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Easy as (Happiness) Pie? A Critical Evaluation of a Popular Model of the Determinants of Well-Being

Nicholas J. L. Brown¹ · Julia M. Rohrer^{2,3,4}

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Abstract

An underlying principle behind much of the research in positive psychology is that individuals have considerable leeway to increase their levels of happiness. In an influential article that is frequently cited in support of such claims, Lyubomirsky et al. (Rev Gen Psychol 9:111–131, 2005. <https://doi.org/10.1037/1089-2680.9.2.111>) put forward a model (subsequently popularized under the name of the “happiness pie”) in which approximately 50% of individual differences in happiness are due to genetic factors and 10% to life circumstances, leaving 40% available to be changed via volitional activities. We re-examined Lyubomirsky et al.’s claims and found several apparent deficiencies in their chain of arguments on both the empirical and the conceptual level. We conclude that there is little empirical evidence for the variance decomposition suggested by the “happiness pie,” and that even if it were valid, it is not necessarily informative with respect to the question of whether individuals can truly exert substantial influence over their own chronic happiness level. We believe that our critical re-examination of Lyubomirsky et al.’s seminal article offers insights into some common misconceptions and pitfalls of scientific inference, and we hope that it might contribute to the construction of a more rigorous and solid empirical basis for the field of positive psychology.

Keywords Happiness · Positive psychology · Heritability · Life circumstances · Interventions

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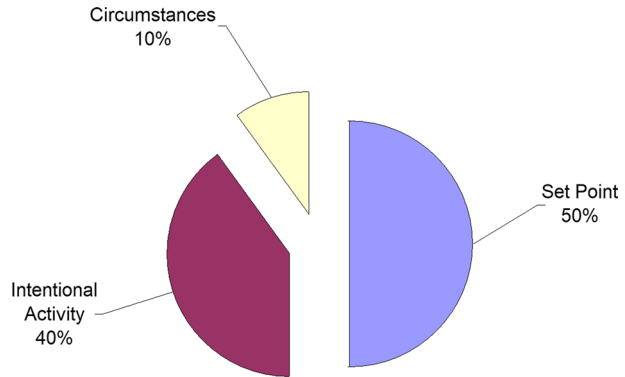
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Fig. 1 The “happiness pie” (after Lyubomirsky et al. 2005, p. 116). Original caption: “Three primary factors influencing the chronic happiness level”



One of the key claims of the positive psychology movement is that most individuals are able to exercise substantial control over their own levels of happiness.¹ On this account, people can become durably happier—in Seligman’s (2002, p. ix) words, “go from plus two to plus seven” in their lives—by adopting a variety of strategies, such as expressing gratitude (Emmons and McCullough 2003), applying one’s character strengths in novel ways (Seligman et al. 2005), writing about positive experiences (Burton and King 2004), or practicing loving-kindness meditation (Fredrickson 2013). Over the past 2 decades or so, these ideas have been widely publicized both within scholarly circles and in the popular media (e.g., Scelpo 2017).

Arguably the most popular model of the factors influencing well-being, and hence people’s ability to improve their own happiness, is the one presented by Lyubomirsky et al. (2005) that has become widely known as the “happiness pie.” This model, reproduced here as Fig. 1, purports to show the percentage of variance in well-being that is explained by each of three sources of variation (which Lyubomirsky et al. referred to as “factors”): genetic predisposition (which was labeled the “happiness set point” by Lyubomirsky et al.; see also Lykken 1999; Lykken and Tellegen 1996), life circumstances, and volitional (intentional) activities. It should be noted that this model attempts to explain “chronic happiness levels,” that is, an experience that is more enduring than momentary fluctuations in well-being and can be captured by retrospective summary judgments or by averaging momentary judgments over a period of months. Lyubomirsky et al. claimed that up to 40% of the variance in well-being levels according to this definition was explained by volitional activities, suggesting further that intentional activity was “arguably [the] most promising means of altering one’s happiness level” (p. 118). According to Lyubomirsky et al., 50% of the variance in well-being is explained by genetic factors and just 10% by “life circumstances,” a term whose meaning and scope we explore in some depth in the present article.

¹ For simplicity, throughout the present article, we assume that the terms “happiness” and “[subjective] well-being” represent the same construct, which can to some extent be captured by “life satisfaction.” Treating these terms as (sometimes) interchangeable appears to be a common practice in the positive psychology literature, as shown by chapter titles such as “Happiness: Also known as ‘life satisfaction’ and ‘subjective well-being’” (Veenhoven 2011). A discussion of the extent to which these constructs might in fact differ and how they are related is beyond the scope of the present article; see Diener et al. (2009) for an overview of this topic.

