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Suicide in Happy Places: Is There Really a Paradox?

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Abstract: In 2011 researchers published a paper that exposed a puzzling paradox: thehappiest states in the U.S. also tend to have the highest suicide rates. In the current study,we re-examine this relationship by combining data from the Multiple Mortality Cause-of-Death Records, the Behavioral Risk Factor Surveillance System, and the AmericanCommunities Survey to determine how subjective well-being and suicide are related across1563 U.S. counties. We extend the original study in important ways: by incorporating bothabsolute and relative measures of subjective well-being; by examining the happiness-suicide association at a more suitable level of analysis; and by including a more robust setof control variables in the model. Contrary to the previous study, we do not observe anysignificant relationship, negativeorpositive, between the absolute and relative well-beingof places and suicide rates at the county-level. Implications for the study of suicide ratesand relative deprivation are discussed

In 2011, a team of researchers published a paper that exposed a puzzling paradox: the happiest places in the United States also tend to have the highest suicide rates. The researchers referred to this finding as the "dark contrasts paradox" (Daly, Oswald, Wilson and Wu 2011: 435). Combining rich data sets, one on life satisfaction and another on causes of death, Daly and colleagues reported that states with people who are generally more satisfied with their lives have higher suicide rates than those that have lower average levels of life satisfaction, invoking a positive association between states' subjective well-being ranking and suicide rates. The authors showed that this finding remains even after controlling for differences in population characteristics (e.g., marriage, joblessness) across states. Moreover, in a separate analysis, the research team was able to replicate this finding for Western industrialized nations (i.e., European countries). Not surprisingly, the study's findings received extensive publicity both nationally and internationally.

While at first blush the findings appear counter-intuitive, Daly et al. (2011) offer an explanation that draws on "the way that human beings rely on relative comparisons" (pg. 440): although one's own happiness protects against suicide, the level of others' happiness is a risk factor. Personal unhappiness, Daly and colleagues argue, may be exacerbated when others are relatively more content with their lives. Theorizing that individuals construct their norms by observing the behavior and outcomes of others, Daly et al. suggest that individuals judge their own position less harshly when they see other people with outcomes like themselves. Conversely, when others are more satisfied with their lives, individuals who do not share this perspective may view their emotional experiences as especially problematic.

Despite the provocative finding and the plausibility of such an argument, we are aware of no other macro-level study that considers how happiness and suicide may be linked. This is

surprising, especially in light of the long and rich history of research on the correlates of suicide rates across place—a history that emphasizes both motivational (e.g., poverty, inequality, joblessness) and opportunity-related (e.g., the availability of firearms) factors of suicide (for a review, see Kubrin and Wadsworth 2009:1205-1209). Indeed, Daly et al. (2011) remark "To our knowledge, the cross-state finding has not been discussed in the earlier literature on suicide and well-being." (pg. 440).

The intriguing finding from Daly et al. raises the question of whether, and to what extent, subjective well-being matters for suicide. Certainly more research is needed to weigh in on this question, a point the authors themselves underscore when they conclude "[b]ecause the correlations reported in this study are only at the border of 95% confidence, they should be treated cautiously, and it will be important for future research to probe their robustness" (pg. 440). The findings also suggest the importance of relative deprivation or inequality, more broadly, as a potentially important mechanism in the study of suicide. While these concepts have been explored in previous work on suicide regarding the influence of racial and economic inequality (Burr et al. 1999; Curtis, Curtis and Fleet 2013) we are not aware of any other work that has examined the relationship between inequality in subjective well-being and suicidality.

In the current study we test the robustness of Daly et al.'s findings by examining the macro-level relationship between subjective well-being and suicide rates across U.S. counties. In particular, we combine data from the Multiple Mortality Cause of Death Records, the Behavioral Risk Factor Surveillance System, and the Census to determine how subjective well-being and suicide are related, controlling for a host of known suicide correlates. We also extend the Daly et al. study in a number of important ways: by incorporating both absolute and relative measures of subjective well-being, allowing us to more directly test Daly et al.'s theoretical claims regarding

relative deprivation; by examining the life satisfaction-suicide association at a more suitable level of analysis, the county, which both minimizes within-unit variation and better captures the process of relative comparision; and by including a more robust set of control variables in the model.

Suicide and Subjective Well-Being: Two Literatures with a Common Thread

There is a long history of research on suicide rates in the social sciences. Unlike individual-level studies, which focus on the characteristics that increase or decrease an individual's propensity for suicide ideation, attempt or completion, aggregate-level research has generally examined how the characteristics of communities or geographic areas may shape overall or group-specific rates of suicide (Wray, Colen and Pescosolido 2011). This work frequently advances a motivational argument—that problematic characteristics of social and geographic collectivities motivate some individuals to commit suicide. Many of these studies examine structural conditions associated with higher rates of suicide, such as poverty, inequality, family disruption, and joblessness (for review, see Stack 2000a; Stack 2000b; Wray, Colen and Pescosolido 2011)— characteristics thought to influence suicide by shaping levels of social integration or the degree to which individuals feel like they are part of a larger social group. The argument that integration influences suicide stems from Durkheim's seminal work, *Suicide* (1897), in which he argued that, "suicide varies inversely with the degree of integration of the social groups of which the individual forms a part" (1951, p. 209). Central to this idea is the belief that integration acts as a type of social control over individuals. When individuals lack a sense of belonging they become isolated, and the ties that might otherwise inhibit suicidal

tendencies become weak or absent. These ideas form the basis of the social integration-regulation thesis, a prominent argument in the sociological literature on suicide.

