CENTRE *for* ECONOMIC PERFORMANCE

CEP Discussion Paper No 1680

March 2020

Machiavelli Versus Concave Utility Functions: Should Bads Be Spread Out Or Concentrated?

Paul Frijters
Christian Krekel
Aydogan Ulker

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

UKRI Economic and Social Research Council

Abstract
Is wellbeing higher if the same number of negative events is spread out rather than bunched in time? Should positive events be spread out or bunched? We answer these questions exploiting quarterly data on six positive and twelve negative life events in the Household, Income and Labour Dynamics in Australia panel. Accounting for selection, anticipation, and adaptation, we find a tipping point when it comes to negative events: once people experience about two negative events, their wellbeing depreciates disproportionally as more and more events occur in a given period. For positive events, effects are weakly decreasing in size. So for a person's wellbeing both the good and the bad should be spread out rather than bunched in time, corresponding to the classic economic presumption of concave utility rather than Machiavelli's prescript of inflicting all injuries at once. Yet, differences are small, with complete smoothing of all negative events over all people and periods calculated to yield no more than a 12% reduction in the total negative wellbeing impact of negative events.

Key words: wellbeing, mental health, life events, non-linearities, hedonic adaptation, welfare analysis
JEL Codes: I31; D1; P35

This paper was produced as part of the Centre's Wellbeing Programme. The Centre for Economic Performance is financed by the Economic and Social Research Council.

We are grateful to Richard Layard for helpful comments and suggestions.

Paul Frijters, London School of Economics. Christian Krekel, London School of Economics and Centre for Economic Performance, LSE. Aydogan Ulker, Deakin University.

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

1. Introduction

"Injuries, therefore, should be inflicted all at once, that their ill savour being less lasting may the less offend; whereas, benefits should be conferred little by little, that so they may be more fully relished."
– Niccolò Machiavelli, The Prince

Ceteris paribus, would one inflict bad things all at once or spread them out? And would one do the same or the opposite with positive events? Machiavelli urges us to bunch the bad and space the good. We address this question empirically by looking at non-linearity in the effects of positive and negative events on life satisfaction and mental health in a large panel of Australian individuals observed since 2002.

In classic utility function terms, Machiavelli argues for an S-shaped utility function that is concave in positive and convex in negative shocks, like the value function of Kahneman and Tversky (1979).[1] Then, the average absolute impact of negative shocks decreases in their size (or number), with the same holding for positive effects. Under classic economic assumptions, on the other hand, the utility function is concave everywhere, which means the average absolute impact of negative shocks increases in their size.

Implicit in the arguments of both Machiavelli and Kahneman and Tversky (1979) is the idea that individuals' reference positions adapt to shocks, so that one can speak of a cumulative effect of positive and negative events over a long period of time. This hedonic adaptation has a long tradition in psychology, dating back at least as far as Brickman's and Campbell's *Hedonic Relativism and Planning the Good Society* (Brickman and Campbell, 1971). There is now an established body of evidence on hedonic adaptation to various positive or negative life events, including changes in marital status (Lucas, 2005; Lucas and Clark, 2006; Oswald and Gardner, 2006; Stutzer and Frey, 2006), disability (Menzel et al., 2002; Oswald and Powdthavee, 2008), income (Di Tella et al., 2010; Kuhn et al., 2011), or unemployment (Clark et al., 2008), as well as studies looking at anticipation and adaptation to life shocks in relative comparison (Clark et al., 2008; Frijters et al., 2011; Clark and Georgellis, 2013). The phenomenon of adaptation is also explicit in the idea of homeostasis and set point theory, and often thought to be responsible for the lack of a strong relation between GDP and life satisfaction in rich countries.[2] In our empirical analyses, we must therefore pay attention to the phenomenon of adaptation in order to separate that issue from the issue of non-linearity that determines the optimal spacing of events.

[1] Apart from convexity in the negative and concavity in the positive realm, Kahneman and Tversky (1979)'s value function displays another characteristic which is analysed only indirectly in this paper: a discontinuity in the derivative around the reference point with losses weighing higher than gains. We will indeed find that phenomenon in our empirical analyses, but it is not the main focus of this paper.
[2] The notion that economic growth did not coincide with growth in wellbeing in developed countries over the last fifty years or so dates back to Easterlin (1974).

There is a large literature on how individuals' wellbeing and behaviour reacts to various positive or negative life shocks. Apart from the aforementioned studies, which have a particular focus on hedonic adaptation, the literature includes studies on, for example, shocks to income and wealth (Gardner and Oswald, 2007; Adda et al., 2009; Baird et al., 2013; Apouey and Clark, 2015; Schwandt, 2018), war time experiences (Johnston et al., 2016), crime victimisation (Johnston et al., 2017), own criminal behaviour (Corman et al., 2011), homelessness (Curtis et al., 2013), and various other life shocks (Lindeboom et al., 2002). However, despite the large interest in this topic, the question of optimal bunching of events has never been posed, to our knowledge. This reflects, in part, the inherent difficulty in finding random variation in enough life events simultaneously to be certain about their cumulative effect. Researchers, therefore, have typically restricted themselves to look at single events in isolation, such as unemployment or marital breakdown, or else have been interested in particular psychological mechanisms that hold for many events, such as the phenomenon of adaptation and the relation between decisions and feelings. Yet, for both individuals and policy-makers alike, the question of optimal bunching is quite relevant for choice behaviour: individuals can make 'clean breaks' (all events at once), 'bite the bullet' (all bad events at once), 'take it one at a time' (events one by one), and so on. It would help for individual and policy deliberations to know whether negative events should be bunched or spread out, *ceteris paribus*.

States can shield their populations from the full consequences of particular events, like health and income shocks, and they can create special provisions for individuals hit by multiple events, like hardship payments. The optimality of doing so crucially depends on the shape of the utility function: if utility was convex in the negative realm and budgets were finite, it would be better not to cushion negative shocks but let them impact simultaneously as the marginal utility lowers with further bad shocks. Yet, welfare safety nets follow the rationale of classic economics, namely that utility is concave everywhere and marginal utility is highest at the lowest level of consumption rather than at the reference point. The rationale of poverty alleviation and welfare states is partly given by the notions of 'basic needs' and that individuals should be shielded from particularly harsh outcomes brought about by accumulated bad shocks.