Since the publication of Lyubomirsky et al.'s (2005) article, which according to Google Scholar had 3086 citations as of May 7, 2019, the “happiness pie”—including the relative proportions of its components, and especially the claim that intentional activity is a far more important determinant of well-being than life circumstances—has become a key element of the discourse surrounding well-being. In the academic sphere, this model has been cited by scholars working not only on topics that might be considered as the traditional domain of positive psychology, such as employee well-being (Page and Vella-Brodrick 2009), the relation between pleasure and engagement (Schueller and Seligman 2010), or interventions to enhance happiness in normal populations (Proyer et al. 2013), but also in research areas as diverse as psychotherapy (Rashid 2008), aging (Butler and Ciarrochi 2007), consumer behavior (Hudders and Pandelaere 2012), negative emotions (Jordan et al. 2011), self-care for psychologists (Wise et al. 2012), heart disease (Huffman et al. 2011), tourism (Nawijn and Mitas 2012), and intellectual disability (Dykens 2006). In wider society, the happiness pie has been a prominent element in the popularization of positive psychology, especially in the areas of happiness-related coaching, self-help books (e.g., Achor 2010; Fredrickson 2009), and other “personal development” products and services that have sprung up on the periphery of this new subfield. For example, a large cherry pie cut into two parts (60–40%) features prominently on the front of the hardcover edition of Lyubomirsky's (2007) book *The How of Happiness: A Scientific Approach to Getting the Life You Want*, and the same image was used by a training company to promote a “Positive Psychology Master Class” with the same author (MentorCoach 2008). The 40% figure has been widely touted as an empirical fact, as an Internet search for the terms “happiness” and “40%” will quickly reveal. As the New York-based British writer Ruth Whippman put it:

This 40 per cent figure is much quoted in the positive-psychology literature in both academic and popular texts, and represents the field's great marketing opportunity.

This is the 40 per cent that anyone with a book to sell, a course of coaching to offer or a happiness technique to promote is hoping to co-opt. (Whippman 2016, p. 195)

Although some researchers have written brief critiques of the “happiness pie” in blog posts (e.g., Bergink 2015; Kashdan 2015; Krueger 2015), it seems that until now no prominent peer-reviewed articles have been published in the formal psychological literature that discuss the origins and validity of Lyubomirsky et al.'s model. Such an exploration is the focus of the present article. First, we consider some conceptual issues that arise when using population-level variance decomposition to make claims about individual-level potential for change. Second, we discuss weaknesses of the “happiness equation” that is implied by the “happiness pie” and Lyubomirsky et al.'s claim that up to 40% of the variance in happiness can be attributed to volitional activities. Third, we re-examine the numerical estimates that Lyubomirsky et al. assigned to the genetic set point and circumstances. We conclude with a summary of our findings and some recommendations for future research directions.

1 Between-Subjects Variance Decomposition Versus Individual-Level Potential for Change

Lyubomirsky et al.'s (2005) examination of the determinants of chronic happiness levels draws on the well-known logic of variance decomposition. For example, psychologists frequently report how the percentage of variance of a certain outcome that can be explained by a set of predictors (typically using the coefficient of determination, R^2), or the

percentage of variance that a new construct can explain over and above established measures (incremental R^2). However, such a variance decomposition can only be interpreted in terms of variation within a certain population (e.g., “10% of the between-subject variance in happiness can be explained by life circumstances”), and cannot be translated into individual-level variation (e.g., “10% of a person’s variance in happiness can be explained by that person’s life circumstances”), unless it was explicitly established on the within-subject level (which, as we will see later, is not the case for the studies underlying Lyubomirsky et al.’s model).

Lyubomirsky et al. (2005) seem to have been aware of this distinction, as they pointed out that previous research has been dominated by cross-sectional, between-subjects studies (p. 112). However, these authors’ language was not always consistent throughout their article; for example, they wrote that their derivation of the 50:10:40 ratio “implies that *one’s* [emphasis added] chronic happiness during a particular life period can be increased” (p. 117), which could be taken to suggest that each individual necessarily has a substantial margin within which to improve their well-being. In line with this interpretation, popular self-help books and web sites often use the 50:10:40 ratio as evidence that (all) *individuals* can choose to affect their own well-being substantially. The 40% of a person’s happiness that, on this account, can be changed (implicitly for the better) by one’s own choices is typically described using phrases such as “providing an excellent opportunity to increase our level of happiness” (Cygan 2013, p. 22) or “a substantial amount of control to have over one’s own well-being” (Vondruska 2017, p. 11), demonstrating that regardless of what Lyubomirsky et al.’s intended interpretation may have been, many writers have decided to go with the within-subject version. (Later in this article, we discuss these issues in more detail for the benefit of researchers who are interested in investigating well-being at the level of individual subjects.)

