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ISSN: 1743-9760 (Print) 1743-9779 (Online) Journal homepage: www.tandfonline.com/journals/rpos20

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To cite this article: Daniel Martin & Stewart I. Donaldson (2025) Lessons from debates about foundational positive psychology theories & frameworks: Positivity Ratio, Broaden & Build, Happiness Pie, PERMA to PERMA+4, The Journal of Positive Psychology, 20:2, 254-268, DOI: 10.1080/17439760.2024.2325452

To link to this article: https://doi.org/10.1080/17439760.2024.2325452

THE JOURNAL OF POSITIVE PSYCHOLOGY
2025, VOL. 20, NO. 2, 254–268
https://doi.org/10.1080/17439760.2024.2325452

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RESEARCH ARTICLE

Lessons from debates about foundational positive psychology theories & frameworks: Positivity Ratio, Broaden & Build, Happiness Pie, PERMA to PERMA+4

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ABSTRACT

Positive psychology examines psychological phenomena that make life worth living. Critics of the field have argued that it engages in poor methodological and measurement practices. To elucidate some historical context surrounding these perceptions, and outline pathways by which positive psychological scientists may work to mitigate these perceptions, this review sought out to identify prominent lines of debate surrounding measurement and methodology. Five such debates surrounding foundational work on well-being were identified and reviewed. These involved the existence of a 'critical' positivity ratio that universally distinguishes flourishing and languishing individuals, positive upward spirals and whether positive emotions exhibit reciprocal causality with a broadening of thought-action repertoires and acquisition of social resources, the 'Happiness Pie' Model of Wellbeing and the appropriate role of mathematical analogy in conceptual theory-building, and the scientific value of well-being frameworks like PERMA and PERMA+ 4. Enclosed are lessons learned and recommendations for improving the science of positive psychology.

ARTICLE HISTORY
Received 15 June 2023
Accepted 31 January 2024

KEYWORDS
Positive psychology; methodological debates; methodological criticism; well-being; positivity ratio; Broaden-and-Build; positive upward spirals; Happiness PIE; PERMA; PERMA+4

The field of positive psychology has grown by leaps and bounds since its introduction about a quarter century ago. Donaldson et al. (2015) took stock of the science of positive psychology in their widely cited article 'Happiness, excellence, and optimal human functioning revisited: Examining the peer-reviewed literature linked to positive psychology', which identified more than 1,300 peer-reviewed publications on positive psychology topics, with more than 750 of these articles including empirical tests of positive psychology theories, principles, and interventions. These findings confirmed that the science of positive psychology had become a growing sub-area within the broader discipline of psychology specialized in using the scientific methods of psychology to better understand well-being, excellence, and optimal human functioning.

While the first decade of positive psychology was mostly experienced in the United States, Kim et al. (2018) in their article 'The International Landscape of Positive Psychology Research: A Systematic Review' demonstrated that the science of positive psychology quickly became an international endeavor. It was estimated that the majority of scholarly contributions to positive psychology are outside the US. The International Association of Positive Psychology (IPPA) was established in 2007 to create rigorous standards for positive psychology so that the field always represents the best levels of current knowledge (IPPA: https://www.ippanetwork.org/, International Positive Psychology Association, n.d. Gaffaney & Donaldson, 2024). The mission of IPPA is:

- To advance the scientific study and ethical application of positive psychology.
- To facilitate collaboration among researchers, teachers, students, and practitioners of positive psychology around the world and
- across academic disciplines.
- To share the findings of positive psychology with the broadest possible international audience.

As with most new scientific innovations, the science and practice of positive psychology has had its fair share of criticisms, critiques, and methodological debates. For example, van Zyl et al. (2023) systematically reviewed the literature and identified 177 unique criticisms and critiques of positive psychology (PP), which they grouped into six overarching themes (see Figure 1):

- PP lacks proper theorizing and conceptual thinking.
- PP has problems of measurement and research design.

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Figure 1. Summary of criticisms and critiques of positive psychology (van Zyl et al., 2023).

- PP is a pseudoscience.
- PP lacks novelty.
- PP is a decontextualized neoliberal ideology.
- PP is a capitalistic venture.

While the authors of this original review offered initial insights into the validity of each claim, Donaldson & Gaffaney (under review, Gaffaney & Donaldson, 2024) provided an evaluation framework for positive psychology researchers with criteria to evaluate the validity of each claim and to help researchers draw firm conclusions of whether these claims are unfounded, dated, or still relevant in 2023. While these reviews provide a wide angle of the range of critiques and criticisms of positive psychology, they stop short of examining each claim in depth to understand what the field might learn from these critical exchanges, debates, and diverse viewpoints. The main purpose of this paper is to study some of the most central methodological critiques and debates about the validity of positive psychology theories, frameworks, and research studies, with the aim of providing a better understanding of what we have learned from the debates, and how this new knowledge may be used to improve the science and practice of positive psychology in the future.

Methods

The primary goal of this review is to isolate and explore specific lines of methodological debate surrounding peer-reviewed positive psychology research focused on the topic of well-being, the most popular research topic in positive psychology (Donaldson et al., 2015). As a first step towards this end, a systematic literature search was conducted to capture all peer-reviewed articles linked to lines of criticism or debate aimed at specific methodological topics within the greater field of positive psychology. The literature search was conducted through the Web of Science™ and Google Scholar in four waves. Each wave was conducted with a specific goal vis-a-vis the development of a comprehensive list of articles constituting the most prominent lines of methodological debate surrounding the field of positive psychology and positive psychological topics. The goals of and processes underlying each wave are detailed below.