We find in our empirical analyses that Machiavelli, and by implication Kahneman and Tversky (1979), were wrong: accounting for selection, anticipation, and adaptation, and holding the number of negative life events constant over an individual's life, we find that wellbeing decreases when negative events occur all at once as opposed to being spread out. For positive events, the same holds, meaning that the optimal policy is to spread out both the good and the bad, in line with classic economic assumptions. The utility function appears to be concave everywhere, not S-shaped.

We use data on six positive and twelve negative life events in the Household, Income and Labour Dynamics in Australia (HILDA) panel. HILDA has several advantages over comparable datasets: it uniquely tracks the 18 life shocks we use for the entire duration of the panel (2002-now), has a large numbers of individuals (about 20,000), consistently measures life satisfaction and mental health in every survey year, and records life events on a quarterly rather than annual basis. The panel dimension allows us to look at within-person variation in life events and wellbeing, reducing some of the bias resulting from self-selection into particular events. The availability of quarterly event information allows us to account for the adaptation profile on a quarterly basis.

In our most simple specification, we pool all positive life events into a single count variable and all negative events into another, finding clear evidence of a non-linear effect on both life satisfaction and mental health in line with the notion of a concave utility function. In our extended specification, where each event has its own adaptation and anticipation profile, we use indices of negative and positive events, finding the same overall pattern. In sensitivity analyses, we show that the results remain qualitatively the same when looking only at a specific subset of the more exogenous (for example, the death of a close friend) and unanticipated events in our dataset. Further robustness checks, including tests for selective attrition, respondents' fidelity and engagement with the survey questions, alternative outcomes, and alternative estimation procedures, are all in line with the main findings.

We then ask: how much does the non-linearity in negative life events matter for overall wellbeing? We find that spreading losses evenly in a given period of time reduces the overall wellbeing loss from these events by about 10%, whereas spreading benefits evenly raises overall wellbeing gain by about 2%, yielding an overall net wellbeing gain of about 12% of the total effect of the life shocks relative to the *status quo*. This is not a huge effect in terms of levels, only worth around 0.01 points increase in life satisfaction each period.

Our findings add to two streams of literature: first, there is an established stream of literature studying anticipation and adaptation regarding various life events, both positive and negative. Clark et al. (2008) use annual data on four negative (unemployment, divorce, widowhood, and lay-off) and two positive life events (marriage and childbirth) from the German Socio-Economic Panel Study (GSOEP), showing that respondents anticipate and later fully adapt to most life events when it comes to life satisfaction. Frijters et al. (2011) extend this analysis by studying wellbeing dynamics around changes in employment status (being promoted and being laid off), changes in family life (births, deaths, and divorce), and changes related to the physical person (victimisation and health) in the HILDA panel. The authors confirm that respondents adapt to most changes in life circumstances.

A second stream of literature looks at the concavity of utility, with many studies focusing on the non-linearity around the reference point. A general finding is that financial worsening looms larger than financial improvement of the same absolute size, in line with concave utility functions that have a kink at the reference point and the prescript of Kahneman and Tversky (1979). Using nationally representative longitudinal household data from the British Household Panel Survey (BHPS) and the SOEP panel, Boyce et al. (2013) find that, over a relatively long time horizon, positive changes in income from one year to another yield a lower absolute change in life satisfaction than negative changes. A similar asymmetry is found by De Neve et al. (2018) at the macro level when it comes to positive and negative fluctuations in economic growth. Likewise, Vendrik and Woltjer (2007) provide evidence of an S-shaped utility function in the context of relative income, showing that positive deviations of own income from average income yield a lower absolute change in life satisfaction than negative deviations. We join both streams of literatures, allowing for a non-linearity at the reference point but focussing mainly on non-linearities further away from it. Importantly, we account for the dynamics of events by explicitly modelling anticipation and adaptation regarding each life event.

The rest of this paper is organised as follows: Section 2 gives an overview of the data we use and provides summary statistics on the life events we study. Section 3 introduces the empirical strategy, including different types of estimation and different ways to operationalise the occurrence of life events in a given period of time. Section 4 presents our main findings and scrutinises their robustness regarding alternative operationalisations and explanations. Section 5 calculates counterfactuals. Finally, Section 6 concludes and discusses implications for individual and policy choices.

2. Data

We use nationally representative longitudinal household data from the HILDA panel for the period 2002 to 2017. HILDA was first conducted in 2001 on a representative sample of 7,682 Australian households and 19,914 individuals. Since then, every year, interviews have been conducted with all members of a household who are at least fifteen years old at the time of the interview.[3] Information is collected on a wide range of topics including educational attainment, health status, labour force dynamics, and income. The survey also asks household members about their overall life satisfaction, and importantly, whether major life events occurred during the last year, identifying the timing of each event on a quarterly basis relative to the interview date.

Our primary outcome is *life satisfaction*, a cognitive, evaluative measure of subjective wellbeing, which is obtained from a single-item eleven-point Likert scale question asking respondents: "All

[3] Unfortunately, we cannot use data from 2001 since life events have only been sampled from 2002 onwards.

things considered, how satisfied are you with your life?" Answer possibilities range from zero ("completely dissatisfied") to ten ("completely satisfied"). In our analyses, the largest sample with a complete set of information on both life satisfaction and life events includes 176,280 person-year observations. In this sample, mean life satisfaction is about 8.0, with a standard deviation of about 1.4, suggesting, in line with panel data evidence from other countries, that Australian respondents are, on average, rather satisfied with their lives. Life satisfaction is sometimes referred to *experienced utility* (Kahneman et al., 1997; Dolan and Kahneman, 2008), and seen as a proxy for utility for a wide range of choice behaviours (Benjamin et al., 2012). By and large, in experimental settings, people have been shown to make choices that are consistent with maximising their subjective wellbeing (Adler et al., 2017).