Furthermore, even if the numbers used to partition the happiness pie held on the within-subject level, they would still not necessarily imply anything about the *potential* of possible volitional activities or interventions, for two reasons. First, the variance that can be explained by certain factors will necessarily be constrained by the variability of these factors in the population. For example, imagine that a highly effective method was found that allowed individuals to intentionally raise their chronic happiness levels by multiple points. If this method gained some popularity—say, being adapted by half of the population—then it would, by definition, increase the amount of variance in chronic happiness levels attributable to volitional activities. However, if almost everybody in the population adapted the method, it would no longer explain much variance in chronic happiness levels, because it would have consistently raised the level of the whole population. Hence, the variance attributable to this hypothetical intervention would change, even if its potential to increase an individual’s well-being remained constant. Second, there is no evidence for the proposition that the activities that individuals choose to undertake can actually explain all of the “missing” 40% of the variance in their well-being; this leads us to another major issue with the general idea of the happiness pie, which we explore in the next section.

2 Does the “Happiness Pie” Add Up?

Lyubomirsky et al. (2005) based their pie chart on the idea that, if 50% of variance in well-being is explained by genetic factors and 10% by circumstances, this “leaves as much as 40% of the variance for intentional activity” (p. 116). While these authors’ arithmetic

cannot be faulted, it is not clear that the rest of their reasoning is as impeccable. The variance decomposition suggested by Lyubomirsky et al. implies an underlying “happiness equation”, which bears a resemblance to the formula for multiple linear regression:

$$H = \beta_1 S + \beta_2 C + \beta_3 V \quad (1)$$

where H is happiness (or well-being), S (“set point”) is the genetic component,² C is circumstances, and V is volitional activities. However, Eq. (1) suffers from several defects, which we investigate in the following sections.

2.1 Genes, Circumstances, and Volitional Activities are Not Independent Additive Factors

The conceptualization of the happiness pie and its underlying variance decomposition is only correct when all three factors are independent (i.e., they do not interact and do not covary). As Krueger (2015) has pointed out, this assumption is unlikely to hold. As an example of an interaction, lower well-being due to anxiety might be the result of the interaction of childhood stress with a genetic predisposition (cf. Swann and Seyle 2005).

Considering covariation between the factors influencing happiness, the simple additive model ignores the possibility that the effects of genes on happiness might be largely mediated by circumstantial factors and volitional activities (e.g., Lykken 1999, p. 81). Lyubomirsky et al. (2005) acknowledged that genes influence happiness indirectly through experiences and environments, but they seemed to interpret this only in terms of mitigation of *negative* genetic influences, as in the claim that “unwanted effects of genes could be minimized by active efforts” (p. 114). It seems equally plausible, however, that *positive* genetic influences on happiness might be mediated through behaviors that could be classified as volitional activities. For example, Lyubomirsky et al. mentioned exercising regularly and striving for important personal goals as volitional activities, but both the inclination to perform daily physical activity and the tendency to persevere in one’s efforts seem to be partly heritable (Moore-Harrison and Lightfoot 2010; Rimfeld et al. 2016). This is neither particularly surprising (cf. Turkheimer 2000), nor does it constitute support for genetic determinism, but merely demonstrates that the simple breakdown of the three factors into proportions that sum to 100% is unjustified from an empirical point of view.

Furthermore, the distinction between the slices of the happiness pie might reify common misunderstandings regarding the nature of heritability estimates. While it seems popular to assume that high heritability implies low malleability, this is not the case: A trait can be both highly heritable and malleable at the same time. For example, the heritability of general intelligence is high, but education reliably increases intelligence (Plomin and Deary 2015; Ritchie and Tucker-Drob 2018).

² The meaning of S remains conceptually somewhat unclear throughout Lyubomirsky et al.’s (2005) article, as the authors referred to it as the “happiness set point” but then simply used heritability estimates to gauge its impact. A conceptual discussion of the relation between the concept of an individual “set point” and the percentage of population-level variance in well-being explained by genetic factors is beyond the scope of the present article.

2.2 Lack of an Error Term

To the extent that Eq. (1) corresponds to a multiple regression formula, an element that is obviously missing is an error term. Given the vicissitudes of human subjects, it seems rather optimistic to expect that this would ever be zero,³ even if someone were to actually conduct a single study to examine the relative contributions of genetic factors, circumstances, and volitional activities to chronic levels of well-being. At the very least, measurement error in H would need to be considered.⁴ For example, if one measured H with a reliability of .80, the three factors S , C , and V would add up to 80% at best—the remaining 20% of variance in happiness would be attributable to measurement error and thus unable to be explained. Assuming the additive model held true, and assuming the estimates for 50% and 10% were true, this would immediately decrease the amount of variance *potentially* attributable to volitional activities to $80\% - 50\% - 10\% = 20\%$.

It is, of course, possible that Lyubomirsky et al. (2005) conceptualized their formula as a thought experiment (cf. Werner, 2018) on the latent variable level (or that they were thinking about estimates of chronic happiness that were averaged over many measurement occasions, thus reducing the measurement error), so that one could assume that the 100% of the “pie” refers to the reliable variance in chronic happiness levels. However, in such a case, the estimates for S and C would need to be based on models that take into account measurement error (which was not the case for the studies from which the estimates were drawn). Holding everything else equal, using such models would revise estimates of the respective percentages for the impact of genes and life circumstances upwards, since measurement error attenuates observed associations and heritability estimates (see Kendler et al. 1999 for a demonstration of this phenomenon). Consequently, the “leftover” variance attributable to volitional activities would need to be revised downwards once again.