The first wave of the search consisted of developing an initial list of methodological critiques aimed at the field of positive psychology in general and was conducted in three steps. First, a Boolean search for the terms 'Positive Psychology' AND 'Critique' OR 'Positive Psychology' AND 'Criticism' on the Web of Science™ database yielded 110 peer-reviewed articles. Abstract readings of these articles were conducted to filter out works that provided conceptual, ethical, or otherwise non-methodological criticisms. After filtering out articles that were not explicitly aimed at discussing methodological concerns, the search yielded 15 articles total. Next, a Google Scholar searches for the term 'Criticisms of Positive Psychology' was conducted. After having manually filtered out novel documents, those that had not already appeared in previous searches, and documents that were not published in peer-reviewed journals, abstract readings of the top 100 results were conducted to filter out novel articles that provided non-methodological criticisms. Eight novel articles were added to the initial list after this filtering process took

place. Finally, a Google Scholar searches for the term 'Critiques of Positive Psychology' was conducted. After having manually filtered out novel articles and documents that were not published in peer-reviewed journals, abstract readings of the top 100 results were conducted to filter out novel articles that provided non-methodological criticisms. In total, the first wave of searches yielded an initial list comprising 28 peer-reviewed articles discussing lines of methodological criticisms levied at the field of positive psychology.

The second wave of the search involved expanding this initial list of 28 articles based on information directly attainable from articles in the list itself and consisted of two separate steps. First, a reference list search was conducted on each of the 28 initial articles, and documents published in peer-reviewed journals whose titles and abstracts indicated some form of discussion centered on methodological criticism of positive psychology as a whole or specific positive psychological topics were added to the list. This step yielded 27 additional peer-reviewed articles that were added to the initial list. Secondly, Google Scholar user profile searches were conducted for each author listed on each of the 55 articles included in the expanded list. Every article listed in each author's Google Scholar user profile that had been published in a peer-reviewed journal whose titles and abstracts indicated the presence of methodological criticisms aimed at either positive psychology as a whole or specific positive psychological topics were added to the list, yielding an additional 19 articles. In total, the second wave of searches yielded an additional 46 peer-reviewed articles to the initial list, expanding the list to 74 articles in total.

The third wave of the search was aimed at filling in any gaps in specific lines of debate present among the 74 articles established by the first two waves of the search. First, articles were parsed into specific lines of debate through a process of content coding by which articles were coded as being either critiques of another article, targets of a critical article, responses to a critical article, or untethered to a specific methodological debate. This process yielded 8 lines of debate surrounding specific topics in positive psychology. A series of Google Scholar searches for specific articles were then conducted to identify any articles missing from the debates outlined in the content coding process outlines above. Fifteen additional articles were identified in this wave, yielding 89 articles in total.

The fourth and final wave of the search involved conducting a series of Google Scholar searches to identify the lines of debate surrounding the PERMA Framework of the Building Blocks of Wellbeing, which had been determined a priori by the authors to have been subject to prominent criticism, but which hadn't been uncovered by the systematic search process. 7 peer-reviewed articles were identified in this wave as being constitutive of the single most prominent line of debate surrounding this topic. After including these in the final list of articles, the search process ultimately uncovered a total of 96 peer-reviewed articles aimed at discussing either generalized methodological critiques of positive psychology or specific methodological critiques of positive psychological topics. Of these 96 articles, 51 articles were methodological critiques aimed at positive psychology in general. The 45 remaining articles were tied to one of 10 lines of debate on methodological concerns surrounding specific positive psychological topics in positive psychology. Of the 10 lines of debate identified via systematic literature review, 5 broadly revolved around prominent topics in Positive Psychology related to well-being science, comprising a total of 31 articles included in the final review.

Results

Outlined below is a discussion of 5 key methodological debates identified via this systematic literature review. These debates revolved around 4 prominent positive psychology theories focused on understanding and improving well-being. These debates focused on

(1) The Positivity Ratio and its 'Critical' 3:1 value (B. Fredrickson, 2009).
(2) Positive Upward Spirals as conceptualized under the Broaden and Build theory of positive emotions (West & Fredrickson, 2020).
(3) The 'Happiness pie' model of Wellbeing (Lyubomirsky et al., 2005); and
(4) The PERMA building blocks of well-being (Cabrera & Donaldson, 2023; Donaldson et al., 2022; M. Seligman, 2018).

Below we present and analyze 5 lines of debate and criticism surrounding these 4 positive psychological theories and frameworks, each culminating in a review of relevant takeaway knowledge and perspectives. It is our hope that positive psychologists will develop a deeper understanding of these prominent positive psychology theories by exploring the methodological debates and criticisms and intricacies contained therein.

The positivity ratio

The positivity ratio is a measure of the ratio of instances of positive emotion to instances of negative emotion over some given period of time. The history of the

positivity ratio's use in positive psychology began in 1999, when research led by Marcial Losada sought to examine predictors of working group performance in business settings (Losada, 1999; Losada & Heaphy, 2004). By observing teams communicating during business meetings and coding every speech act as either indicative of a positive or negative emotional state in the speaker, inquiring about or advocating for a given position on an issue, and centered around either the speaker or another person, Losada (1999) was able to construct a positivity ratio (as well as an inquiry-to-advocacy ratio and a self-to-other centeredness ratio) for various business teams. Losada then used time series data of the changes in these three ratios over the course of business meetings to construct a nonlinear dynamical system akin to the famous Lorenz (1963) system in the field of fluid dynamics, which modeled the value of the three ratios over time. Nonlinear dynamical systems are mathematical models that assess how multiple variables co-evolve over time. For an overview of nonlinear dynamical systems and their applications in the psychological sciences, see Guastello and Koopmans (2008) and Pincus et al. (2018).

The values of the variables modeled by nonlinear dynamical systems tend to follow three types of patterns over time, referred to as attractors. These are either point attractors, where the values of the system's variables converge on a single (three-dimensional) value; limit cycle attractors, where the values of the system's variables converge on a finite, cyclical pattern of values; or chaotic attractors, where the systems values never converge on any identifiable pattern of values, making the long run behavior of the system essentially unpredictable (Goldstein, 2011). Losada's work ultimately found that the performance of workplace teams could be predicted from the type of attractor that characterized the team's communication patterns, with high performing, medium performing, and low performing teams exhibiting chaotic, limit cycle, and point attractors, respectively (Losada, 1999). Losada's work further outlined precise theoretical values of the positivity ratio for which these trajectories would shift from one type of attractor to another, ostensibly allowing researchers to precisely distinguish between low, medium, and high performing teams by their positivity ratios alone (Losada & Heaphy, 2004). The theoretical value distinguishing high from medium and low performing teams came to be known as the 'critical' positivity ratio and was determined by Losada's equations to be 2.9013 (Losada & Heaphy, 2004).