As an alternative outcome, we use *mental health* from the SF36 health survey. The SF36 is a multi-purpose questionnaire on health-related quality of life and co-administered with the HILDA panel (Ware et al., 1995). Following Mervin and Frijters (2014), we construct a mental health summary score from fourteen items of the SF36 item battery covering four health domains: *(i)* mental health in general (i.e. being a happy person, being a nervous person, being calm and peaceful, feeling down, and feeling down in the dumps); *(ii)* role-emotional functioning (i.e. changes in the amount of time spent at work as a result of emotional problems); *(iii)* social functioning (i.e. emotional problems interfering with social activities); and *(iv)* vitality (i.e. feeling tired, feeling worn out, feeling full of life, and having a lot of energy). The resulting summary score ranges from zero to 400, with higher values implying better mental health. We divide it by 40 so that it has the same scale as our measure for life satisfaction, and then take its natural log to reduce its skewedness.

Our variables of interest are major life events, both positive and negative. These are obtained from a battery of binary items asking respondents about whether a specific life event occurred during the past twelve months. If respondents report to have experienced a specific event, they are asked whether it occurred up to three months ago, three to six months ago, six to nine months ago, or nine to twelve months ago. To avoid small cell sizes, we recode these events on a biannual basis.

We exploit information about the timing of the event to account for anticipation and adaptation, which have been shown to be important features surrounding major life events (see Clark et al. (2008), Frijters et al. (2011), or Clark and Georgellis (2013), for example). To account for anticipation, we create dummy variables for periods preceding the interview in which the event was reported (i.e. leads), including dummies for, respectively, up to six months ago, six to twelve months ago, twelve to eighteen months ago, and eighteen to 24 months ago. Similarly, to account for adaptation, we create dummy variables for periods succeeding the interview in which the event was reported (i.e. lags), including dummies for, respectively, the next six months, the next six to twelve months, the next twelve to eighteen months, the next eighteen to 24 months, and more than 24 months. We assume that respondents cannot anticipate life events further than two years into the future, and that any adaptation is complete within two years after the interview so that the dummy for an event which occurred more than 24 months ago picks up the long-run effect of that event.

We are initially agnostic about which life events to include and exploit all eighteen major life events available in the HILDA panel. These can be broadly categorised into six positive and twelve negative life events.

Positive life events are:

1. Birth or adoption of a new child
2. Major improvements in finance (e.g. won lottery)
3. Got promoted
4. Got married
5. Retired
6. Got back together with spouse

Negative life events are:

1. Death of a close friend
2. Death of an extended family member or relative
3. Death of a spouse or a child
4. Major worsening of finances (e.g. went bankrupt)
5. Made redundant
6. Serious illness or injury to a family member
7. Serious personal illness or injury
8. Family member detained in jail
9. Detained in jail (self)
10. Victim of property crime (e.g. theft, breaking and entering)
11. Victim of physical violence (e.g. assault)
12. Separated or divorced from spouse

Table 1 shows summary statistics on these life events, split by positive and negative events, including the number of occurrences of each event. It also reports, conditional on experiencing a specific event, how many positive or negative events there are recorded for that person, at which age of respondents the events occur, and which household income and educational attainment respondents report to have, on average, when reporting the events.

Table 1 Column 1 shows that the positive life event reported most often is being promoted, followed by the birth or adoption of a new child; the least frequently reported is getting back together with a spouse after prior separation. The negative life event that is reported most often is serious illness or injury of a family member, followed by the death of an extended family member or a relative; the least frequently reported is being detained in jail.

Column 2 yields the mean number of positive or negative life events, respectively, conditional on having experienced a specific event. For example, respondents reporting to have experienced a promotion report, on average, about 4.1 positive events (including the promotion itself), respondents reporting to have experienced serious illness or injury of a family member about 9.6 negative events (including the serious illness or injury itself). Thus, respondents reporting to have experienced a positive life event report, on average, between 3.6 and 4.1 positive events, while respondents reporting to have experienced a negative life event report between 8.4 and 11.1 negative events.

There are some average age differences between people experiencing positive or negative events (Column 3), with birth and jail happening to younger individuals, and retirement and the death of a spouse to older individuals. Those experiencing positive events have slightly more educational attainment (Column 4) and higher household income (Column 5). To net out such differences in observables between people experiencing positive and negative events, we routinely control for age, education, and income throughout our regressions. Table A1 in the Appendix shows, in addition, the distribution of life events, split by positive and negative events, over the past twelve months as counts of person-year observations. Here, we observe, for example, that 421 individuals experience five negative life events in the same year, but less than 200 three or more positive events, which implies that the statistical power to identify non-linearities in the positive realm will be weaker than the power to identify non-linearities in the negative realm.

3. Empirical Strategy

We estimate all models on both life satisfaction and mental health, both taken as measures of wellbeing. We start with the following parsimonious model, which is linear in form, treats life events as continuous, and initially does not account for dynamics around life events (i.e. anticipation and adaptation):

$$Y_{it} = \beta_0 + \gamma_0 \#Pos + \gamma_1 \#Pos^2 + \gamma_2 \#Neg + \gamma_3 \#Neg^2 + \beta_1 X_{it}' + u_i + \varepsilon_{it} \qquad (1)$$

where Y_{it} is either the life satisfaction or mental health of individual i in year t; *#Pos* is the number of positive and *#Neg* the number of negative life events in the last year (where we suppressed the subscripts i and t); X_{it} is a vector of controls, including age, age squared (divided by 100), years of education, and log household income. u_i is an individual fixed effect to net out time-invariant unobserved heterogeneity at the individual level, acknowledging that individuals differ substantially in their ability to anticipate and adapt to changing life circumstances (Lucas, 2007; Buddelmeyer and Powdthavee, 2016; Etilé et al., 2019). Individual fixed effects also ensure that variation comes from within individuals, reducing some of the bias from self-selection into particular events. Robust standard errors are clustered at the individual level.