2.3 Potentially Omitted Determinants of Happiness

Lyubomirsky et al.’s (2005) argument regarding the potential of volitional activities to influence levels of happiness assumes that genetic factors, circumstances, and volitional activities are the only three possible causes of variance in well-being. This depends on the use of “circumstances” as a catch-all term to include all of the vicissitudes of life that are outside of one’s personal control and that “*happen to people*” (p. 118; emphasis in original). Thus, assuming this definition, factors like in utero development effects would need to be considered in the estimate for C . Because a multitude of such factors has likely been omitted due to the nature of the surveys on which the estimate is based, this estimate would almost certainly need to be revised upwards. Again, under the assumption that the subtraction logic of the “happiness pie” is valid, this would thus lead to a smaller estimate of V . Note that Lyubomirsky et al. did not explicitly claim that their choice of three factors (S , C , and V) was exhaustive; however, once S and C have been defined, the third section of the pie chart (V) ought logically to be labeled

³ Note that assuming that the error term is zero implies that *all* differences in chronic happiness can be explained in a deterministic manner—a very strong claim, to which most psychologists probably would not want to subscribe.

⁴ If the outcome measures are different in each case (e.g., “happiness” and “well-being”), then to the extent that these constructs do not overlap (cf. footnote 1), a certain amount of variance due to the difference in these constructs will also need to be accounted for in the overall “error term.”

“anything that is not circumstances and set point, including volitional activities.” Of course, this would result in a much less convincing thought experiment, as it does not allow us to infer how promising volitional activities, on their own, potentially are.

2.4 Adding Up Percentages of Variance Explained from Different Studies is Questionable

Lyubomirsky et al.’s (2005) drew their estimates of the variance explained by genetic factors and life circumstances from different sources, who studied samples drawn from different populations. It seems questionable that these estimates can simply be combined and then subtracted from 100% to derive an estimate of the influence of something that has not been measured. The percentage of variance that can be explained by any single construct, or set of constructs, is always specific to a certain population. Thus, it seems ill-advised to combine estimates across studies without ensuring that they are referring to the same populations.

3 Re-examining the Numerical Estimates of the Effect of Genes and Circumstances

3.1 How Much Variance in Chronic Happiness Levels can be Explained by Genetic Factors?

It appears that Lyubomirsky et al. (2005) derived their figure of 50% for the heritability of well-being by combining, in a way that was not clearly specified, the results from three studies (Braungart et al. 1992; Lykken and Tellegen 1996; Tellegen et al. 1988). Lykken and Tellegen estimated that “the heritability of the stable component of subjective well-being approaches 80%” (p. 186). Tellegen et al. examined general personality traits in adult twins and determined that heritability ranged from 39 to 58% with an estimate of 48% for the personality trait labeled “Well-Being”. In contrast, Braungart et al. measured the influence of genetic factors on externally-reported developmental and emotional behaviors in children aged 1 or 2 and found heritability ranging from 35 to 57%. Even taking the lower bound of the estimated range of heritability from this study (which did not measure adult well-being), we arrive at an average figure of around 61%, whether or not the studies are weighted to take into account their sample sizes. About the best that can be said, then, for the figure of 50% for genetic factors is that it is surrounded by considerable uncertainty, and appears—based on the studies cited by Lyubomirsky et al.—likely to be a lower bound. Of course, any upward adjustment of this number would necessarily imply a downward adjustment of the percentage of variance attributable to volitional activities, if we accept the subtraction logic suggested by Lyubomirsky et al. Note that current overviews of the literature locate the heritability of *overall* (i.e., including momentary) happiness at 32–41%, but for the *stable* component of happiness (i.e., the chronic levels that are the outcome of interest in Lyubomirsky et al.’s model) heritability is reported in the 70–80% range (Nes and Røysamb 2017).

3.2 Origins of the Claim that Only 10% of the Variance in Well-Being is Due to Life Circumstances

Lyubomirsky (2007, p. 41) claimed that the figure of 10% for the amount of variance in happiness explained by life circumstances “represents an average from many past investigations, which reveal that all life circumstances and situations put together account for only about 10 percent in how happy different people are.” Lyubomirsky et al. (2005) cited two sources in support of the 10% claim: a book chapter by Argyle (1999) and an article by Diener et al. (1999). Argyle in fact gave two figures on his pp. 353–354: “less than 10 percent of the variance,” which he attributed to Andrews and Withey (1976), and 15%, which he reported as having been proposed by Diener (1984). The first of these figures appears to correspond to the following quote from Andrews and Withey (1976, p. 109): “The demographic variables, either singly or jointly, account for very little of the variance in perceptions of global well-being (less than 10 percent)”, while the second appears to refer to this: “individual demographic variables rarely account for more than a few percent of the variance in SWB, and taken together probably do not account for much more than 15% of the variance” (Diener 1984, p. 558). Notice that both of these quotes refer to *demographic variables*, which, crucially, are not the same as life circumstances, as we discuss below.