Consistent with this thesis, scholars have examined the relationship between suicide rates and a variety of measures of social and economic cohesion including unemployment (Almgren et al. 1998; Coope et al. 2014; Phillips and Nugent 2014), poverty and income inequality (Burr et al. 1999; Curtis, Curtis, and Fleet 2013; Kubrin, Wadsworth, and DiPietro 2006; Coope et al. 2014), divorce and family structure (Baller and Richardson 2002; Stockard and O'Brien 2002; Sun and Zhang 2016), immigration and cultural assimilation (Wadsworth and Kubrin 2007), and cohort size (Stockard and O'Brien 2002). Regardless of measure, integration is typically found to affect suicide rates in the direction the social integration-regulation thesis predicts—more integration results in less suicide.

Note that Durkeim's original thesis, as well as much of the more recent work, does not suggest that integration necessarily makes people happier or more content with their lives (though in some cases it may) but that a variety of contextual factors influence social cohesion, which in turn increase individuals' commitments and sense of obligation in ways that make suicide less appealing. Only recently have scholars questioned whether happiness or contentedness, above and beyond the characteristics associated with cohesion and integration, may also influence rates of suicide (Daly et al. 2011). This line of inquiry has developed out of a burgeoning literature on subjective well-being (SWB) and the belief that SWB may be considered a meaningful characteristic of both individuals and places.

In many ways, the growing literature on subjective well-being has paralleled the suicide literature by considering similar social and economic factors seen as indicators of cohesion in aggregate studies of suicide (e.g. marital status, unemployment, poverty). However, in the

literature on subjective well-being, these factors are generally treated as correlates of happiness and life satisfaction *at the individual level*. In fact, employment and marital status, most commonly associated with suicide at the aggregate level (Stack 2000a; 2000b), are also two of the strongest predictors of individual-level subjective well-being (Waite and Gallagher 2002; Dolan, Peasgood, and White 2008; Wadsworth 2016). A variety of other indicators of cohesion and integration, including income (Clark, Frijters and Shields 2008), education (Blanchflower and Oswald 2004), religious and civic participation (Helliwell 2003), and social trust (Helliwell and Putnam 2004) have also emerged as correlates of happiness and life satisfaction at the individual level.

In 2010, Oswald and Wu suggested that in addition to using self-report data to examine the correlates of well-being at the individual-level, we could also use newly available data from the Behavioral Risk Factor Surveillance System (BRFSS) to examine the distribution of subjective well-being across geographic areas. While much work had been done to answer the question "who are the happiest people?" we could also now ask the question, "which are the happiest places?" Oswald and Wu aggregated BRFSS respondents' scores on a measure of life satisfaction to the state level and ranked the states by average life satisfaction. In doing so they documented significant heterogeneity in average life satisfaction across states (Mean= 3.4, SD= 0.6), suggesting that there are, in fact, places where people tend to be more or less happy. Seeking to validate these measures of aggregate SWB, they then compared these rankings to the results of Gabriel, Mattey, and Wascher's (2003) attempt to objectively rank states on a variety of quality of life measures (e.g. low housing prices, clean air, public lands, sunshine, etc.). Oswald and Wu (2010) hypothesized that areas with desirable amenities should also exhibit high average SWB. Though perhaps not surprising, they documented a strong positive correlation

between states' objective quality of life scores and average SWB. Oswald and Wu (2010) used this confirmatory finding to argue both for the validity of subjective well-being measures (of which economists have generally been skeptical) and for the value of using aggregated SWB as a characteristic of places as well as people.

Is There A Relationship Between Subjective Well-Being and Suicide Rates?

Collectively, the large body of research on suicide rates and the emerging work on the geography of SWB suggest that place characteristics influence suicide rates and that SWB can be considered a meaningful characteristic of place (Oswald and Wu, 2010). Further, since many of the same characteristics that increase SWB at the individual level also decrease suicide rates at the aggregate level, we might expect a negative correlation between area measures of well-being and suicide rates across geographic areas. Such a relationship could be driven by two distinct but related mechanisms—one compositional, the other contextual.

Most simply, if a place is inhabited by happier or more satisfied people, and we expect such people to be less likely to commit suicide, we would anticipate lower rates of suicide in happier places. This reflects a compositional effect: the aggregate-level inverse relationship between average well-being and suicide rates is observed because of the individual-level association between an individual's SWB and their propensity for suicide. Importantly, this explanation does not suggest that the characteristics of an area influence suicide but rather that the distribution of individual characteristics within the population influences the suicide rate of a place.

It is also possible that higher average well-being of areas does, in fact, decrease the probability of suicide by creating a more pleasant atmosphere for all of its residents (both happy

and unhappy). In this sense we could think about areas with high average SWB the same way that we might think about areas with high income. High-income areas often have more amenities for all residents to enjoy (e.g. cleaner streets, more shops, higher quality schools), regardless of one's socioeconomic status. Similarly, areas with higher average levels of positive affect may also have attributes that all can enjoy such as more interactions with affable people, less road rage, less substance abuse, more people willing to help those in need, and a generally more pleasant context in which to navigate one's daily affairs. This context (or "climate") of positive affect may theoretically decrease suicide rates by increasing daily enjoyment of social interactions, providing hope to those in despair, increasing the emotional support available in a given area, or by strengthening family and kinship networks that provide emotional, physical, and financial resources in times of need. If the benefits of a "happy place" extend beyond just the happier residents, this can be considered a contextual effect: characteristics of happy places influence residents above and beyond their own personal attributes.