In 2005, prominent positive psychologist Barbara Fredrickson teamed up with Losada to test the value of this 'critical' positivity ratio outside the domain of team performance by testing whether it would serve to differentiate between individuals who were flourishing and languishing psychologically (B. L. Fredrickson & Losada, 2005). They did so by examining the mean differences in groups of undergraduates who'd been categorized as either psychologically flourishing or psychologically languishing. They found that flourishers and languishers had significantly different positivity ratios on average, and that these mean values flanked the critical value implied by Losada's models (B. L. Fredrickson & Losada, 2005). Fredrickson and Losada argued that this implied a ratio of 2.9013, or approximately 3–1, distinguished people who experience elevated states of wellbeing from those who do not (B. L. Fredrickson & Losada, 2005). What resulted was an influx of positive psychology research examining the relationship between positivity ratios and various forms of wellbeing, most of which found similarly beneficial results at positivity ratios of about 3–1 (Amabile et al., 2005; Diehl et al., 2011; Larsen, 2009; MacIntyre & Vincze, 2017; Rego et al., 2012; Shrira et al., 2011).

Brown et al. (2013) questioned and criticized the concept and success of the 'critical' positivity ratio. He walked readers through a variety of mathematical errors and inconsistencies in Losada's (1999) and B. L. Fredrickson and Losada's (2005) work with positivity ratios, from which the 'critical' value of 2.9013 was derived. This article called into question the validity of Losada's findings along with those of all subsequent works that had taken them as their theoretical grounding, generating enormous criticism of the positivity ratio as a construct, positive psychology theory, and positive psychology as a field (Brown et al., 2013, 2014; Friedman, 2014; Friedman & Brown, 2018; C. A. Nickerson, 2018a).

One major criticism levied against Losada's work was that it included no description of the procedure used to statistically fit his data work to the equations used to model it, thus making any replication studies impossible (Brown et al., 2013). Another criticism was that any 'critical' positivity ratios derived from Losada's equations would have been entirely dependent on the values of three arbitrary parameters characteristic to Lorenz systems (Brown et al., 2013). Due to the lack of information presented in Losada's (1999) original work regarding how his equations were fit to his data, there would have been no reason to believe that the Lorenz system parameters that gave rise to a 'critical' positivity ratio of approximately 3–1 were indeed the best possible parameters to include in the equations, making this 3–1 figure entirely arbitrary (Brown et al., 2013). Brown's criticisms also extended to Fredrickson's work with Losada, claiming that mean differences in the positivity ratios of flourishers and languishers couldn't constitute

a nonlinear relationship between the positivity ratio and psychological flourishing, as one would expect a significant degree of overlap in positivity ratio values between the two groups by artifact of statistical chance alone (Brown et al., 2013). Furthermore, Brown argued that the fact that these mean differences flanked the 3–1 ratio meant nothing with regards to supporting the validity of Losada's equations because the 'critical value' implied by these equations was entirely arbitrary.

In response to this criticism, B. L. Fredrickson (2013) walked back some of her claims regarding the universality of the 3–1 ratio, but argued that at the very least, her work, along with the work of many others, demonstrated empirical evidence for the existence of beneficial outcomes related to the positivity ratio. Fredrickson's sentiments would be echoed in a recent review of the empirical research involving the positivity ratio that had been conducted between 1999 and 2018 (Schwartz & Grice, 2022). The review concluded that, while many positivity ratio researchers during the period attributed greater implications to their findings than could be reasonably assumed from the results alone, the empirical findings during this period did generally reflect the idea that people with higher positivity ratios scored higher on various measures of wellbeing (Schwartz & Grice, 2022).

The history of the positivity ratio carries many lessons for positive psychologists and social scientists as a whole. First, claims surrounding the relationship between constructs must be grounded in the limitations of the analytical techniques used to uncover these relationships. Techniques involving categorical predictor variables, especially when the categorical data is the result of artificially dichotomizing a naturally continuous variable, can only make claims about mean differences, not about the linearity or nonlinearity of the resulting relationship (Brown et al., 2013). To make any claims about the shape of the relationship between constructs, predictor variables must be measured continuously, and analytical techniques should revolve around some form of regression analysis rather than techniques like the t-test or Analysis of Variance (Brown et al., 2013). Techniques involving categorical outcome variables, on the other hand, like Logistic Regression techniques, can make claims about the shape of a relationship between predictor variables and a categorical outcome variable (in the case of Logistic regression, the shape of a relationship between predictor variables and the Log-Odds or probability of belonging to one category or another of a given outcome variable). Given this fundamental difference in the type of claims one can make about the relationship between a pair of variables (in which one is continuous while the other is categorical) when the categorical variable is conceptualized as predictor rather than outcome, it is of paramount importance that researchers craft their hypotheses with caution and precision before constructing studies to test said hypotheses. Doing so can help researchers make better informed decisions regarding their choice of analytical technique and the resulting avenues open to them when interpreting the results of their studies.

Furthermore, whenever researchers are working with constructs that are defined as the ratio of two values, such as the positivity ratio itself, it is possible to have infinity-valued observations in a dataset. Such values make many statistical techniques impossible to conduct, requiring researchers to throw away data that may otherwise provide useful information. To get around this issue, researchers working with such constructs may instead seek to use something akin to a proportion, or the ratio between one value and the sum of another value and itself. In the case of the positivity ratio, a positivity proportion would be given by the ratio of positive affective experiences to the sum of positive and negative affective experiences (where the positivity ratio is given by PA/NA, the positivity proportion is given by PA/(PA+NA)). Such an alternative measurement captures all the same information as a ratio and could be easily mapped onto specific ratio values for post hoc analyses involving the search for inflection points in nonlinear relationships between constructs (Friedman, 2014).

Broaden and Build theory: positive upward spirals part I

The Broaden and Build Theory of positive emotion was introduced to the field of positive psychology by Barbara Frederickson in 2001 (B. L. Fredrickson, 2001). The theory introduces a set of evolutionary arguments for the existence of and benefits underlying positive emotional experience. In essence, the theory argues that positive emotions broaden people's momentary thought – action repertoires, encouraging environmental exploration and engagement in experimental methods of resource acquisition, which in turn serves to buttress access to physical, intellectual, social, and psychological resources (B. L. Fredrickson, 2001). An important prediction of Broaden and Build Theory is the existence of positive upward spirals whereby the environmental experimentation prompted by positive emotion enhances access to resources, which in turn enhances positive emotion, prompting more environmental experimentation, and so on. In this sense, Broaden and Build Theory argues that the experience of positive emotion begets long lasting and stable increases in positive

emotional experience across time (B. L. Fredrickson & Joiner, 2002).