In the second article cited by Lyubomirsky et al. (2005) and Diener et al. (1999, pp. 278–279) reported three candidate percentages for the variance in happiness explained by circumstances: 20% according to Campbell et al. (1976), 8% according to Andrews and Withey (1976), and the same 15% mentioned by Argyle that was cited separately by Lyubomirsky et al. (which was, of course, Diener’s original informal estimate from 1984). Later in their article, Lyubomirsky et al. stated that “all circumstances combined account for only 8% to 15% of the variance in happiness levels” (p. 117), again with citations of Argyle (1999) and Diener et al. (1999); for some reason they omitted to mention the figure of 20%, derived from Campbell et al.’s study, which Diener et al. had cited in the sentence immediately preceding their discussion of the 8% and 15% figures. Lyubomirsky et al. did not report how they finally settled on their “headline” figure of 10%, but we tentatively assume that this was derived by some sort of informal interpolation between 8 and 15%. In summary, it seems that there is a considerable lack of clarity about how the (subsequently highly influential) figure of 10% was arrived at. Hence, we turned to the original sources to look for this information.

First, we examined Andrews and Withey’s (1976) book, which describes the results of a large, multiple-occasion study involving an overall total of 5142 US Americans. Of interest here are the surveys that were conducted in May 1972 ($N=1297$), and April 1973 ($N=1433$), which were the ones used by Andrews and Withey (1976, pp. 138–142) to illustrate their discussion of the limited value of “classification variables” in predicting overall life satisfaction. We found two tables (Exhibit 4.6 on p. 139 and Exhibit 4.7 on p. 141) showing that the percentage of variance explained by “six classification variables” was 8% in the May 1972 survey and 11% in the April 1973 survey. These “classification variables” are age, family income, education, race, sex, and “family life-cycle stage”, with the last of these being a categorical variable based on “the respondent’s own age and marital status, and the age of the youngest child living in the family” (Andrews and Withey 1976, p. 138). These variables, which Andrews and Withey (1976, p. 138) described as “demographic or social characteristics,” were used mainly as the basis of classifying their subjects into subgroups; it is clear, using Lyubomirsky et al.’s (2005) own definition (which we discuss below), that they do not constitute an exhaustive inventory of “life circumstances,”

IF R IS A HOUSEWIFE:

F44. Different people feel differently about taking care of a home. I don't mean taking care of children, but things like cooking, sewing, and keeping house. Some women look on these things as just a job that has to be done; other women really enjoy them. How do you feel about this?

Fig. 2 A question from Campbell et al.'s (1976, p. 540) survey

sufficient to allow conclusions to be drawn about the effect of such circumstances on an individual's well-being (Fig. 2).

Turning to Campbell et al.'s (1976) book, which was based on a survey of 2147 US Americans conducted in 1971, we found a number of tables (e.g., those on pp. 230, 241, 253, 279, and 302) that explored the relation between satisfaction with an individual domain of life (e.g., "housing" or "life in the United States") on the one hand, and participants' subjective assessments of that domain and their "personal characteristics" on the other. The percentage of variance explained by the combination of subjective assessments and personal characteristics in these tables is typically in the range of 20–30%, with personal characteristics typically accounting for around 8–10%, but—as with Andrews and Withey's (1976) "classification variables"—the lists of these characteristics were short (five or six items), with race and (where present) age and sex typically having the largest partial correlations with the relevant satisfaction measure. Indeed, Diener et al. made it clear that their estimates of the variance explained in these two books were based on "demographic factors," not an extensive inventory of life circumstances:

Campbell, Converse, and Rodgers (1976) found that demographic factors (e.g., age, sex, income, race, education, and marital status) accounted for less than 20% of the variance in SWB. Andrews and Withey (1976) could only account for 8% by using these variables. (Diener et al. 1999, pp. 278–279)

In summary, although it is not clear exactly how Lyubomirsky et al. (2005) arrived at their estimate that only 10% of variance in well-being is explained by life circumstances, the available evidence suggests that this well-publicized figure may have been derived from an erroneous conflation of "classification variables" or "demographic factors" with the much wider category of "life circumstances," in a few tables of results in two books describing studies that were conducted by researchers at the same institution⁵ (the Institute for Social Research, Ann Arbor, Michigan) in the early 1970s. Whether or not this constitutes "many past investigations," as claimed by Lyubomirsky (2007) in the sentence quoted at the start of this section, is perhaps a matter of opinion. However, given that these sources provided the empirical evidence that was ultimately used by Lyubomirsky et al. to support their claims about the effect of life circumstances on well-being, it would seem interesting

