. For instance, in explaining why older adults exhibited less variability in their daily emotions than younger adults, Röcke, Li, and Smith (2009) argued that older adults tend to prefer familiar and predictable environments and routines. Research also suggests that older adults have fewer daily stressors and interpersonal tensions (Almeida & Horn, 2004; Birditt, Fingerman, & Almeida, 2005; Stawski, Sliwinski, Almeida, & Smyth, 2008) and manage their environments in ways that maximize positive emotions (Aspinwall & Taylor, 1997; Diamond & Aspinwall, 2003). Therefore, older adults may be less likely than young adults to be in social situations that elicit negative emotions or benefit from what Fredrickson and Losada (2005) called "appropriate negativity" (p. 685). Indeed, it is possible that the hypothesized critical ratio of 2.9 could be important at all ages, however, it may be most important within social situations that are not as common in later versus earlier adulthood (e.g., educational or employment situations). Nonetheless, our research suggests that, in general, the critical ratio of 2.9 is more applicable in younger adults compared to middle-aged and older adults.

Limitations and Future Research

Although adults' positive and negative affect was assessed daily over a 30-day period, this study is limited by its cross-sectional design and the use of the PANAS (Watson et al., 1988). First, as in all cross-sectional studies the effects of age and cohort are confounded and observed age differences may, in part, be due to cohort effects rather than chronological age. Second, the sample consists of relatively highly educated participants who, by design, were free of any major cognitive impairments, concurrent depression, or history of severe mental illness. This sample, therefore, is better suited to a consideration of individuals who fit the criteria of being 'moderately mentally healthy' and 'flourishing' and likely under-represent adults at the opposite end of the spectrum, namely those who are 'languishing' and

those with diagnosable mental illness. Ideally, studies on the positivity ratio would benefit from including a more representative sample of individuals. The degree of commitment and motivation required of participants to complete diary studies that span many days, however, often results in samples that are biased towards the more advantaged members of society.

Third, the PANAS primarily assesses high-arousal forms of positive and negative affect (Watson et al., 1988). Age differences in emotional experience, however, may not be the same when low- and high-arousal forms of positive and negative affect are considered separately (Carstensen et al., 2000; Kessler & Staudinger, 2009). Despite this limitation, however, recent research by Kessler and Staudinger (2009) suggests that age differences in low-arousal affect either favor older adults (i.e., for positive affect) or are neutral with respect to age (i.e., for negative affect). Our findings, therefore, are likely to underestimate the extent to which age differences in the positivity ratio favor older adults and provide a conservative test of the associations between age, affect, and mental health status.

This study leaves questions for future research. First, research should attempt to replicate our findings regarding age differences in the positivity ratio using measures of affect that assess low-arousal affect more comprehensively. Second, future research might consider whether there are particular domains of life (e.g., work versus home) in which the critical ratio hypothesized by Fredrickson and Losada (2005) is more closely linked with successful outcomes. Finally, our research clearly suggests that the proposed critical value of 2.9 is not age universal. Nonetheless, our research shows that the positivity ratio has utility in predicting mental health and the proposed critical value of 2.9 appears to be applicable to young adulthood. It remains possible, therefore, that future research could identify whether there are age-adjusted critical values that would be more discriminating of mental health status in middle-age and older adulthood. A search for such age-adjusted critical values, however, would be better suited to a study that included a larger and more representative sample.

Despite the limitations and questions that remain, data from this 30-day diary study showed that the positivity ratio differed across adulthood such that age was associated with an increasing preponderance of positive to negative affect. Furthermore, the positivity ratio was clearly associated with adults' mental health status, such that higher ratios of positive-to-negative affect were predictive of more positive mental health. Finally, our data support the conclusion that although the ratio of 2.9 may be a critical value in young adulthood, this value is not as discriminating of mental health status among middle-aged and older adults.