Our coefficients of interest are γ_0, γ_1, γ_2, and γ_3. Machiavelli's proposition – neglecting dynamics around life events for the time being – would lead one to expect that $\gamma_0 > 0$ and $\gamma_1 < 0$ (i.e. the relationship between positive life events and wellbeing is concave) and $\gamma_2 < 0$ and $\gamma_3 > 0$ (i.e. the relationship between negative life events and wellbeing is convex), implying that losses loom larger than gains and that there is no tipping point when it comes to losses.

An alternative, more flexible way to specify Equation (1) is to use binary instead of continuous measures of life events. This is shown in the following model:

$$Y_{it} = \beta_0 + \gamma_0 Pos_{3+} + \gamma_1 Pos_2 + \gamma_2 Pos_1 + \gamma_3 Neg_1 + \gamma_4 Neg_2 + \gamma_5 Neg_3 + \gamma_6 Neg_4 + \\ + \gamma_7 Neg_5 + \gamma_8 Neg_{6+} + \beta_1 X_{it}' + u_i + \varepsilon_{it} \qquad (2)$$

where $Pos_{\#}$ and $Neg_{\#}$ are dummy variables (where we again suppressed the subscripts i and t) equal to one if a respondent experienced, respectively, # positive or # negative life events in the previous year, the remainder being the same as before. In this case, Machiavelli's proposition would lead one to expect that *(i)* coefficients for positive events have positive signs and coefficients for negative events have negative signs, and *(ii)* there is a concave relationship between wellbeing and positive events as well as a convex relationship between wellbeing and negative events.

These initial models do not take into account anticipation and adaptation regarding life events, implicitly assuming that no life events are anticipated and full adaptation occurs after exactly 12 months. To account for anticipation and adaptation, we extend our parsimonious model to become:

$$Y_{it} = \beta_0 + g(W^{pos}{}_{it}, W^{neg}{}_{it}) + \beta_1 X_{it}' + u_i + \varepsilon_{it} \qquad (3a)$$

where W^{pos}_{it} and W^{neg}_{it} are positive and negative events indices that themselves include both anticipation and adaptation elements, such that the main question reduces to whether *g()* is concave in both W^{pos}_{it} and W^{neg}_{it}. These negative and positive events indices are constructed as follows:

$$W^{pos}_{it} = \sum_{j\in Jpos}\sum_{s} z_{ji,t+s} y_{j,t+s} \qquad (3b.1)$$
$$W^{neg}_{it} = \sum_{j\in Jneg}\sum_{s} z_{ji,t+s} y_{j,t+s} \qquad (3b.2)$$

Here, J_{pos} and J_{neg} are the sets of positive and negative events; $z_{ji,t+s}$ is the positive or negative life event *j* experienced by individual *i* in biannual period *t+s*, with *s* ∈ *S = {less than -24 months,-24 to -18 months, -18 to -12 months, -12 to -6 months, 0 to 6 months, 6 to 12 months, 12 to 18 months, and 18 to 24 months}*. For each positive or negative event, we therefore estimate eight parameters.

We start by estimating Equation (3a) in two steps, by assuming in a first step linearity (i.e. $g(W^{pos}_{it}, W^{neg}_{it}) = W^{pos}_{it} + W^{neg}_{it}$) to estimate the parameters *y*, which allows for the construction of the indices W^{pos}_{it} and W^{neg}_{it} in Equations (3b.1) and (3b.2). In a second step, we estimate Equation (3a) using the imputed values of W^{pos}_{it} and W^{neg}_{it}, allowing us to study the effects of the non-linearities *versus* the initial specification without them. In an alternative specification, we estimate Equation (3a) in one go, which requires a non-linear regression as *g(.)* can be various non-linear parametrisations of the positive and negative events indices.[4] We should mention that estimating Equation (3a) in two steps or in one go makes little difference to our results: the main finding is somewhat stronger if it is estimated in one go (see the discussion of Table 6), but the two-step procedure is easier to interpret.

The positive and negative events indices explicitly take into account anticipation and adaptation regarding life events by aggregating events weighted by their coefficient estimates, that is, by their relative contributions to the wellbeing dynamics around the respective events. Note that the positive events index has a positive and the negative events index a negative sign. Our indices implicitly take into account that positive and negative events may not be symmetric and may differ from each other in terms of nature and magnitude of impact.

As to the choice of *g(.)* in the second step of our two-step estimation, we are initially agnostic and assume two different parametrisations: first, we assume a simple quadratic polynomial whereby the question of concavity is determined by the sign of the quadratic terms:

[4] See Appendix Tables A2a and A2b for the parameters of the positive and negative index numbers estimated via Equation (3). Since these are in line with estimates from previous studies, we do not discuss them in more detail. The most important thing to note is that positive events have cumulative positive and negative events cumulative negative effects.

$$Y_{it} = \beta_0 + \theta_0 W^{pos}{}_{it} + \theta_1 W^{pos}{}_{it}{}^2 + \theta_2 W^{neg}{}_{it} + \theta_3 W^{neg}{}_{it}{}^2 + \beta_1 X_{it}' + u_i + \varepsilon_{it} \qquad (3c.1)$$

Second, we use a weighting on the positive and negative realms depending on these indices:

$$Y_{it} = \beta_0 + \theta_0 W^{pos}{}_{it} + W^{pos}{}_{it} / (1 + \theta_1 |W^{pos}{}_{it}|) + \theta_2 W^{neg}{}_{it} + W^{neg}{}_{it} / (1 + \theta_3 |W^{neg}{}_{it}|) + \beta_1 X_{it}' + u_i + \varepsilon_{it} \quad (3c.2)$$

Here, the positive and negative events indices $W^{pos}{}_{it}$ and $W^{neg}{}_{it}$ enter the model in a non-linear manner: θ_0 and θ_2 capture the main impacts of life events, whereas θ_1 and θ_3 capture accelerating or decelerating impacts. As these models must be estimated using non-linear least squares, and non-linear least squares estimation cannot readily be applied to the individual fixed effect u_i, we transform the non-linear model by subtracting the first observation, i.e. we estimate the transformed model $Y_{it}{}^* = Y_{it} - Y_{i0}$.