⁵ Indeed, Andrews and Withey's (1976) book refers to the studies conducted by their colleagues Campbell et al. (1976) at numerous points, and even describes (p. 244) an exploratory analysis using a combination of their own data and those of Campbell et al.

to examine the evidence provided by these studies, while not losing sight of the limitations just mentioned. We were able to obtain the data sets on which Andrews and Withey (1976) and Campbell et al. (1976) based their books, and reanalyze them to see what percentage of variance in these authors' respective life satisfaction outcomes was explained by a set of 15 to 18 variables (depending on the exact questions asked in each survey) that were agreed by external evaluators to correspond to "life circumstances." With the same statistical techniques that had been used by the original authors to arrive at the figure of 8–10% for demographic variables, we obtained values of between 18.13 and 26.47% for life circumstances. (A more modern approach using cross-validation results in a wide range of estimates, between 1.92 and 17.90%, highlighting how such estimates depend both on the statistical methods employed and on the variables available in the datasets.) Further details are provided in the Supplementary Information of the present article.

3.3 Measures of Well-Being are Specific to Given Populations and Periods of Time

Even if one were to assume that the variance decomposition suggested by Lyubomirsky et al. (2005) was valid (which we questioned above), it is not clear that these numbers still hold today (or, indeed, whether they did so when Lyubomirsky et al.'s article was published). Campbell et al. (1976) collected their data in 1971, while Andrews and Withey (1976) collected theirs in 1972–1973. This was a time when baby boomers were reaching adulthood and the Vietnam War was at its height. The relevance of these studies to the modern social landscape probably cannot be taken for granted. For example, the participants were between 87 and 90% White, with the rest being mostly reported as Black and no more than about 1% described as being of another race, while the demographic questions make it clear that the default expectation of the researchers was that cohabiting adults would be heterosexual and probably married. It is not clear whether the same results would be found were these studies to be repeated today, after 40 years of social change in the United States and with considerably greater diversity in the population and people's lifestyles. Any estimate of the percentage of variance that can be explained by a certain combination of predictors is only meaningful with respect to the population from which the sample has been drawn. Of course, in the period spanning almost half a century since these studies were conducted, other researchers have collected data that show the relation between demographic variables and well-being (see Diener et al. 2018 for a review), but as we have already noted, such relations tell us little about the influence of variables that fall under the much wider category of life circumstances.

A further caveat to note here is that when estimating the amount of variance in an outcome that can be attributed to certain predictors, analyses are necessarily constrained by the amount of variability in those predictors (as already explained for the case of volitional activities above). For example, broader economic circumstances are often constant within a survey at a given time point in a given sample. However, changes in these circumstances can have remarkable effects on well-being, as indicated by the World Happiness Report (United Nations 2015), which is based on the Gallup World Poll. This report periodically measures the self-reported well-being of the inhabitants of most of the countries of the world on a "ladder" from 0 to 10 (Cantril 1965). The 2015 report showed that between the measurement periods of 2005–2007 and 2012–2014, self-reported well-being in Greece fell from 6.327 to 4.857, a drop that represents almost one and a half steps down the ladder from the best possible life towards the worst. This reduction of 1.470 points also corresponds to 31.0% of the range of country-average well-being scores in the 2015 report from

the highest (Switzerland, at 7.587) to the lowest (Togo, at 2.839). It seems unlikely that more than a trivial part of this decline in well-being over the better part of a decade can be accounted for by a change in the genetic characteristics of the population of Greece, or a decision by Greek citizens to eschew *en masse* the forms of intentional activity that might contribute to their individual happiness. Rather, the drastic change in their (economic) circumstances forced on the majority of Greeks by the ongoing financial crisis affecting their country would seem to be by far the most plausible candidate to explain this drop in national well-being (cf. Rhodes Hatzimalonas 2017). Of course, one could argue that these changes are in some sense transitory, and ought to fade over the course of the years as the Greek economy recovers. However, if such a multi-year criterion is to be used to distinguish between mere fluctuations in circumstance and true changes to people's chronic level of well-being, it should logically also be applied to intervention studies claiming to produce sustainable changes in happiness.

The wide range of scores between the top and bottom countries on the *World Happiness Report* list is another indication that there might be many circumstantial factors that affect well-being beyond those that were (or, indeed, could have been) included by Andrews and Withey (1976) and Campbell et al. (1976) in their surveys of US Americans. On a continuum from the smaller democracies of northern Europe at one end through to the poorest countries of sub-Saharan Africa at the other, there are considerable variations in political freedom or repression, institutional transparency or corruption, and the availability or lack of basic services such as electricity and clean drinking water, to name just a few examples of factors that might be expected to influence well-being, but would not be expected to vary much among any sample drawn from just one country. Indeed, Lyubomirsky et al. (2005, p. 117) acknowledged that "Happiness-relevant circumstances may include the national, geographical, and cultural region in which a person resides," but these authors then failed to limit their own claims to the specific population from which the data were drawn (i.e., US Americans from the 1970s). We suggest that future research into the effects of life circumstances on well-being should take into account potential cross-cultural concerns and acknowledges the limitations of the samples being studied. For example, it has recently been suggested that researchers should explicitly limit conclusions to specific target populations to avoid unjustified generalizations (Simons et al. 2017).