While the suggestion of an inverse relationship between area happiness and suicide rates, driven by compositional or contextual effects, is intuitively appealing, the only research to date on the topic does not support it. Instead, Daly et al. (2011) find that places with higher average subjective well-being have *higher* rates of suicide, at both the (U.S.) state and international levels (in a comparison of Western industrialized nations). Their interpretation is that above-average SWB may actually increase the propensity for suicide at the individual level, and therefore suicide rates at the aggregate. They also argue that this is a contextual, rather than a compositional, effect—that happy places actually increase individual propensity for suicide above and beyond individual characteristics. They hypothesize (but acknowledge that they do not test) that social comparison and relative deprivation in SWB may be the mechanism driving

the relationship. In other words, when people are unhappy in places where average happiness is high, dissatisfaction is more apparent and may ultimately lead to more suicide. They argue, "[d]iscontented people in a happy place may feel particularly harshly treated by life. Those dark contrasts may in turn increase the risk of suicide… [alternatively] the lows of life may thus be most tolerable in an environment in which other humans are unhappy" (pg. 440). From this perspective, instead of increasing social support and fueling optimism, being surrounded by happier people aggravates one's own unhappiness.

We find Daly et al.'s argument intriguing. In many ways it is consistent with other work in the area of social comparison and subjective well-being. For instance, Easterlin (1974, 2001, 2003) has made a strong argument for the power of relative income: having more income in a general sense doesn't make people happier; what is important is having more income than those with whom we compare ourselves. While the role of social comparison is still underdeveloped in the SWB literature, recent work has added support to this general thesis by demonstrating that social comparison plays an important role in moderating the relationship between SWB and a variety of its correlates, including marriage (Wadsworth 2016), obesity (Wadsworth and Pendergast 2014) and sexual activity (Wadsworth 2014). In all of these studies the influence of individual characteristics on well-being can only be understood after considering the distribution of these characteristics in respondents' reference groups. Daly et al.'s suggestion that being unhappy is more problematic when surrounded by happy people is consistent with the findings that being poor, obese, single or sexually inactive is more detrimental to one's subjective well-being when surrounded by wealthier, thinner, married or more sexually active peers.

Though theoretically intriguing and consistent with related work in the area, we have some concerns regarding Daly et al.'s findings. One concern relates to the unit of analysis they

employed in their study—states. For one, the social contexts most likely to influence individuals' well-being and suicide are those that are geographically proximate. Given the relatively large size of states, counties constitute a more appropriate unit of analysis in this respect. Indeed, as argued by others, counties tend to more closely reflect the individuals comprising them than do states and other more macro aggregate units (Berkeley and Fox 1978; Kowalski, Faupel and Starr 1987:89). Second, as smaller units, counties are generally more homogeneous and therefore are better represented by aggregate indicators of the social, economic, and demographic factors that may influence suicide (Pescosolido and Mendelsohn 1986; see also Breault (1988) for a discussion of methodological limitations associated with state-level suicide studies). And finally, given their size and heterogeneity, states are areas that may not influence residents equally in terms of social comparisons that are likely to take place between individuals who share common characteristics such as race and socioeconomic position. For all these reasons, counties are a more appropriate unit of analysis than are states for examining potential contextual determinants of individual behavior and for considering the role of reference group influence. As such, following a long line of studies, we examine variation in suicide rates across U.S. counties (Baller and Richardson 2002; Berkeley and Fox 1978; Breault 1988; Kowalski, Faupel and Starr 1987; Pescosolido and Mendelsohn 1986).

Second, Daly et al.'s state-level relationship fails to control for notable covariates of both suicide and subjective well-being that may explain a potential relationship between the two. One of these is geographic region. Regional variation in both suicide rates (Kaplan and Geling 1998) and well-being (Plaut, Markus, and Lachman 2002) has been extensively documented, and may well be the primary driver of a state-level association between the two variables. This would suggest a regional rather than state-level paradox, which would be difficult to explain as a result

of relative comparisons rather than other exogenous factors (e.g. climate and seasonal affective disorder, population density, or culture). Alternatively, if county or even state-level relationships between suicide and well-being exist after adjusting for this regional variation, the idea that social comparisons drive this association remains plausible. To test whether this is true at the county-level, we include controls for geographical region in the present study. There is also substantial evidence that suicide rates are influenced by the availability of firearms (Miller and Hemenway 2008; Miller, Azrael, and Hemenway 2002; Kubrin and Wadsworth 2009; Wadsworth, Kubrin and Herting 2014). While we are unaware of any evidence that firearm availability is directly related to subjective well-being, leaving such an important measure out of the analysis may lead to an underdeveloped model, wherein estimates are subject to omitted variable bias. We thus include a measure of firearm availability that allows us to obtain more precise estimates of the relationship between well-being and suicide. However, debatably the most important factor missing from the Daly et al. analysis is self-reported health. Those who commit suicide are more likely to be in poor health (Brown & Amiram 2003; Turvey et al. 2002) and self-ratings of health are among the strongest correlates of individuals' assessments of well-being (Dolan et al. 2008; Wadsworth 2016). This point is underscored by bivariate analyses of county-level BRFSS data and suicide rates, which reveal negative correlations between both health and suicide ($r = -.125$, $p<.001$) and well-being and suicide ($r = -.042$, $p=.10$), but a strong positive correlation between well-being and health ($r = .451$, $p<.001$). Thus, it is possible that healthy places contribute to positive emotional climates of an area and mediate an observed relationship between well-being and suicide rates at the aggregate level. While this would not discount the relative comparisons hypothesis, *per se*, it is an important confounding factor that may impact both the individuals and places in which these comparisons occur. As such, it is

essential to include measures of health in the analysis if we hope to determine whether the happiness of places really does impact suicide rates

Our last concern is more theoretical than methodological in nature. Daly et al. suggest that their findings may be the result of relative deprivation and the process of social comparison. However, they acknowledge that they are not able to empirically evaluate this proposed mechanism. In the current work we offer a preliminary test of this hypothesis by including a measure of individual-level deviations from the county mean. This approach is discussed in more detail below.