One important line of empirical evidence supporting the existence of positive upward spirals comes out of a 2002 study that employed a cross-lagged correlational design, a type of study that uses measurements of multiple variables across multiple points in time to assess the directionality of causal relationships between variables, to test the pattern of relation between positive affect and broad-minded coping (i.e. reliance on broadened thought-action repertoires to take on challenges; B. L. Fredrickson & Joiner, 2002) over time. This study tested the hypotheses that positive affect at time 1 would predict broad-minded coping at time 2 (beyond the effect of autocorrelation), and that the relationship between positive affect at time 1 and time 2 would be mediated by broad-minded coping at time 2. The study also claimed that the opposite pattern of relations should emerge, hypothesizing that broad-minded coping at time 1 would predict positive affect at time 2 (beyond the effect of autocorrelation), and that the relationship between broad-minded coping at time 1 and time 2 would be mediated by positive affect at time 2 (B. L. Fredrickson & Joiner, 2002). The study employed regression analyses to test these hypotheses individually, ultimately finding support for all four, supporting the notion that present levels of positive emotion predict future levels of broad-minded coping, which in turn predict future levels of positive affect, ultimately demonstrating the positive upward spiral phenomenon implied by Broaden and Build Theory (B. L. Fredrickson & Joiner, 2002).

A 2007 article by Carol Nickerson argued that B. L. Fredrickson and Joiner's (2002) work suffered from severe unacknowledged limitations and could not thus serve as support for the existence of positive upward spirals. According to Nickerson, the existence of positive upward spirals is a within-person across-occasions hypothesis, but B. L. Fredrickson and Joiner's (2002) analyses tested a within occasion-across persons hypothesis by regressing between persons data for time 2 broad minded coping on time 1 positive affect, and vice-versa (C. Nickerson, 2007). Furthermore, testing a within-person across-occasions hypothesis would have required first including data from multiple time points (more than 2), then regressing the change in broad minded coping from time n to time n + 1 on time n positive affect on across all 'n' time points in the dataset, and vice-versa (C. Nickerson, 2007). Nickerson also argues that the regression analyses employed by B. L. Fredrickson and Joiner (2002) were inappropriate for dealing with a lack of statistical independence present in between-persons data nested across multiple measurement occasions. Nickerson further states that better methods would have to be designed to account for the various complexities associated with modeling of longitudinal processes (C. Nickerson, 2007). Such methods may include modeling techniques like individual trajectory analysis, multiple group and finite mixture models, multiplicative interaction models, longitudinal multilevel modeling (Curran & Wirth, 2004), individual growth curve models and renewal process models (Rogosa, 2004; P. C. M. Molenaar, 2005), longitudinal exponential random graph modeling (Snijders & Koskinen, 2013), and replicated single-subject time-series analysis and dynamical systems modeling (B. L. Fredrickson & Losada, 2005; P. C. Molenaar, 2004; P. C. M. Molenaar, 2004), all of which are designed explictly for modeling complex dynamical processes.

In a 2018 review paper on the study of positive upward spirals, Frederickson and Joiner thoroughly examine the evidence base for the existence of positive upward spirals while addressing the limitations of the two-wave dataset used in their initial (2002) study on the matter. Frederickson and Joiner argue that recent advancements in statistical modeling, such as group iterative multiple model estimation, see (Beltz et al., 2016) and latent curve models with structured residuals (Curran et al., 2014), have made it possible to test both between within-person longitudinal hypotheses related to positive upward spirals. According to Frederickson and Joiner, these advancements represent an exciting opportunity to continue studying the phenomenon of positive upward spirals, and that there is still a need for further work to build on their (2002) study by running these types of analyses on multi-wave panel data to test whether hypotheses related to the positive upward spiraling process hold both within and between persons.

An important takeaway from this line of debate is that regression analyses are generally unsuited to testing hypotheses concerning complex longitudinal processes (B. L. Fredrickson & Joiner, 2018; C. Nickerson, 2007). There exists a multitude of alternative modeling approaches that can deal with a lack of statistical independence in longitudinal data (which can lead to an increased risk of type I errors with respect to the statistical significance of regression coefficients; see Kenny and Judd (1986)) while utilizing multi-wave panel data to simultaneously test within and between persons hypotheses (B. L. Fredrickson & Joiner, 2018; C. Nickerson, 2007). These methods generally require large datasets consisting of both many participants ($n > 250$) and many time points ($t > 5$) to yield any substantive information about longitudinal processes (B. L. Fredrickson & Joiner, 2018), so researchers should be sure to

appropriately specify the models they wish to test to conduct power analyses prior to data collection before utilizing them. There is still considerable debate as to whether the testing of longitudinal hypotheses should revolve around classical modeling techniques, which takes as their base unit of analysis the value of a given variable at multiple time points, or change score modeling, which takes as its base unit of analysis the change in each variables value between time points (B. L. Fredrickson & Joiner, 2018; C. Nickerson, 2007). Future researchers may consider testing longitudinal hypotheses using both to examine whether disparate modeling approaches yield substantively different results.

Broaden and Build theory: positive upward spirals part II

Another heavily criticized publication supporting the existence of positive upward spirals was a 2013 study that sought to examine whether a loving kindness meditation (LKM) intervention would lead to long-standing improvements in physical health by enhancing the experience of positive emotion and subsequent acquisition of social resources (Kok et al., 2013). This study implemented a 9-week longitudinal experimental design with a LKM group and control group, modeling the relationship between LKM participation and the pattern of dynamic relation between an important health indicator in Vagal Tone (VT), positive emotion (PE), and social connectedness (SC) over a 9-week period (Kok et al., 2013). The authors hypothesized that participants in the LKM condition and those with higher baseline VTs would exhibit steeper increases in PE, which would in turn lead to a steeper increase in SC, which would then result in higher end point VT (Kok et al., 2013).