We are initially agnostic whether Equation (3c.1) or (3c.2) fits the data best, and therefore let our model choice be guided by goodness-of-fit. In Equation (3c.1), Machiavelli's proposition boils down to the same condition as in Equation (1): it is true if $\theta_0 > 0$ and $\theta_1 < 0$ (i.e. the relationship between positive life events and wellbeing is concave) and $\theta_2 > 0$ and $\theta_3 > 0$ (i.e. the relationship between negative life events and wellbeing is convex), implying that losses loom larger than gains in absolute terms and that there is no tipping point for losses. Note that we expect $\theta_2 > 0$ (rather than $\theta_2 < 0$) since the negative events index is, by definition, negative, so that θ_2 yields the strength of the correlation between negative life events and life satisfaction. In contrast, in Equation (3c.2), concavity in both realms boils down to $\theta_0 > 0$, $\theta_1 > 0$, $\theta_2 < 0$, and $\theta_3 < 0$.

4. Results

4.1. Baseline Results

Table 2 shows our baseline results. We first look at Column 1, which correspondents to the linear model of Equation (1) which lacks anticipation and adaptation effects. Recall that all specifications control for demographics, including age, education, and income, as well as individual fixed effects.

Column 1 shows that the number of positive life events experienced during the past twelve months has a significant positive effect on life satisfaction, whereas the number of negative events has a significant negative effect, both at the 1% significance level. Unlike for positive events, the quadratic for negative events also has a significant negative effect at the 1% level, which is, however, smaller in size; the quadratic for positive events fails to meet a conventional significance level. From this parsimonious model, it seems that there is a linear relationship between positive life events and wellbeing, but a concave one for negative life events, whereby wellbeing is decreasing at an increasing rate in the number of negative events. This rejects Machiavelli's proposition, and is more in line with a tipping point interpretation for negative events: inflicting all injuries at once would bring about greater wellbeing loss than inflicting the same amount of injuries little by little during a given period of time.

Column 2 corresponds to Equation (2) and uses binary measures corresponding to how many positive or negative events were experienced during the past twelve months. This binary parametrisation is more flexible, yet a similar picture arises as for the continuous parametrisation: there seems to be a linear (or slightly concave) relationship between positive life events and wellbeing, with wellbeing increasing linearly (or at a slightly decreasing rate) in the number of positive events (significance levels tend to decrease in the number of positive events). The picture for negative life events is less clear but also suggestive of a concave as opposed to convex relationship, pointing again towards a tipping point interpretation for negative events. Figure A1 in the Appendix plots coefficient estimates obtained when estimating Equation (2).

Column 3 corresponds to the two-step linear model in Equation (3c.1), with positive and negative life events entering the model as indices in both levels and quadratics. Accounting for anticipation and adaptation within these indices, a similar picture arises as before: the index for positive life events has a strong, significant positive effect on life satisfaction at the 1% level, whereas the quadratic effect of the positive life events has the expected sign (negative). However, its t-value of 1.6 fails to meet the conventional levels of statistical significance. The index for negative life events and its quadratic are, on the contrary, both significant at the 1% level. Note that the index for negative events is, by definition, negative itself, so that a positive sign for the coefficient estimate shows the strength of the correlation between negative life events and life satisfaction only. The negative on the quadratic, which is itself always positive, implies a concave relationship.

Overall, these results are in line with the previous, showing a linear (or slightly concave) relationship between positive life events and life satisfaction and a concave relationship for negative events. This is in line with a tipping point interpretation for negative events: inflicting all injuries at once would bring about greater damage than inflicting them little by little during a given period of time. Figure 1 plots coefficient estimates obtained when estimating Equation (3c.1): there is concavity between gains and wellbeing as well as concavity between losses and wellbeing, unlike the S-shaped value function by

Kahneman and Tversky (1979). Note that we are agnostic about whether there exists a kink at the reference point, since our measure of life events is not on a single continuous dimension that would allow to cardinally compare the positive with the negative.[5]

We ran joint hypotheses tests to check more formally whether we can reject linearity in the effects of positive and negative life events on life satisfaction. For positive events, we cannot reject the null that the coefficient for the positive events index in levels equals one and the quadratic equals zero: F(2, 18,709) = 1.26; Prob > F = 0.2848. For negative events, however, we can reject the null that the coefficient for the negative events index in levels equals one and the quadratic equals zero: F(2, 18,709) = 6.27; Prob > F = 0.0019. The hypotheses tests again confirm linearity in the positive and concavity in the negative realm, as shown previously.

Column 4 corresponds to Equation (3c.2), which inserts the indices in a non-linear manner (i.e. $\theta_0 W^{pos}_{it} + W^{pos}_{it} / (1 + \theta_1 |W^{pos}_{it}|)$ and $\theta_2 W^{neg}_{it} + W^{neg}_{it} / (1 + \theta_3 |W^{neg}_{it}|)$), whereby γ_0 and γ_2 capture the main impacts of events and γ_1 and γ_3 accelerating or decelerating impacts.

Column 4 is in line with the previous results: positive events (θ_0) have a positive effect on life satisfaction which is significant at the 1% level, whereby the dampening effect (θ_1) also has a strong positive coefficient. However, it fails to reach statistical significance at a conventional level (t=1.7). This suggests a linear (or slightly concave) relationship between positive life events and life satisfaction. In contrast, both θ_2 and θ_3 have significant negative coefficients, in line with a concave relationship. Figure A2 in the Appendix plots the predicted relation between the events indices and life satisfaction estimated from Equation (3c.2).

We again ran joint hypotheses tests to check more formally for linearity in the relationships between life satisfaction and positive or negative life events. In case of our non-linear model, we conducted likelihood-ratio tests. For positive events, we reject the null hypotheses that the coefficients for the positive events index (first term) and for its absolute value (second term) equals zero: LR $\chi^2(2)$ = 26.87; Prob > χ^2 = 0.0000. Likewise, for negative events, we reject the null: LR $\chi^2(2)$ = 118.18; Prob > χ^2 = 0.0000. Once again, this is in line with concavity in both positive and negative realms.

[5] If one looks at the two life events that potentially allow one to construct a cardinal, one-dimensional interpretation (that is, predicted income changes when respondents report positive or negative financial shocks), the resulting non-linearity around the reference point is indeed roughly a factor of 2 (Frijters et al., 2011), in accordance with the kink predicted by Kahneman and Tversky (1979).