Data & Methods

Data & Measures

We examine the relationship between subjective well-being, sociodemographic characteristics, and suicide using data from the MMCD (Multiple Mortality Cause of Death) Records and BRFSS (Behavioral Risk Factor Surveillance System), collected by the Centers for Disease Control and Prevention at the National Center for Health Statistics (NCHS). The MMCD file contains cause-of-death and demographic information for all deaths occurring in the U.S. each year. By aggregating this information to the county level, we can obtain an accurate estimate of the number of suicides occurring in each U.S. County between 2005 and 2008, the years of our study. Measures of subjective well-being and self-rated health are taken from the BRFSS, the United States' largest ongoing telephone health survey. The BRFSS is carried out by state and federal health departments who work collaboratively to construct a representative sample of households with telephones in each state, using disproportionate stratified random samples with area density (high vs. medium) as strata. This approach is more efficient than

random-digit dialing and results in yearly national sample sizes ranging from n=355,241 to n=414,366 between 2005 and 2008. Critically, these four years of the BRFSS included the questions "In general, how satisfied are you with your life?" and "Would you say that in general your health is...", which are ranked on an ordinal scale from zero ("Not at all satisfied"; "Poor") to four ("Very Satisfied"; "Excellent"). In addition, the BRFSS data provide geocoded information for respondents living in counties where 50 or more people were sampled. This allows us to construct county-level measures of subjective well-being and self-rated health for 2,353 of the 3,143 counties in the U.S. by constructing means and standard deviations from all valid responses observed in each county between 2005 and 2008. However, we further restrict this sample to those counties that had 50 or more valid responses to the life satisfaction question, specifically, over this time period in an effort to construct more statistically valid estimates of our focal explanatory variable, mean county-level life satisfaction, resulting in a total sample of 1,563 counties (representing 66.4% of the original geocoded sample) with valid data on both suicide and SWB. Previous research has constructed similar contextual measures using this dataset (e.g. Daly et al., 2011; Wadsworth and Pendergast, 2014).

The omission of over a third of potential counties raises questions of selection bias—how different are the counties that are included in the sample from those that are not? To better understand how counties in the analytic sample differ from those that could not yield reliable estimates of county-level life satisfaction, we employ a series of logistic regression models predicting missingness as a function of all other variables included in the study. These models reveal that missing counties (N= 1587) tend to be significantly less populous (total population, p=.000), older (higher median age, p=.000), with more whites (% white, p=.017) and fewer Asians (% Asian, p=.000), have fewer suicides (p=.000), have more men than women (higher

sex ratio, p=.000), have more people who are married (higher marriage rate, p=.002), have higher high school graduation rates (p=.000) but lower college graduation rates (p=.000), and were more likely to be in Midwestern (p=.002) and Southern (p=.022) census regions than the counties included in this analysis.

Since there are numerous differences between counties with and without reliable information for life satisfaction in the BRFSS data, we took steps to ensure that our results are not simply a result of selection bias driven by the inclusion of mostly larger and more populous counties. Using full information maximum likelihood methods, we imputed values stochastically across 20 datasets for counties missing aggregate SWB data due to our calculation procedure (N=1587). All substantive and significant conclusions drawn below are consistent with those obtained from the multiple imputed data, meaning that selection bias likely does not influence the results of our study. We report the results from the analytic sample because the validity of point estimates obtained from multiple imputation (available upon request) depend upon the assumption that data is missing at random, a tenuous assumption to make given the differences observed.

Since proposed mechanisms linking SWB and suicide suggest the importance of both absolute (higher overall levels of SWB increase or decrease suicide) and relative well-being (those who exhibit less normative ratings of SWB are faced with a "dark contrast"), we calculate both the county mean life satisfaction and the sum of individual respondents' squared deviations from that mean for each county over the period 2005 to 2008. This allows us to confirm whether happier places do, in fact, have more suicide and begins to address the question of "why"; greater deviation from the mean life satisfaction ratings within counties represents an increased likelihood of relative deprivation and a situation in which more individuals are likely to

potentially face these "dark contrasts." There is surprising heterogeneity in these aggregate measures, with means ranging from 2.899 to 3.608 and the sum of squares ranging from 15.204 to 14,563.510 across counties, suggesting that both the level of subjective well-being and the inequality of it varies substantially by place. The sum of squared deviations displayed a high positive skew, suggesting that while most counties have only moderate individual deviations from the mean, there are also many counties displaying a large number of more substantial deviations. We thus include a variable representing the natural log of these squared deviations, which displays a relatively normal distribution, rather than the raw measure in the models. We follow the same procedures used to calculate the county mean to also obtain estimates of mean county self-rated health. Descriptive statistics for all measures are displayed in Table 1.

TABLE 1 ABOUT HERE

The MMCD data differentiate between causes of death related to firearms, which others have suggested can provide a good proxy for gun availability— itself an important predictor of suicide (Azrael, Cook and Miller 2004; Kubrin and Wadsworth 2009; Wadsworth, Kubrin and Herting 2014). To compute this measure, we first take the ratios of firearm homicides to total homicides and firearm suicides to all suicides. We then use a confirmatory factor analysis to arrive at an empirically weighted average of the two ratios and include this measure as a control in some iterations of the model to help understand whether the notion of dark contrasts is robust to a fuller range of related covariates.