Likewise, researchers should carefully reconsider the usage of terms such as "volitional activities". What might be a matter of choice for some people can be a question of circumstances for others. For example, middle-class Western parents with a comfortable household income can exercise a wide range of choice over the diet that they and their children consume; they can choose to drive their car to the farmer's market instead of taking the bus to the discount grocery store, and afford to place organic blueberries rather than canned, syrup-laden fruit cocktail in their shopping cart. They can also enjoy a wide range of recreational activities, such as vacations to awe-inspiring or culturally important destinations, enabling them to enjoy the benefits of feeling that they are part of a meaningful world (Gilovich and Kumar 2015). Indeed, Lyubomirsky et al. (2005) themselves described the types of volitional activities that they were considering in decidedly middle-class terms: "rather than running on a track, a fitness-seeking wilderness lover might instead choose to run on a trail through the woods... rather than learning classical pieces, a jazz-loving piano student might instead choose to work on jazz standards" (p. 122). A subsistence farmer working from dawn to dusk in a developing nation, a worker who spends 14 h per day assembling electronic devices in a south-east Asian factory, or a single Western parent living in less fortunate circumstances than the family just mentioned, may not be in a position to make such choices. As with many phenomena studied by primarily Western

psychologists (cf. Henrich et al. 2010), the list of volitional activities that are available to improve one's well-being may be less than universal, not just for cultural reasons but also precisely because of one's life circumstances.

3.4 Moving Forward: Between-Subjects Versus Within-Subject Designs and Causal Inference

We noted earlier that there appeared to be a mismatch between the evidence (such as it was) provided by Lyubomirsky et al. (2005) for their model of variance decomposition—based on between-subjects studies—and the suggestion that individuals can improve their happiness with volitional activities, which is inherently a within-subject effect. Such limitations of positive psychology research have been noted numerous times in the past (e.g., Lazarus 2003; Nickerson 2007, 2014), and calls for more longitudinal, within-subject research are not uncommon even in the discussion sections of studies based on cross-sectional, between-subjects data. In fact, it appears—at least from an informal examination—that within-subject designs may be becoming more popular within positive psychology. In early December 2018, we examined the 50 most recently published articles in the *Journal of Happiness Studies* that reported empirical data, and compared these with a random selection of 50 articles published in the same journal approximately 10 years earlier. Whereas in 2007–2008 only seven out of 50 articles used within-subjects designs, by 2017–2018 this number had risen to 16,⁶ with a variety of methods being used. For example, on a shorter timescale, data collected with the Experience Sampling Method (Csikszentmihalyi and Hunter 2003) were used to investigate how detachment from workplace stresses affect the quality of interactions in romantic relationships (Debrot et al. 2018), while on a longer timescale, data collected as part of a panel study of 1500 households in Nepal were used to investigate the cost of coping on different forms of well-being (Chindarkar et al. 2018).

Part of the appeal of within-subject designs is that they can, if properly analyzed, control stable inter-individual differences, rendering a causal interpretation of associations more plausible (although such designs do not automatically warrant causal conclusions, as time-varying confounders can offer alternative explanations). Causal inference might not always be the *explicitly* stated goal of empirical investigations of subjective well-being, but it often seems to be what authors are most interested in; indeed, Lyubomirsky et al. (2005, p. 116) referred to the genetic set point, life circumstances, and intentional activity as the “three primary types of factors that we believe *causally* [emphasis added] affect the chronic happiness level.” For example, if there is a between-subjects association between a certain activity and happiness (i.e., on average, people who do X are happier), but no within-subject association (i.e., a person who starts doing X does not become happier), we would be quick to dismiss the between-subjects association as spurious and refrain from advising people to do more X to become happier.

However, this advantage becomes a complication when the aim is to give a holistic picture of *all* of the determinants that explain happiness (whether this is measured over an extended period of time or as short-term fluctuations). Many inter-individual differences, such as personality or socio-economic status, hardly vary within individuals, making it

⁶ Although it would not be appropriate to perform an inferential test here, we note in passing that the *p* value associated with a Chi square test of independence for these data is .057. Full details of the method used for this informal study are given in the Supplementary Information of the present article.

difficult to establish any within-subject association with the outcome. Even research on fairly common life events such as marriage or childbirth makes use of the massive sample sizes of ongoing panel studies to ensure that sufficient individuals have actually experienced the event in question while they were part of the study.