4.2. Heterogeneous Effects

Do these findings hold for different types of people? To find out, we run a heterogeneity analysis on our preferred model according to goodness-of-fit, Equation (3c.1). Table 3 shows the results when splitting the estimation sample by gender, education, age, and personality traits of respondents.[6]

Our baseline result – a concave relationship between life satisfaction and life events – holds across the board. There are, however, slight differences in curvature between different types of people. Table 3 Columns 1 and 2 show that men benefit, relative to women, more strongly from positive life events when it comes to life satisfaction, but also show stronger diminishing returns. Moreover, men experience a less strong initial decrease in life satisfaction following negative life events, but at the same time, experience a stronger depreciation as more and more negative events occur in a given period of time. This may relate to differences in risk preferences between gender (as evidenced by Borghans et al. (2009), Sapienza et al. (2009), or Charness and Gneezy (2012), amongst others). This relationship is not straightforward, though: it seems there is more to win for men with positive life events but also more to lose if multiple negative events occur, which has ambiguous implications regarding what would be an optimal choice. One could similarly say that women are more sensitive to small negative but more robust when it comes to larger negative shocks compared to men.

While people with low education (defined as having no high school degree) have a similar profile when it comes to positive life events as people with higher education, they show a larger decrease in life satisfaction following a negative life event, thus being more sensitivity to negative events. However, people with higher education report a steeper decline once more and more negative events occur in a given period of time. Age differences are minor, with the exception that people above 40 years of age show a significant quadratic on positive life events, providing evidence for diminishing returns.

Following Buddelmeyer and Powdthavee (2016) and Etilé et al. (2019), we also test for differences between people with different personality traits (using the extroversion dimension of the Big-5 personality inventory): compared to extroverted people, introverted people exhibit stronger diminishing returns to positive life events while, at the same time, a steeper decline once more and more negative events occur. In principle, these results could be used for targeting groups who experience stronger concavity and have more to gain from optimal spacing of a given number of events.

[6] Table A3 in the Appendix replicates this exercise for Table 2 Column 4, that is, the non-linear model accounting for anticipation and adaptation, which is our second-best model according to goodness-of-fit.

4.3. Robustness to Variable Selection and Sampling Issues

We next run a series of robustness checks using our baseline specification in Equation (3c.1). Results are presented in Table 4; Figure 2 plots coefficient estimates from these robustness checks. We discuss them in turn.[7]

4.3.1. Exogenous and Unanticipated Life Events

One obvious worry is the potential endogeneity of life events, which could, for instance, bias our results if it was true that most of the occasions in which a person experienced a single positive or negative event were the result of conscious choices and thus already anticipated long ago, but where this would not be true for individuals hit by many shocks. We would then underestimate the importance of single shocks *versus* multiple shocks.

To investigate this, in Column 1 of Table 4, we focus only on the (arguably) more exogenous positive and negative events (for example, the death of others) which individuals are less likely to have anticipated or initiated.[8] In Column 2, we focus only on those events that have been shown empirically in our regressions to involve insignificant levels of anticipation.[9]

The signs, sizes, and significance levels of the coefficients in Column 1 closely mimic those of our baseline specification, showing that picking the life events that intuitively seem more exogenous makes little difference. Almost the same is true when restricting the sample to respondents experiencing events for which we do not find significant anticipation effects (Column 2). One exception is that the quadratic for the positive events index turns significant, showing more clearly a concave relationship between positive life events and life satisfaction. Overall, however, restricting the sample to respondents experiencing more exogenous events strengthens the initial conclusions.

---

[7] Corresponding results for Equation (3c.2) can be found in Table A4 in the Appendix. See Figure A3 for the plotted coefficients of these robustness checks.

[8] More exogenous positive life events are *major improvements in finance (e.g. won lottery),* more exogenous negative ones *death of a close friend*, *death of an extended family member or relative*, *death of a spouse or a child*, *major worsening of finances (e.g. went bankrupt)*, *made redundant*, *serious illness or injury to a family member*, *serious personal illness or injury*, *family member detained in jail*, *detained in jail (self)*, *victim of property crime (e.g. theft, breaking and entering)*, and *victim of physical violence (e.g. assault)*.

[9] Positive life events without significant anticipation are *major improvements in finance (e.g. won lottery)*, *retired*, and *got back together with spouse*. Negative life events are *death of a close friend*, *death of an extended family member of relative*, *made redundant*, *family member detained in jail*, *detained in jail (self)*, *victim of property crime (e.g. theft, entering and breaking)*, and *victim of physical violence (e.g. assault)*.

4.3.2. Selective Attrition

Another worry is selective attrition: respondents who are most positively affected by positive life events (for example, winning the lottery) may be more likely to drop out of the sample. By the same token, respondents who are most negatively affected by negative life events (for example, the death of others) may be more likely to drop out. In both cases, systematic out-of-sample-selection biases our results downwards, potentially with knock-on effects for our non-linearities. To investigate this, in Column 3, we show the results when restricting our estimation sample to respondents who are present during the entire observation period.

As expected, we find that, when excluding drop-outs *ex-ante*, coefficient estimates are slightly smaller in size in the positive realm than those in our baseline specification; in the negative, they are only negligibly different. This suggests that selective attrition has little impact on our findings.

4.3.3. Meta-Survey Measures of Respondent's Engagement with Questions

Yet another worry is the fidelity of respondents when answering questions about their life satisfaction, and retrospectively, about experiences of positive or negative life events during the past twelve months. Such non-fidelity in answering behaviour could bias our results in both directions.

To study the extent to which fidelity matters to our findings, we exploit two items that are routinely answered by interviewers after the interview of individual respondents. The first asks interviewers: "In general, how would you describe the respondent's co-operation during the interview?" The second asks: "In general, how would you describe the respondent's understanding of the questions?" For both meta-survey measures, answer possibilities range from one ("excellent") to five ("very poor"). We dichotomise both items such that one equals categories two and above (i.e. "good" and above), and zero equals categories three and less (i.e. "fair" and below). We then supplement our baseline specification with both items as additional controls. Table 4 Column 4 shows the result of this exercise.