Finally, while it may be informative to simply examine the bivariate correlation between SWB and suicide, a host of shared sociodemographic characteristics have emerged from these

otherwise distinct literatures as important determinants of both outcomes (e.g. divorce is a major cause of reduced life satisfaction and is associated with higher suicide rates). County sociodemographic features reflecting the most prominent individual- and aggregate-level correlates of suicide and SWB (median age; sex ratio; marriage, divorce, poverty, unemployment, high school graduation, and college graduation rates; percent black, Hispanic, Asian, Pacific Islander, and Native American; per capita income; percent urban) were taken from the Census Bureau's American Communities Survey (ACS), 2010 5-year estimates (2006-2010). This time period most closely aligns with the time period that the focal variables (suicide and life satisfaction) were measured (2005-2008), while still providing fairly accurate estimates of these population characteristics for all counties in our sample. It may be tempting to use data from the 2005 ACS 5-year estimates (from 2001-2005) instead, as these county characteristics, with the exception of 2005, would be verifiably in place before suicide data were collected and thus would provide a better basis for making causal inferences about any relationships with suicide rates. However, the purposes of this study are exploratory and not interested in or capable of making causal statements due to the nature of the data utilized (e.g. we cannot measure the life satisfaction of those people who provide suicide data in the MMCD) so the 2010 data are used because they capture county characteristics over the most similar period as those obtained from the BRFSS and MMCD.

Analytic Strategy

As our main outcome of interest is the number of suicides occurring in counties, count models are most appropriate for examining the association between life satisfaction, county characteristics, and suicide. An initial examination revealed that counts of county suicides were

over-dispersed, with baseline model-fit statistics and residual plots confirming that negative binomial regression provided a better fit than Poisson. Though zero counts of suicide were observed in up to 10% of counties, zero-inflated negative binomial models roundly failed to significantly improve fit. Taken together, this evidence suggests that for this sample, county suicide frequency is best modeled using negative binomial regression. Following Osgood's (2000) recommendation, we add the natural logarithm of the counties' population size to the model, constraining the resulting coefficient to one. This effectively transforms the outcomes in our regression models from an analysis of suicide counts to one of suicide rates, which better accounts for the differing populations at risk across the diverse set of counties in our sample. Finally, given that counties clustered within states are likely more similar than would be expected by chance and that their geographical proximity to other counties in the state may represent a potential spatial determinant of both suicide and well-being, we include robust standard errors with clustering at the state level to provide less biased estimates of the potential relationship between well-being and county suicide rates.

Since we are primarily interested in clarifying whether SWB is a significant correlate of suicide at the county-level, where the concept of "dark contrasts" can be more appropriately tested, we begin by modeling suicide rates as a function of county mean life satisfaction (Model 1). Next, we examine whether this association is robust to a set of sociodemographic controls similar to those used in the Daly et al. study (2011). Daly et al. (2011) used individual-level hazard models to obtain point-estimates of states' average suicide risk after controlling for age, race, gender, education, income, marital status, and employment (for more information on the methods used to calculate suicide risk, see Daly, Wilson and Johnson 2013). This approach ignores the variance in states' estimated suicide risk (e.g., the "true" population value for each

state is almost equally as probable to lie anywhere within its 95% confidence interval because of post-data degeneracy in factual error probabilities; Spanos 2012). Instead, we use the actual count of suicides occurring in counties and adjust directly for the Census Bureau's estimates of the corresponding county characteristics (median age; sex ratio; marriage, divorce, poverty, unemployment, high school graduation, and college graduation rates; percent black, Hispanic, Asian, Pacific Islander, and Native American; per capita income; percent urban) in Model 2. We next also include three other important determinants of suicide and well-being—region, gun availability, and mean self-rated health—in Model 3 to further test the robustness of the SWB-suicide relationship. Finally, we provide a preliminary examination of whether it is potentially relative, rather than absolute, life satisfaction that leads to more suicide under the "dark contrasts" hypothesis. While we cannot directly examine this contextual effect given that we do not have information on who committed suicide in the BRFSS, we would still expect to see that counties with higher deviance in individuals' life satisfaction tend also to have more suicide because these counties are composed of more individuals who fall further from the normative level (mean), and would thus be more likely to experience relative deprivation. While we recognize that the validity of this argument relies on the assumption that most of this variation occurs below the mean, this appears a reasonable assumption to make because within-county individual SWB is negatively skewed, on average, across the sample. Thus, we include an additional measure of the sum of squared deviations in county life satisfaction in Model 4 to begin examining this hypothesis. We present the findings from these models below. In the subsequent section we also discuss supplemental age group-specific analyses.

Findings

Table 2 displays the results of a series of negative binomial regression models examining the association between county characteristics and suicide rates. Overall, and in contrast to Daly et al., our results do not reveal any support for a relationship between SWB and suicide at the county-level. Rather, they tend to reinforce the importance of well-established correlates of suicide risk identified in the literature.

TABLE 2 ABOUT HERE

Models 1-4 roundly show a statistically non-significant association between mean life satisfaction and county suicide rates. In fact, the coefficient for mean SWB (while not significant) in the baseline model suggests that, on average, counties with lower life satisfaction have higher unadjusted suicide rates than those with greater life satisfaction. While the association shifts to the other direction once we include a similar set of controls to those used in the Daly et al. study (though it is still not significant; Model 2), the additional covariates entered in Models 3 and 4 ultimately result in a finding similar to that of the baseline model: life satisfaction is not a significant correlate of suicide rates at the county-level, and the point estimate for this relationship actually suggests, if anything, that the association is negative, not positive. Similarly, the sum of squared deviations in county life satisfaction scores fails to account for sufficient variance in suicide rates, neither reaching statistical significance nor improving model fit (Chi^2(1)=0.64, p=0.42) in Model 4. However, its inclusion does bring the coefficient for mean life satisfaction to near zero, clarifying that the lack of a significant association is more likely due to no relationship with suicide rates rather than large standard errors. Taken together, these results suggest that Daly et al.'s findings, which hypothesized that

individuals in happy places experience a "dark contrast" that may drive some to commit suicide, are not robust to a lower unit of analysis more appropriate for testing their explanatory mechanism and to a more complete array of control variables. Moreover, we find no evidence that greater disparities in life satisfaction (from the county-level sum of squared deviations) can account for differences in suicide rates across counties, calling into question the role of relative deprivation as a determinant of suicide.