Of course, the above comments merely underscore the self-evident truth that no single type of research design can answer all questions. Within-subject designs may pave the way for interesting new research questions with a different scope, such as whether individuals reliably differ in the volatility of their well-being, or in their reactivity to stressors, and which factors shape these inter-individual differences in intra-individual variation. However, the complex nature of human experience is such that data collected over a range of timescales, from a few minutes to many decades, will likely be needed to fully identify the determinants of well-being as individuals experience daily existence, major life milestones, and the general aging process (as well as any psychological interventions that we might subject them to). To both enhance and complement these efforts, it could be fruitful if researchers working on subjective well-being considered more explicitly whether they are trying to draw causal conclusions (the answer might be “yes” more often than not), and, if so, made use of systematic and established approaches from other fields of research. For example, counterfactuals (e.g., Morgan and Winship 2015; Neyman 1923/1990), directed acyclic graphs (e.g., Kuipers et al. 2018; Pearl 2000), and various types of natural experiments (e.g., Dunning 2008; Rutter 2007) might have been under-utilized in psychological well-being research (likely because they are not routinely taught to psychologists). A more careful consideration of the admittedly complex issue of causality might lead to the sobering conclusion that a complete decomposition of happiness into genes, circumstances, and intentional activities is not only an elusive research goal, but not even a well-defined one.

4 Concluding Remarks

Since the publication of Lyubomirsky et al.’s (2005) model, research on subjective well-being has progressed considerably, as documented extensively by Diener et al. (2018). However, the “happiness pie” is still widely cited, and many of the problematic arguments underlying its claims—for example, misconceptions about the generalizability of between-subjects variance decompositions and about the interpretation of heritability estimates—can be found in contemporary research endeavors, both within and outside of positive psychology. Our somewhat lengthy search—documented earlier in the present article—to track down the claim that only 10% of the variance in happiness is due to life circumstances is a good example of the need, when integrating previous findings, to pay close attention to the details of the empirical studies to ensure that the summarized literature does in fact support the claim being made.

As we have shown in this article, there is a considerable list of issues with the popular “happiness pie” decomposition of variance in well-being. First, a variance decomposition in the population does not necessarily inform us about the potential for individual level changes, although such conclusions are frequently drawn, and not just by statistically uninformed writers in the popular media. Second, the decomposition of the variance in chronic levels of happiness into three factors suffers from a major conceptual issue (the three factors do not additively affect well-being in isolation) and certain omissions (error term, other potential determinants) that bias the analysis towards assigning higher percentages to volitional activities. Third, the estimates assigned to life circumstances and genetic factors

are questionable. The empirical evidence cited indirectly by Lyubomirsky et al. (2005) in support of the idea that individuals' life circumstances account for only 10% of the variance in well-being seems to be based on a misunderstanding of what the relevant studies actually investigated (many factors describing people's life circumstances, versus the narrower category of demographic variables). Likewise, there is only very limited evidence to place the figure for the heritability of well-being as low as (precisely) 50%. Consequently, there is little reason to believe that 40% is a reliable estimate of the variance in chronic happiness attributable to intentional activity—for example, if Lyubomirsky et al. had chosen a different (but, in our view, at least equally plausible) set of estimates, they might just as easily have concluded that as little as $(100\% - 80\% - 15\% = 5\%)$ of variance in chronic happiness can be attributed to volitional activities. Of course, because of the conceptual issues that we have discussed, we do not believe that such an estimate would necessarily be more reasonable or more interpretable.

Although our analyses in the present article have been focused on the “happiness pie,” we feel that it is useful to point out that the issues we have addressed—namely, misconceptions about the interpretation of between-subjects variance decomposition; misconstruction of genes, environment, and volition as orthogonal factors; and misreading or misinterpretation of the findings from previous studies—are certainly not limited to the study by Lyubomirsky et al. (2005). In fact, such issues seem to recur throughout many research fields in psychology. However, the influence on the popular imagination of the “happiness pie” model particularly underscores the need for psychologists to be circumspect in their claims, including when they venture beyond academic writing into popular books and other ways of disseminating their work to a broader public. While this form of outreach ought to be an admirable development, it comes with the responsibility to avoid making claims beyond what the evidence allows for.

Several writers (e.g., Di Martino et al. 2017; Ehrenreich 2009; Whippman 2016) have criticized positive psychology for placing too much emphasis on the purported ability of individuals to improve their psychological well-being regardless of the social conditions under which they live. The idea that only 10% of one's happiness is due to circumstances, with four times as much “capacity” being available to people to forge their own well-being, is attractive and fits into a pervasive contemporary “feel-good” narrative in which self-improvement is claimed to be not only desirable, but also eminently achievable (see Moreau et al. 2019 for a discussion of several other current topics of psychological research where claims about the malleability of traits appear to have been overstated). At this point we take no particular view of the political questions that might be implicitly raised by such claims; our principal interest is to point out some ways in which they might not be justified by the available evidence. Indeed, it seems to us to be vital at this point for positive psychologists to critically re-examine the evidence base for their claims about the ability of people to improve their own happiness. We hope that our discussion of the conceptual limitations of Lyubomirsky et al.'s (2005) model may generate helpful insights for future research programs to ensure a solid empirical foundation of positive psychology.

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