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Table 1
Intercorrelations and Descriptive Statistics of Measures Used to Create the Mental Health Index (N =239)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. LOT-R	---													
2. SES	.62**	---												
3. Autonomy	.22**	.44**	---											
4. Environmental mastery	.54**	.62**	.35**	---										
5. Personal growth	.35**	.41**	.40**	.44**	---									
6. Positive relations	.54**	.48**	.26**	.63**	.46**	---								
7. Purpose in life	.59**	.61**	.32**	.68**	.62**	.65**	---							
8. Acceptance	.66**	.75**	.42**	.71**	.51**	.60**	.81**	---						
9. Extraversion	.46**	.35**	.11	.48**	.39**	.65**	.56**	.48**	---					
10. Neuroticism	-.60**	-.66**	-.51**	-.65**	-.36**	-.48**	-.54**	-.71**	-.33**	---				
11. POMS-Confusion	-.23**	-.32**	-.20**	-.43**	-.24**	-.30**	-.34**	-.34**	-.19**	.43**	---			
12. POMS-Fatigue	-.27**	-.29**	-.10	-.48**	-.15*	-.27**	-.29**	-.38**	-.21**	.44**	.51**	---		
13. POMS-Tension	-.21**	-.33**	-.29**	-.39**	-.10	-.19**	-.25**	-.33**	-.08	.52**	.65**	.49**	---	
14. POMS-Vigor	.36**	.30**	.06	.49**	.27**	.43**	.48**	.43**	.60**	-.32**	-.29**	-.41**	-.15*	---
Mean	17.2	23.9	66.5	64.7	70.8	67.6	69.0	66.8	30.6	14.7	3.2	5.9	5.1	13.6
SD	4.0	4.3	9.5	10.4	7.7	11.2	9.6	12.2	7.5	8.0	3.0	4.7	4.2	5.0
Range	3-24	9-30	43-84	31-84	43-84	33-84	34-84	26-84	9-47	4-42	0-17	0-20	0-19	0-24

Note.

*
 $p < .05$.

**
 $p < .01$

Table 2
Descriptive Information and Key Variables by Mental Health Category

Variable	Mental Health Category		
	Languishing (<i>n</i> = 65)	Moderately Mentally Healthy (<i>n</i> = 113)	Flourishing (<i>n</i> = 61)
Proportion			
Women	.48 _a	.50 _a	.52 _a
White	.86 _a	.87 _a	.92 _a
Married	.34 _a	.28 _a	.23 _a
Means (standard deviations)			
Years of education	15.9 (2.9) _a	16.0 (3.0) _a	17.3 (2.7) _b
Income	6.9 (3.2) _a	6.9 (3.6) _a	7.4 (3.4) _a
Self-rated health	4.8 (1.0) _a	5.2 (0.7) _b	5.6 (0.6) _c
Life satisfaction	4.2 (0.7) _a	4.7 (0.7) _b	5.1 (0.5) _c
Number of physical symptoms	4.6 (1.8) _a	3.5 (1.8) _b	2.6 (1.6) _c

Note. Means in the same row that do not share the same subscript differ at $p < .05$.

Table 3
Means and Standard Deviations for the Positivity Ratio by Mental Health Category and Age Group

	Languishing	Moderately Mentally Healthy	Flourishing	All Mental Health Categories
Young adults				
Mean daily positive affects ^I	4.1 (2.2)	4.8 (2.4)	5.7 (2.3)	4.7 (2.4)
Mean daily negative affects ^I	3.2 (2.0)	2.6 (1.6)	1.9 (1.2)	2.7 (1.7)
Positivity Ratio	1.6 (1.3)	3.0 (3.0)	4.3 (3.4)	2.8 (2.8)
<i>n</i>	25	40	16	81
Middle aged adults				
Mean daily positive affects ^I	5.2 (2.1)	5.6 (2.5)	7.5 (2.0)	5.9 (2.4)
Mean daily negative affects ^I	2.5 (1.7)	1.8 (1.0)	1.1 (0.8)	1.9 (1.3)
Positivity Ratio	3.0 (2.9)	4.8 (5.6)	14.8 (18.0)	6.6 (10.5)
<i>n</i>	25	37	19	81
Older adults				
Mean daily positive affects ^I	4.3 (2.8)	6.3 (2.5)	7.8 (2.1)	6.4 (2.7)
Mean daily negative affects ^I	2.6 (2.1)	1.2 (1.2)	0.9 (0.8)	1.4 (1.4)
Positivity Ratio	3.2 (4.0)	17.3 (34.6)	26.7 (34.3)	17.8 (31.8)
<i>n</i>	15	36	26	77
Total sample				
Mean daily positive affects ^I	4.5 (2.3)	5.5 (2.5)	7.1 (2.2)	5.7 (2.6)
Mean daily negative affects ^I	2.8 (1.9)	1.9 (1.4)	1.2 (1.0)	2.0 (1.6)
Positivity Ratio	2.5 (2.8)	8.1 (20.7)	17.1 (26.0)	8.9 (20.0)
<i>n</i>	65	113	61	239

Note.

^I Positive affect items were counted when daily ratings were ≥ 3 and negative affect items were counted when ratings were ≥ 2 (see method section). Means were first estimated within-person (across study days) and then within age groups. Standard deviations are presented in parentheses.

Function Structure Matrix**Table 4**

	Function	
	1	2
Life satisfaction	.69	-.36
Number of physical symptoms	-.55	.32
Self-rated health	.48	-.09
Positivity ratio	.37	.27
Years of education	.24	.86