The remaining characteristics we examine in models 2-4 essentially affirm that the most established correlates of suicide remain influential in predicting suicide at the county-level. Consistent with expectations derived from the literature, older places with more men tend to have more suicide. Divorce is positively associated with suicide, as is living in the South, West, and Midwest, compared to the Northeast. Interestingly, Daly et al. did not account for region, which may explain a great deal of the variance in both life satisfaction and suicide, especially at the state level. Net of racial composition, socioeconomic and employment measures are not consistently significant predictors of suicides, though race does seem to matter—the higher the percentage black, Hispanic, and Asian, the lower the suicide rate, though counties with high Native populations have high suicide rates—reflecting the fact that Native Americans and whites have the highest incidence of suicide in the US (Nock et al. 2008:45). Though related to suicide at the county-level in bivariate analyses (results available upon request), mean self-rated health is not significantly associated with suicide rates after controlling for sociodemographic and other compositional characteristics. Finally, gun availability appears to be a relatively consistent predictor of suicides, contributing to a slight, but significant, increase in rates in Models 3 and 4.

Supplemental Analyses

We further examined the validity of an aggregate-level relationship between SWB and suicide with a series of models designed to better capture age-graded suicide risk. This is important not only because there are sizable disparities in suicide risk across the life course that peak in middle-age (Nock et al. 2008:135), but because happiness follows a similar age gradation—high in late adolescence, lessening in middle age, and peaking in older age (Baird, Lucas & Donnellan 2010)— and may thus present a substantial threat to the validity of any SWB-suicide findings. We thus tested the robustness of our results by employing a series of additional analyses examining the association between life satisfaction and suicide within each of six 10-year age groupings (15-24, 25-34, 35-44, 45-54, 55-64, 65+) that correspond with marked differences in age-graded suicide risk, following the same iterative model-building process as described above. The results of the complete models obtained from these analyses are presented in Table 3. The age-graded models were also repeated using the multiple imputed data and again showed no substantive differences from those observed in the analytic sample. Collectively, the results of these robustness checks generally aligned with those of the primary analysis, though even the most well-established correlates of suicide exhibit some variability when broken down by age. Notably, the measure of individual deviations from the county level mean ("logWithin-County SS" in Table 3) shows a significant, positive association with suicide rates among the 45-54 year old age group, suggesting a 2.5% increase (IRR=1.0247, $p<.05$) in the suicide rate for every one unit gain in the logged deviation measure. For counties two standard deviations above the mean (logWithin-County SS=7.686), this corresponds with a 19% increase in the expected suicide rate—no trivial amount. While the direction of this association aligns with the expectations drawn from the "dark contrasts" hypothesis, the result should, however, be viewed with caution given the number of statistical tests employed across each of the 6 age groupings.

TABLE 3 ABOUT HERE

Discussion and Conclusion

A crucial element of scientific research is the reproducibility and robustness of findings, particularly those that appear especially novel and attract widespread attention both within and beyond academia. This study investigated whether Daly et al.'s (2011) widely publicized findings of a positive relationship between happiness rankings and state-level suicide rates, suggesting that social comparisons of life satisfaction contribute to suicide, could be confirmed using a more suitable level of analysis (counties), a fuller set of covariates, and a more rigorous examination of their hypothesized mechanism. Overall, our results generally fail to find evidence of these "dark contrasts" driving suicide rates, except potentially among 45-54 year olds. Instead, our findings highlight the importance of traditional predictors of suicide and well-being in the aggregate, consistent with a large body of research on the correlates of suicide rates.

Collectively, much of the research in both the areas of subjective well-being and suicide suggest the likelihood of a negative relationship, either due to compositional or contextual effects. Individuals who are more satisfied with their lives should be less likely to commit suicide. And places that have happier people all around should experience a variety of benefits that result in a happier "emotional climate" for *all*, thereby decreasing the likelihood of suicide. However, both the suicide and subjective well-being literatures have also found that relative deprivation can be quite influential. High levels of economic inequality can result in more suicide (Burr et al. 1999; Curtis, Curtis and Fleet 2013), even after controlling for absolute economic position, and individuals who experience less of a desirable commodity or

characteristic than others often exhibit lower levels of SWB (Wadsworth 2014; 2016; Wadsworth and Pendergast 2014). Surprisingly, with the one exception noted above, we do not observe a relationship, negative *or* positive, between the well-being of places (measured in both absolute and relative terms) and suicide rates at the county-level.