The study yielded support for a cross-sectional relationship between PE and SC, as well as support for changes in PE predicting subsequent changes in SC beyond the mediative effect of SC autocorrelation. Both higher baseline VT and participation in LKM predicted greater increases in PE across the 9 weeks, which in turn, along with predicted greater increases in SC, predicted greater increases in VT across the 9 weeks (Kok et al., 2013). These results supported the authors' hypothesis that higher levels of PE would support increased SC, which would in turn drive improved health outcomes in the form of VT, which would then reinforce further increased PE in a positive upward spiral, which could be initiated by driving some preliminary increase in PE through interventions like LKM (Kok et al., 2013).

Heathers et al. (2015) put forth several methodological criticisms of Kok et al. (2013) based on a re-analysis of their original data, including that:

(1) Kok et al. (2013) used VT as a measure of physical health despite mixed clinical evidence regarding its efficacy as a health marker.
(2) Kok et al. (2013) reported no measure of week-by-week participation in LKM or other forms of meditation by participants, and that variable participation in meditation practice within both conditions would have served to confound the study's results.
(3) Kok et al. (2013) square transformed their VT where a log transformation was a more appropriate method of dealing with violations univariate normality assumptions.

When VT data was log transformed, Heathers et al. (2015) found no significant effect of experimental condition on endpoint VT. Furthermore, even when using the original square transformed data, Heathers et al. (2015) found that the change in LKM VT was not significantly different from zero, but rather differed significantly from an unexpected and unexplained decrease in control group VT. Heathers et al. (2015) thus argue that this indicates no significant effect of experimental condition on end point VT, so despite the significant effects of each step in the path from condition to endpoint VT (via PE and SC), claims of an upward spiral set-in motion by an LKM intervention couldn't hold because they were predicated on the intervention's direct effect on VT.

Another line of criticism based on a reanalysis of Kok & Frederickson's original data was outlined by C. A. Nickerson (2018b), which argued that Kok et al. (2013) included 7 univariate outliers in end-point VT that substantively affected the results of the study. Excluding these 7 participants, initial VT no longer predicted changes in PE across the 9 weeks, and changes in SC across the 9 weeks slope no longer predicted endpoint VT, resulting in a breaking of two crucial relationships necessary for supporting Lyubomirsky and Layous (2013) hypothesis.

In response to Heathers et al. (2015), Kok and Fredrickson (2015) argue that the same pattern of relationships emerged whether end point VT data was log transformed or root transformed, so this critique is immaterial to the results of the study. Kok and Fredrickson (2015) acknowledged the mixed clinical evidence about VT's efficacy as a health marker and called for future studies to examine additional health indicators in conjunction with VT. In addressing Heathers et al.

(2015) critique that, while the effect of participation in the LKM condition on end point VT significantly differed from an unexplained inverse effect of control group participation, it did not significantly differ from an assumed null effect of control group participation, Kok and Fredrickson (2015) argue that such an effect was not necessary to establish substantive support for their hypotheses regarding positive upward spirals. This is because the study's goal was not to establish a link between LKM participation and increased VT per se, but rather to demonstrate a reciprocal relationship between VT and Positive Emotion, with SC mediating PE's effect on VT. Kok and Fredrickson (2015) argue that, although people in the LKM condition didn't show any change in end point VT, they did exhibit significant increases in PE, and people with greater increases in PE, regardless of their assigned condition, showed higher endpoint VT (with this relationship being mediated by increases in SC). As such, the results of Kok et al. (2013) provided substantive support for the existence of positive upward spirals but did not necessarily provide commensurate support for the claim that such spirals can be precipitated by participating in LKM interventions.

In response to C. A. Nickerson (2018a), B. L. Fredrickson and Kok (2018) argue that Nickerson's reanalysis excluded seven outliers where only two should have been excluded due to having 'impossibly high' endpoint VTs. B. L. Fredrickson and Kok (2018) point out that the insignificant results reported by C. A. Nickerson (2018b) was likely due to a reduction in statistical power due to dropping all 7 participants, as this represented a 13% decrease in the original sample size. Furthermore, three of the remaining five participants had statistically large initial scores to accompany the large endpoint scores as pointed out by C. A. Nickerson (2018a), but the change in VT from pre to post testing for these three participants were well within the realm of statistical plausibility. This left two potential outliers remaining, which B. L. Fredrickson and Kok (2018) argue for winsorizing (replacing outlier values with the highest acceptable non-outlier value) rather than dropping outright due to the study's small sample size. While dropping all 7 participants from their 2013 analyses resulted in the substantive changes reported by C. A. Nickerson (2018b), dropping the two participants with impossible scores and winsorizing the other two legitimate outliers did not result in any substantive changes to the results of Kok et al. (2013).

There are several important takeaways for positive psychologists stemming from this line of debate. The first of these is that expert consultation should be included on all research projects relying on the construct validity of measures that generally fall outside the purview of psychological science. Furthermore, properly controlling for potential confounds is essential when running experimental designs and ensuring that the measures taken to control for such confounds are adequately reported is of paramount importance to communicating the effectiveness of such studies. This line of debate also highlights the importance of running sensitivity analyses to test for the effect of different outlier identification and treatment procedures. Of further note is that, while sample size limitations may in many cases be limited by resource constraints, researchers should take care to properly operationalize all aspects of a study design and perform a priori power analyses before undergoing participant recruitment whenever possible. Carrying out this procedure can inform target sample size goals, mitigating the risk of study results lacking robustness to variation in outlier treatment protocols due to underpowered designs. Finally, researchers must take special care to formulate working hypotheses in such a way as to properly capture all essential elements of a desired conceptual mapping from a hypothesized pattern of statistical results to substantive claims about theoretical processes. Failure to do so may result in a potential source of confusion about the interpretation of a study's results.