There is little evidence that non-fidelity affects our findings: signs, sizes, and significance levels of coefficient estimates mimic closely those in our baseline specification.

4.4. Alternative Outcome: Mental Health

We next look at mental health from the SF36 health survey as our alternative outcome. Figure 3 plots the coefficient estimates for mental health from our baseline specification in Equation (3c.1). For benchmarking, it also plots the coefficient estimates for life satisfaction as our primary outcome.[10] Recall that we have log-transformed mental health to reduce its skewedness.[11]

While mental health shows a negligible influence arising from positive events (this impact, however, becomes more pronounced in the non-linear specification), the impact of negative events mimics that of life satisfaction. In fact, the curvature for mental health is even steeper, suggesting that mental health depreciates faster than life satisfaction as more and more negative life events occur: life satisfaction reaches a tipping point after about two events; mental health, on the contrary, reaches this point after only one event. Thereafter, mental health depreciates disproportionally. Qualitatively, mental health and life satisfaction are, therefore, similarly affected by negative events.

4.5. Estimation Procedure: Two-Step Versus One-Go

It is important to note that the two-step procedure for estimating Equation (3c.1) essentially imposes first-step estimates on elements of *g(.)* in the second step. This can lead to bias if the first-step estimates are themselves picking up non-linearities via sample correlations between the underlying non-linearities and particular shocks. We therefore check next whether the results remain the same when estimating both the indices and the non-linearities in one go.

Table 6 shows the results of this exercise, with Column 1 presenting the results of the two-step procedure for estimating Equation (3c.1) and Column 2 the corresponding results when estimating the same equation in one go. The reason why the linear terms for the negative and positive events have no standard errors is because there is perfect collinearity between the coefficients of the events indices and the coefficients of the events in these indices in the one-go procedure. We therefore set the linear terms to coincide with their counterparts in the two-step procedure.

[10] Figure A4 in the Appendix replicates this figure for the non-linear model in Equation (3c.2): the plot is qualitatively similar. Table 5 Column 2 shows the corresponding coefficient estimates: in contrast to the quadratic model, these fail to reach statistical significance in the positive realm at a conventional level. Because of its better goodness-of fit, we take the quadratic model in Equation (3c.1) as our baseline specification.

[11] Figure A5 in the Appendix presents results where mental health has not been log-transformed (Table A5 presents corresponding coefficient estimates): here, mental health decreases linearly in the number of negative life events (rather than depreciating disproportionally, yet still contrary to Machiavelli's prescript). This is not that surprising due to the high skewedness of the non-log-transformed mental health data, which in the regressions places more weight on the right-hand tail rather than variation closer to the mean.

Importantly, the baseline results strengthen when using the two-step procedure in the sense that the coefficient estimate of the quadratic of the positive events index becomes even more negative and now statistically significant (-0.588 *versus* -0.415). Likewise, the coefficient estimate of the quadratic of the negative events index become more negative and significant (-1.644 *versus* -0.201).

The R^2 requires careful interpretation as the underlying models do not naturally yield comparable estimates of explained variance. This is due to the fact that the implicit individual fixed effects in the two-step model differ from those in the one-step model. We therefore have to define the relevant baseline variation against which the explained variation of the two model can be judged. We chose within-person variation, that is, the total variation is the sum of the squares of individual outcomes less their first observed outcome. Using this as our baseline variation, we find that the one-step model fits slightly better than the two-step model (0.0752 *versus* 0.0711).

5. Counterfactuals

How relevant are these non-linearities? To gauge the potential for gains from optimal spacing, we look at hypothetical policies in which the negative and positive events are spaced out in time and over people rather than how they are distributed in the actual data. We make no comment on whether such a policy is feasible or how it could be implemented, but only look at the potential gain, *ceteris paribus*, of spreading negative and positive events.

To calculate potential gains from hypotheticals, we first need estimates for how much wellbeing is changed in the actual data by positive events and negative events, on average per year. This is relatively easy, as it is the predicted average value of the positive and negative indices. For these estimates, we use Table 2 Column 3.

The *status quo* currently yields the following wellbeing gain for positive events:

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}(positive\ index)} = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{t_i}\sum_{t=1}^{t_i}(1.141 * positive\ index_{it} - 0.415 * positive\ index\ {}_{it}{}^{2}) = 0.0521$$

The equivalent wellbeing loss for negative events is given by:

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}(negative\ index)} = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{t_i}\sum_{t=1}^{t_i}(0.816 * negative\ index_{it} - 0.201 * negative\ index\ {}_{it}{}^{2}) = -0.1012$$

As there are twelve negative and six positive events in the data, it is not entirely surprising that the total positive effects are about half those of the total negative effects. These somewhat low average effects reflect the fact that many individuals report no life events in a particular year, and that many events have somewhat small impacts.

If we first think about the gain that individuals could get if the events they experienced in the actual data were evenly spaced, we can calculate total effects as:

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}(\overline{positive\ index})_{at\ individual\ mean}} = \frac{1}{n}\sum_{i=1}^{n}[1.141 * (\frac{1}{t_i}\sum_{t=1}^{t_i} positive\ index_{it}) - 0.415 * \left(\frac{1}{t_i}\sum_{t=1}^{t_i} positive\ index_{it}\right)^2] = 0.0533$$

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}(\overline{negative\ index})_{at\ individual\ mean}} = \frac{1}{n}\sum_{i=1}^{n}[0.816 * (\frac{1}{t_i}\sum_{t=1}^{t_i} negative\ index_{it}) - 0.201 * \left(\frac{1}{t_i}\sum_{t=1}^{t_i} negative\ index_{it}\right)^2] = -0.0988$$

Here, we are looking at the gain for individuals of spreading the events they experienced in the sample completely evenly. The results imply that the gain to an individual from spreading his or her positive events over time is about 2% compared to the *status quo*, whereas the gain from spreading his or her negative events over time is about 2.5%. In points of life satisfaction, the gains from spreading are small, only +0.0012 for spreading the positive events and +0.0024 for spreading the negative events.