We believe our findings answer some questions and demonstrate the need for different methodological approaches and data requirements to address others. Overall, is the average subjective well-being of a place associated with suicide rates? No—or a least, not at the county level. When using one of the most common levels of analysis for examining how the characteristics of place shape suicide, we demonstrate the importance of standard correlates of suicide and the lack of influence of aggregate SWB. In light of the many differences in our analytical approaches we cannot be sure exactly why Daly et al. identified a relationship at the state level that we were not able to reproduce at the county level. We focused here on modeling this relationship as precisely as possible for our unit of analysis rather than simply trying to replicate their work, and in so doing, feel confident that this overarching relationship between area SWB and suicide rate is not likely to exist at the county level. Are individuals with lower levels of SWB at higher risk of suicide when surrounded by people with higher than average levels of well-being? In other words, can relative deprivation of happiness or life satisfaction increase suicide? We don't really know. If the potential effects of relative deprivation were strong enough we would expect to have seen them manifest in higher rates of suicide in counties with greater individual-level deviations from county means in well-being. While we did find some evidence of a "dark contrast" for 45-54 year-olds in an age-graded analysis, it is difficult to conclude that this is a robust finding given the number of analyses undertaken. However, our analytic approach to examine deprivation was relatively gross and further research using data

that can be geocoded and that contain measures of suicide and SWB, collected from the same individuals, are necessary to fully answer this important question. Unfortunately, to our knowledge, no such data currently exist.

The differences between our and Daly et al.'s results also underscore the importance of several methodological considerations for future studies of suicide at the aggregate-level. Researchers should examine data at a unit of analysis that best aligns with their research questions and hypothesized theoretical mechanisms. For example, states and nations may simply be too heterogeneous for the study of contextual effects on an outcome like suicide and any findings at these levels of aggregation should be careful to not confound state with well-established regional effects (like the regional variation in both suicide and well-being). It is also important to consider how sampling strategies may influence data at various levels of analysis. While it is hard to estimate how much this may explain our and Daly et al.'s disparate findings, the BRFF over-samples rural respondents (comprising 57% of the sample but only 19% of the U.S. population in the 2010 census) who tend to report significantly higher levels of life satisfaction than their urban counterparts; thus, state-level averages of subjective well-being would be upwardly biased by the ratings of those residents in more rural areas. In contrast, official death records give a more-or-less comprehensive count of the number of suicides occurring in U.S. counties or states. However, since rural places tend to have much higher suicide rates than urban places across all age ranges, even after controlling for sociodemographic factors (Fontanella et al. 2015; Singh and Siahpush 2002), states characterized by large rural populations should have much higher per capita suicide rates than more urban states. Given that more rural states would thus exhibit higher mean life satisfaction, due to BRFSS sampling bias, and higher suicide rates, due to the higher prevalence of suicide in rural places, it would not be

surprising to observe a positive correlation between suicide and well-being at the state-level. However, this may be an artifact of the data being used to construct the estimates; if it is really true that the same places displaying higher satisfaction also have more suicides, then it is important to confirm that the relationship also exists at the county-level, where there is less sampling bias and heterogeneity. In this study, we do not observe such an association.

Researchers should also be sure to control for potentially relevant confounding variables, such as health, if they want to ensure that an observed association with suicide is not spurious and in fact does suggest an important theoretical mechanism that could be targeted by suicide prevention or other public health efforts. Finally, close attention should be paid to identifying other exogenous factors influencing suicide to obtain the most precise estimates of factors contributing to suicide risk. Failing to adjust for factors like gun availability can lead to inflated estimates or standard errors that may over or understate the importance of certain variables. Models should be as fully specified as possible, while keeping parsimony in mind, for researchers to make the strongest claims about what characteristics of places really influence suicide rates.

Despite these advances in studying aggregate-level suicide and SWB, our study does have some limitations. First, the decision to restrict our sample to only those counties that have geocoding information and 50 or more valid responses to the life satisfaction question, though important for obtaining accurate estimates of how SWB varies across place, limits the generalizability of our findings. The remaining counties are no longer truly representative of all U.S. counties and instead reflect somewhat larger and more urban places. However, a rigorous set of robustness checks using multiple imputation that were designed to simulate data for the full population of U.S. counties suggest there is little reason to believe that selection bias

substantially impacted our results. As mentioned earlier, another concern is that, like Daly et al. (2011), we were unable to employ a dataset with both county-level identifiers and individual-level suicide and life satisfaction data. This data would have permitted us to fully examine whether there is a truly contextual relationship between individuals' suicide decisions, their life satisfaction, and the "happy climates" that might aggravate their dissatisfaction; though, if this hypothesis is true, we would have expected to see a significant and positive association between the sum of individual deviances from county mean life satisfaction and suicide rates, as this would signify that more people in these counties fail to attain the mean satisfaction of the area they live in.

These limitations aside, our findings challenge the paradoxical idea that happy places tend to have higher suicide rates, calling into question the role that happiness or SWB may play in suicide. Of course, with only two studies that explicitly examine the happiness-suicide relationship at the aggregate level, more research is needed to adjudicate this issue. Future studies that are able to more precisely represent and empirically evaluate the possible interaction between individual and area SWB would be especially fruitful.

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Table 1

Descriptive Statistics for Sample County Characteristics

	M	SD
Suicide		
All Suicides	77.58	155.96
Life Satisfaction		
Mean	3.27	0.09
log(Within-County SS)	5.70	1.19
Sociodemographic Characteristics		
Median age	38.54	4.75
Sex ratio (M:F)	98.26	6.46
Marriage rate	52.69	6.76
Divorce rate	11.05	2.07
Poverty rate	15.23	6.17
Unemployment rate	7.84	2.87
High school graduaton rate	34.80	7.81
College graduation rate	6.39	4.33
Per capita income ($1k)	18.63	4.48
% Urban	0.20	0.31
Racial Composition		
% White	0.79	0.19
% Black	0.10	0.14
% Hispanic	0.06	0.11
% Asian	0.01	0.03
% Pacific Islander	0.00	0.00
% Native	0.02	0.07
Region of Residence		
Northeast	0.05	0.22
South	0.45	0.50
West	0.18	0.38
Midwest	0.27	0.45
Other County Characteristics		
Gun Availability	0.06	0.76
Mean self-rated health	3.38	0.22
N	1563	