The "Happiness Pie" model of well being

The 'Happiness Pie' model of wellbeing is an informal name given to a conceptual model developed by Lyubomirsky et al. (2005) that sought to lay out a framework for estimating the degree to which a person's experience of was influenced by their choice of voluntary activities across the lifespan (see Figure 2). Lyubomirsky et al. (2005) estimated that 50% of the variability in a person's chronic level of happiness could be attributed to some genetically determined set point governing the experience of happiness, and that 10% could be attributed to circumstantial factors out of

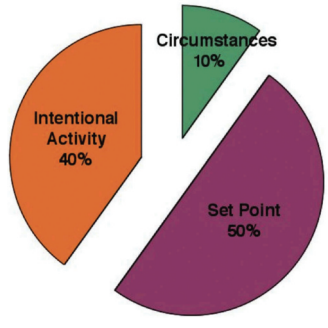

Figure 2. Happiness pie Model (Lyubomirsky et al., 2005).

an individual's control, leaving as much as 40% of the variability in a person's chronic experience of happiness to be accounted for by their choice of volitional activities. Lyubomirsky et al. (2005) based the first of these estimates on the results of a wide range of twin studies examining the heritability of happiness, which on aggregate seems to suggest that approximately 50% of individual differences in happiness could be attributed to genetic factors. Furthermore, the authors based the second of these estimates on a wide range of studies examining the effect of involuntary circumstantial factors like region of residence, demographic factors, experience with traumatic events, marital status, occupational status, job security, income, health, and religious affiliation, on happiness. On aggregate, the authors found that involuntary circumstantial factors consistently accounted for approximately 10% of individual differences in happiness (Lyubomirsky et al., 2005).

In a criticism of the 'Happiness Pie' model, Brown and Rohrer (2020) outline several of the methodological shortcomings underlying the process by which Lyubomirsky et al. (2005) arrived at their estimated happiness variance decomposition. One of these arguments was that it is unclear whether the 'Happiness Pie' model was meant to reflect a within or between persons variance decomposition but was based entirely on the aggregated estimates of studies that explicitly examined between persons data. Given a lack of theoretical reasoning to support the notion that the relative effects of genetic, circumstantial, and choice-related factors on happiness should be the same both within and across individuals, Lyubomirsky et al. (2005) had no justification for attaching any specific values to their theoretical variance decomposition if it was indeed meant to operate at the within persons level of analysis (Brown & Rohrer, 2020). Another criticism laid out by Brown and Rohrer (2020) was that the 'Happiness Pie' model included no error term in its variance decomposition to account for imperfect measurement reliability, no interaction terms to account for interdependencies among the model's three factors, nor any theoretical justification for these exclusions. One final criticism was that the percentages attributed to the 'Happiness Pie' Model were estimated by aggregating the results of studies that were performed on different populations. If there were systematic differences between these variegated populations in the effect of genetics and circumstance on happiness, this would have certainly led to biased estimates in the 'Happiness Pie' Model's decomposition of happiness variance (Brown & Rohrer, 2020).

In a response to the criticisms laid out by Brown and Rohrer (2020), Sheldon and Lyubomirsky (2021) argue that the 'Happiness Pie' Model was a conceptual model developed with the aim of emphasizing the role of volitional activity in influencing happiness and spurring the development of more rigorous theoretical frameworks rather than to make any formal predictions about the percentage contribution of genes, circumstance, and choice, to happiness. In this sense, the authors argue, the model has served and continues to serve its purpose in inspiring the development of more formalized models of happiness which have generated testable predictions about the role of volitional activity in affecting happiness that have been supported in empirical studies (Sheldon & Lyubomirsky, 2021). Among such models are Martela and Sheldon's (2019) Eudaimonic Activity Model (EAM), Sheldon and Lyubomirsky's (2012) Hedonic Adaptation Prevention Model (HAP), and Lyubomirsky and Layous' (2013, 2014) Positive Activity Model (PAM).

Despite this beneficial influence on the advancement of happiness science, the authors do concede that attaching a formal happiness variance decomposition which could be interpreted as a precise and testable prediction was a mistake that overstepped the bounds of the 'Happiness Pie' model's theoretical justification and explanatory power (Sheldon & Lyubomirsky, 2021). Furthermore, Sheldon and Lyubomirsky (2021) did not clarify whether the 'Happiness Pie' model was meant to apply to a within or between persons level of analysis, leaving one of Brown and Rohrer's (2020) key criticisms unaddressed.

By our estimation, there are three key lessons to be learned by the story of the 'Happiness Pie' model. The first of these are that phenomena that exist at the between persons level of analysis cannot be assumed to exist in the same way at the within persons level of analysis. While counterintuitive, this can be illustrated by framing occasions and persons as categorical predictors in a multi-way analysis of variance whose interaction with an independent variable (IV) predicts variability in a dependent variable (DV). In other words, the occasions variable and persons variable can each be said to exercise a main effect on the strength of the observed IV-DV relationship. Only when these main effects are equivalent will the focal IV-DV relationship exist in the same way at both the within and between persons levels of analysis. For further illustration of this concept, please see Cattell (1966); Hoffman and Stawski (2009); and Wang and Maxwell (2015). Claims about the existence of some relational pattern amongst a set of psychological constructs at one level of analysis need to have appropriate theoretical justification and should not be simply based on the existence of similar relational patterns at another level of analysis. Another important lesson is that, when

employing statistical techniques that rely on aggregating results across multiple different populations, researchers must be cautious to actively account for any systematic differences that might exist among the populations included for analysis. The final lesson that positive psychologists should take away from this line of debate is that, for the most part, conceptual models should avoid making precise mathematical predictions, and should instead serve as the basis for inspiring the development of more rigorous, testable theoretical models. The conflation of conceptual and mathematical theorizing has been a prominent point of criticism surrounding positive psychology, and researchers must take this historical context into account when making claims based on theory developed within the positive psychological framework (Friedman & Brown, 2018). Even when theoretical models can make testable predictions, researchers should take special care to ensure that the level of detail contained in their predictions falls strictly within the limits of the precision at which these models operate. Otherwise, positive psychologists may run the risk of both incurring personal reputational damage and inflicting larger scale reputational damage on the field as a whole.