Sources: MMCD, BRFSS 2005-2008; American Communities Survey 5-year estimate, 2006-2010

Table 2

Negative binomial regression models predicting suicide rates; U.S. counties, 2005-2008

	Model 1	Model 2	Model 3	Model 4
Life Satisfaction				
Mean	-0.1260	0.0248	-0.0155	-0.0047
log(Within-County SS)				0.0046
Sociodemographic Characteristics				
Median age		0.0220 ***	0.0222 ***	0.0223 ***
Sex ratio (M:F)		0.0039 **	0.0038 **	0.0039 **
Marriage rate		-0.0051 +	-0.0046	-0.0045
Divorce rate		0.0419 ***	0.0428 **	0.0425 **
Poverty rate		0.0290	0.0037	0.0039
Unemployment rate		-0.0026	-0.0023	-0.0024
High school graduaton rate		0.0014	0.0014	0.0150
College graduation rate		0.0032	0.0032	0.0030
Centered Per capita income ($1k)		-0.0010 ***	-0.0011 ***	-0.0012 ***
% Urban		0.0450 +	0.0428 +	0.0390
Racial Composition				
% Black		-0.7438 ***	-0.7403 ***	-0.7449 ***
% Hispanic		-0.6143 ***	-0.6138 ***	-0.6182 ***
% Asian		-1.5983 ***	-1.5585 ***	-1.5427 ***
% Pacific Islander		1.1154	1.1159	0.9505
% Native		0.7247 **	0.7144 **	0.7068 **
Region of Residence (Northeast)				
South		0.2360 ***	0.2395 ***	0.2418 ***
West		0.4295 ***	0.4231 ***	0.4236 ***
Midwest		0.1492 **	0.1494 **	0.1535 **
Other County Characteristics				
Gun Availability		0.0270 +	0.0282 *	0.0285 *
Mean self-rated health			0.0683	0.0662
Constant	-7.1513	-9.0808	-9.2134	-9.4978
ln(alpha) Constant	-2.4536	-4.0668	-4.0679	-4.0697

Sources: MMCD, BRFSS 2005-2008; American Communities Survey 5-year estimate, 2006-201
*** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$; + $p \leq .10$.
Notes: Standard errors are adjusted for clustering at the state-level. "Northeast" is the comparison group for region. N=1,563

Table 3

Negative binomial regression models predicting age-specific suicide rates; U.S. counties, 2005-2008

	15-24		25-34		35-44		45-54		55-64		65+	
Life Satisfaction												
Mean	0.0408		-0.0915		-0.0038		-0.0062		0.0562		0.0667	
log(Within-County SS)	0.0109		0.0010		0.0032		0.0244	*	0.0033		-0.0223	+
Sociodemographic Characteristics												
Median age	0.0145	*	0.0179	***	0.0241	***	0.0210	***	0.0122	***	0.0127	***
Sex ratio (M:F)	0.0066	**	0.0019		-0.0002		0.0024		0.0077	***	0.0078	***
Marriage rate	0.0295	***	-0.0019		-0.1080	**	-0.0136	**	-0.0071		-0.0076	+
Divorce rate	0.0821	***	0.0405	***	0.0379	**	0.0291	**	0.0424	***	0.0510	***
Poverty rate	0.0065		0.0060		0.0060		0.0099	+	0.0085		0.0051	
Unemployment rate	-0.0342	***	-0.0126	+	-0.0067		0.0002		0.0099		0.0053	
High school graduaton rate	0.0075	**	0.0008		0.0028		0.0035	+	0.0010		-0.0015	
College graduation rate	0.0154	***	-0.0089	+	0.0035		-0.0001		0.0022		0.0039	
Centered Per capita income ($1k)	-0.0015	*	-0.0015	***	-0.0020	***	-0.0010	**	0.0001		-0.0003	
% Urban	-0.0017		0.0436		0.0569		0.0973	***	0.0891	+	0.0285	
Racial Composition												
% Black	0.8101	***	-0.7051	***	-1.0673	***	-1.3353	***	-0.9946	***	-0.6713	***
% Hispanic	-0.0391		-0.9469	***	-1.0023	***	-0.8764	***	-0.5330	**	-0.1353	
% Asian	-1.8065	**	-1.4756	*	-1.8949	***	-1.6447	***	-1.1153	***	-0.7482	*
% Pacific Islander	4.1570	*	0.9034		0.2179		0.6385		-0.5107		-0.4209	
% Native	2.9350	***	1.0781	***	0.2765		-0.3943	+	-0.6295	*	-0.0850	
Region of Residence (Northeast)												
South	0.0297		0.1836	**	0.2388	***	0.3442	***	0.2522	***	0.2230	***
West	0.3975	***	0.2841	***	0.3985	***	0.5060	***	0.3681	***	0.4504	***
Midwest	0.2479	***	0.1561	*	0.2066	**	0.2256	**	0.0854		0.0435	
Other County Characteristics												
Gun Availability	-0.0067		0.0313		-0.0224		0.0304		0.0856	***	0.1448	***
Mean self-rated health	-0.1234		-0.0603		-0.0136		0.2634	*	0.1810		0.0729	
Constant	-11.5392		-8.1046		-8.0674		-9.2386		-9.9564		-9.4121	
ln(alpha) Constant	-3.2794		-3.9311		-3.7614		-3.8893		-4.2241		-4.0541	

Sources: MMCD, BRFSS 2005-2008; American Communities Survey 5-year estimate, 2006-2010

*** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$; + $p \leq .10$.

Notes: Standard errors are adjusted for clustering at the state-level. "Northeast" is the comparison group for region. N= 1563