The PERMA model of well being

The PERMA model was developed by Martin Seligman as a first step in what he believed would be a rich and insightful program of research aimed at constructing a theory of the elements, or building blocks, of human wellbeing (M. Seligman, 2018; M. E. Seligman, 2012). The components of wellbeing captured by the PERMA model include Positive Emotions, Engagement, Relationships, Meaning, and Accomplishment (M. Seligman, 2018; M. E. Seligman, 2012). Donaldson et al. (2021, 2022) summarized each building block as:

(a) **Positive Emotions** capture a person's experience of pleasurable or desirable emotions like happiness, joy, gratitude, etc.
(b) **Engagement** captures the feeling that one can use their strengths to meet challenges, and that there exists enough of a balance between the two in one's life to experience some degree of flow.
(c) **Relationships** refers the experience of connecting with, loving, and feeling loved by other people.
(d) **Meaning** refers to feeling that one's life is aimed at fulfilling a purpose of personal significance.
(e) **Accomplishment** refers to having the experience of setting, pursuing, and accomplishing one's goals.

Preliminary support for this model was found in a series of studies demonstrating that item clusters designed to measure each component of PERMA loaded onto a single factor (Butler & Kern, 2016; Kern et al., 2015), and that the five factors of PERMA in turn loaded onto a single higher order Well Being factor (Coffey et al., 2016).

In a 2018 study on PERMA and Subjective Well Being (SWB), another popular model which holds that Well Being consists of three dimensions, namely positive emotion, (lack of) negative emotion, and life satisfaction (E. D. Diener et al., 1985), Goodman et al. put forth two notable arguments against Seligman's PERMA model as a theory of wellbeing. The first of these arguments held that early empirical support for PERMA was developed solely with the use self-report measures. As a result, the correlations between individual items comprised by PERMA's five factors were likely to have been inflated due to mono-method and self-report biases. These inflated correlations may have in turn created distortions in the factor structure implied by the data from which the model was originally built. The second of these arguments followed from results of the study that found high enough Latent correlations between PERMA and SWB to suggest that PERMA essentially serves as nothing more than an alternative method of partitioning Subjective Well Being's classical 3 factor structure. Because PERMA partitions wellbeing into 5 factors instead of 3, Goodman et al. (2018) argue that the PERMA is less parsimonious and can thus only be justified with substantial theoretical reasoning, which they felt it lacked.

In response to Goodman et al. (2018) criticism of PERMA's lack of parsimony, M. Seligman (2018) put forth a series of theoretical justifications for assessing the incremental validity of models offering different methods of partitioning well-being including:

(1) The elements included in the theory must contribute to well-being, both as a whole and individually;
(2) There must exist evidence that people pursue each element for its own sake and not solely for the purpose of pursuing a different element;
(3) The set of elements must be both exclusive and exhaustive, meaning that the set of items includes only the items defined therein and no latent elements that arise out of the various combinations

of these items, and that the set comprises all meaningful components of wellbeing:

(4) There must be ways to construct and carry out specific interventions aimed at building each individual element in isolation.
(5) The set of elements must be parsimonious, or otherwise encapsulating the minimal degree of complexity necessary to explain enough about wellbeing to be able to say that improving any individual element will lead to improvement in wellbeing beyond any incidental influence on auxiliary elements.
(6) Each element must be able to be defined and measured independently of the other elements, meaning that no two elements are the same thing or that no given element is the same thing as any combination of any of the remaining elements.

M. Seligman (2018) argued that PERMA modestly fulfills these requirements, and that, while SWB does outperform PERMA in terms of parsimony, on balance of all 6 requirements, PERMA incrementally outperforms SWB as a model of well-being.

In response to Goodman et al.'s (2018) criticisms that empirical support for PERMA was built entirely on self-report data and that PERMA was redundant with SWB, Donaldson et al. (2021) put forth a Multitrait-Multimethod (MTMM) analysis of PERMA and SWB. This study was aimed at finding support for PERMA's five-factor structure, for this five-factor structure loading onto a single higher order wellbeing structure, and for the explanation of unique variance beyond that explained by SWB. This study measured PERMA and SWB in dyads using both self and other reports and found self-reported PERMA to correlate significantly with collateral reported PERMA, indicating that self-reported PERMA was corroborated to a large degree by others, in contrast to Goodman et al.'s (2018) claims. This study also found self-reported and collateral reported PERMA to both be significant predictors of self and collateral reported SWB, with correlations between PERMA and SWB being systematically higher when measured using the same method (i.e. self-report PERMA & self-Report SWB; collateral-report PERMA & collateral Report SWB) than when measured using different methods (i.e. self-report PERMA & collateral-report SWB; collateral-report PERMA & self-report SWB). This finding indicates that common method bias is an important factor to consider when analyzing the degree to which constructs correlate when measured using the same methods, especially when working with self-report data on well-being and its antecedents or building blocks. Donaldson et al. (2021) go on to further argue that the latent correlations between PERMA and SWB found by Goodman et al. (2018), upon which their claims about PERMA's redundancy with SWB were based, may have been due to common method bias related to both PERMA and SWB being measured using solely self-report measures in Goodman et al. (2018) study. To highlight this point, a recent systematic review of the empirical evidence supporting the PERMA framework found that, while PERMA did strongly predict SWB across multiple studies, most of these studies were based on cross-sectional self-reports, with the highest correlation by far being .98 from Goodman et al. (2018) study (Cabrera & Donaldson, 2023).

There are several important takeaways from the debate surrounding the use of PERMA as well-being framework. One such takeaway is that attempts to delineate a substructure of well-being should be judged on the basis of a proposed substructure's incremental validity over existing alternative structures rather than on the adequate fit of a confirmatory factor structure alone, which initially served as the earliest empirical support for PERMA (Butler & Kern, 2016; Coffey et al., 2016; Kern et al., 2015). Furthermore, incremental validity should be judged on balance of parsimony, explanatory power, both convergent and discriminant validity, and practical utility, rather than on parsimony alone. In addition to this, incremental substructure validation studies for any proposed models of well-being would likely benefit from MTMM analyses to account for the role of common method bias in explaining shared variance among competing models whose base components are measured using fundamentally different scale items (Donaldson & Donaldson, 2021; Donaldson & Grant-Vallone, 2002; Donaldson et al., 2021). In an effort to expand the methodological toolbox available to researchers looking to conduct such MTMM analyses, researchers may look to employ observational methods designed to capture behavioral and economic indicators of well-being and its components. Such validation studies may also look to incorporate longitudinal methods to examine the temporal stability of competing substructures across the lifespan.

In outlining his six criteria for assessing the incremental validity of competing models of well-being, M. Seligman (2018) acknowledged that there may indeed be more than PERMA's 5 building blocks or antecedents of well-being amenable to development via positive psychology interventions (PPIs). PERMA + 4 was developed especially for use in the workplace by adding four additional elements of physical health, positive mindset, environment, and economic security to the original PERMA model, and has found strong support in

early empirical evidence. Like PERMA, PERMA + 4 has been shown to strongly predict well-being and positive functioning across multiple cross-sectional studies (Cabrera & Donaldson, 2023; Donaldson et al., 2022). However, PERMA and PERMA + 4 researcher would do well expand the next wave of basic research to explore longitudinal methodologies to examine the degree to which findings hold at the within persons level of analysis. Finally, it should be noted that substantive claims about the empirical support for theories and frameworks of well-being should be viewed within the context of the entire body of evidence available rather than on the result of any single study (see Cabrera & Donaldson, 2023).

General discussion and future directions

The goal of this review has been to identify the most prominent methodological debates surrounding theories and frameworks used in positive psychology. Five such debates on theories and frameworks focused on well-being were identified and reviewed, culminating in a discussion of lessons for future researchers to take away from each. Enclosed is a synthesis of the most important takeaways for positive psychologists to adapt into their methodological practices moving forward.

One important takeaway from these debates is the need for positive psychologists and wellbeing researchers to ensure that they are employing the appropriate statistical tools and techniques when testing a specific class of hypotheses. Researchers must take special care to outline all essential elements of the conceptual mapping from a hypothesized pattern of statistical results to substantive claims about hypothesized theoretical processes prior to designing a study to test a given hypothesis. Doing so can inform decision-making about analytic approaches and how to interpret the results of these approaches when making determinations about whether a study yields substantive support for a given hypothesis.

One example of this is that analytical techniques involving the use of categorical predictor variables can only make claims about groupwise mean differences. As such, these techniques should not be used to test hypotheses regarding any specific shape of relationship between predictor and outcome. Another important example has to do with the testing of longitudinal hypotheses. Many researchers have historically employed traditional regression-based techniques in these cases, but there are numerous special statistical concerns related to testing hypotheses about dynamical processes that yield such techniques unsuitable in this regard. There exist many alternative modeling approaches that are specialized for such testing, but these methods generally require both large numbers of participants and many timepoints to yield any substantive information about dynamical processes. As such, researchers seeking to employ these methods should be sure to appropriately specify all models they wish to test and conduct power analyses prior to data collection to mitigate the risk of running underpowered studies.

Another important lesson for positive psychologists and well-being researchers to take away from these debates is the importance of exercising caution with respect to making claims about the scope within which our findings can be applied. It is important that we always exercise professional humility and position our claims within the contexts and limitations of the data and analytical techniques used to test them. One key area in which such humility need especially be applied is in the realm of interdisciplinary research. While positive psychology has historically embraced multidisciplinary approaches and recognized the importance of crossing disciplinary boundaries for the advancement of scientific inquiry, it is important for researchers to exercise appropriate caution when attempting to stretch their domain of study beyond their immediate areas of expertise. Whenever a research project relies on the construct validity of measures that generally fall outside the purview of psychological science, researchers need to include appropriate expert consultation and outline the role of outside experts in their research.

Furthermore, researchers making claims about the empirical support for psychological theories and frameworks should take heed to ensure that their claims are made within the context of the entire body of evidence related to a theory rather than on the results of any single study. Furthermore, the validity of such claims should not be assessed in a vacuum, but rather judged by their incremental validity over existing alternative frameworks. Furthermore, this incremental validity should be judged on balance of parsimony, explanatory power of statistical models, both convergent and discriminant validity, and practical utility. To assess convergent and discriminant validity of competing frameworks, incremental validation studies should consist of one than one measurement method to account for common method bias. Lastly, researchers developing such frameworks should avoid the inclusion of numerical components that may sensibly be interpreted as precise mathematical predictions, unless they explicitly intend for these frameworks to make such predictions.

Limitations

The scope of this review was relatively limited and may have thus left out less prominent but nonetheless salient and valuable debates that carry lessons useful for informing future research practices in well-being science and positive psychology. Furthermore, by not exploring methodological debates surrounding the fields of positive psychology or wellbeing science in general, this review is limited in its ability to draw inferences about how the topics of these debates relate to general methodological practices in positive psychology and wellbeing science. Positive psychology spans a wide array of subject areas and best practices, so it is to be expected that a review as narrow in scope as this one can't necessarily capture all trends related to methodological practice in the field. Future reviews may aim to carry out a more comprehensive screening of the field, including explicitly combing through positive psychological journals and special issues pieces to identify smaller debates and identify larger trends surrounding methodological practices in the fields of positive psychology and well-being science. Future reviews may also seek to expand beyond wellbeing science to explore targeted methodological debates in other areas of positive psychological study such as positive institutions and positive psychological interventions

Conclusion

Positive psychology offers an approach to the study of psychological phenomena which emphasizes the investigation of experiences that make life worth living and the pathways by which people can live out this experience despite the challenges and demands of daily life. Wellbeing science is a subset of positive psychology concerned with understanding how to conceptualize, measure, manage, and improve well-being both for individuals and organizations alike. One of the major criticisms that have been historically levied towards positive psychology and wellbeing science has been that the fields engage in poor methodological and measurement practices (van Zyl et al., 2023). In an effort to elucidate some of the historical context surrounding these perceptions, and outline pathways by which positive psychological researchers may help ameliorate these perceptions in their future practice, this review sought out to identify the most prominent lines of debate surrounding measurement and methodology applied to well-being research. By outlining the key points made across all sides of these debates and delineating the most important lessons for positive psychologists to take away with regards to their methodological practices, we hope that this review serves as an important step in the direction of improved reflexivity and a continued devotion to the improvement of research practices within positive psychological science (Donaldson et al., 2020).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work received no institutional funding.

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Data availability statement

No data was explicitly collected for this project. All works reviewed in this manuscript are appropriately cited and contained in the reference section.

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