Importantly, these counterfactuals do not assume that individuals will have fully adapted to all life events by the end of the observation period: what is spread is the index of effects from life events, which includes both anticipation and adaptation effects. Hence, individuals are not 'done' anticipating the next events at the end of the period, nor are they 'done' adapting to events at that point. In the hypothetical, we are only spreading all effects associated with positive and negative events evenly over the observation period. In reality, such a thing would only be practically possible if one would be able to have fractional negative events, which in many cases is impossible, for example when it comes to death. We are thus establishing an upper bound of the benefits of spreading events, noting that it is not a trivial mathematical exercise to determine the best spread over time of a finite set of actual events.[12]

[12] To see the difficulties of thinking about the spread of dichotomous events over time, consider that one would effectively assume one can do away with all anticipation effects by having all negative events happen at time zero. Also, the anticipation benefit of all positive events together with adaptation benefits are optimised by having a positive event happen in the middle of a bounded time period. Such implications are not in the spirit of the idea of optimal spreading by either individuals or policy-makers and would require fairly *ad-hoc* additional conditions to avoid. Simply spreading the index respects both anticipation and adaptation effects and hence concentrates the discussion on the benefits of optimising the non-linearity of effects.

We next consider the potential benefits of not only spreading events over time, but also spreading events over individuals. We find that spreading positive events evenly over time *and* over individuals yields the following wellbeing gain, which is slightly larger (about 3%) than under the *status quo*:

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}\left(\overline{positive\ index}\right)_{at\ population\ mean}} = 1.141 * \left(\frac{1}{N}\sum_{j=1}^{N} positive\ index_{itj}\right) - 0.415 * \left(\frac{1}{N}\sum_{j=1}^{N} positive\ index_{itj}\right)^{2} = 0.0629$$

Equivalently, spreading negative events evenly over time and over individuals yields the following wellbeing gain, which is lower (about 5%) than under the *status quo*:

$$\frac{1}{n}\sum_{i}^{n}\overline{\hat{g}\left(\overline{negative\ index}\right)_{at\ population\ mean}} = 0.816 * \left(\frac{1}{N}\sum_{j=1}^{N} negative\ index_{itj}\right) - 0.201 * \left(\frac{1}{N}\sum_{j=1}^{N} negative\ index_{itj}\right)^{2} = -0.0961$$

An optimal, net-wellbeing-maximising policy, which is one that inflicts all injuries and confers all benefits little by little (as opposed to all at once) and which is spread evenly over time and over individuals, yields a wellbeing gain of +0.0108 for positive events and +0.0051 for negative events. Taken together, this is about 12% of the absolute effect of life events.

7. Conclusion

We set out by asking whether it makes a difference for net wellbeing if a given number of losses and gains are inflicted all at once or little by little during a given period of time. Machiavelli, in his treatise on political philosophy, argued that losses should be inflicted all at once, whereas benefits should be conferred little by little. The same logic follows from the S-shaped value function by Kahneman and Tversky (1979). On the contrary, the classic economic assumption of a concave utility function leads to a different conclusion: it is better not to bunch negative events.

We tested Machiavelli's prescript empirically and found that life satisfaction and mental health are concave in both negative and positive life events, strongly supporting the standard model which uses a concave utility function. The non-linearity is particularly strong for more than two negative events, with five negative events in the same year rated as just as bad as eleven events each experienced in different years. This finding continues to hold after allowing for selection, anticipation, and adaptation, as well as for event-specific effects. Moreover, we arrive at the same result when using only events that individuals themselves say were unanticipated, or when using the most exogenous events in our sample – the best we can do to overcome potential endogeneity. Finally, our finding also holds when including meta-measures of how seriously respondents have answered the questions, addressing the possibility that the result may be based on frivolous respondents.

Whilst important for individuals who experience many positive and negative life events, we find that the benefits of spreading events over time are modest on average, simply because in empirical reality negative and positive events are already quite spaced in time. Thus, spreading all events evenly across all time periods and across all individuals increases the positive effects by 20% and decreases the negative effects by 5% – a modest improvement compared to preventing negative events altogether. Indeed, average improvements in life satisfaction of such an extreme spacing over time and over individuals are only about +0.016 per individual on a zero-to-ten scale.

There are two main research and policy take-aways: first, the classic economic assumption of a concave utility function is borne out by data on both life satisfaction and mental health, in line with the focus of welfare states on the groups at the bottom of the wellbeing distribution. Second, while there is clear evidence for non-linearities in the negative and positive life events we looked at, these are of second-order consideration relative to their sheer occurrence, unless one is specifically interested in the very left or right tail of the wellbeing distribution. For these extremes, however, one wants to know more about implications of having many negative and positive life events, such as the costs imposed on others and the possibility that adaptation becomes slower if one has experienced many negative shocks in quick succession. These considerations are part of future inquiries.

References

Adda, J., J. Banks, and H.-M. von Gaudecker, "Impact of Income Shocks on Health: Evidence from Cohort Data," *Journal of the European Economic Association*, 7(6), 1361-1399, 2009.

Adler, M. D., P. Dolan, and G. Kavetsos, "Would you choose to be happy? Tradeoffs between happiness and the other dimensions of life in a large population survey," *Journal of Economic Behavior & Organization*, 139, 60-73, 2017.

Apouey, B., and A. Clark, "Winning Big but Feeling no Better? The Effect of Lottery Prizes on Physical and Mental Health," *Health Economics*, 24(5), 516-538, 2015.

Baird, S., J. de Hoop, and B. Özler, "Income Shocks and Adolescent Mental Health," *Journal of Human Resources*, 48(2), 370-403, 2013.

Borghans, L., J. Heckman, B. Golsteyn, and H. Meijers, "Gender Differences in Risk Aversion and Ambiguity Aversion," *Journal of the European Economic Association*, 7(2-3), 649-658, 2009.

Brickman, P., and D. Campbell, "Hedonic Relativism and Planning the Good Society," in: Apley, M. H. (ed), *Adaptation-Level Theory: A Symposium*, New York: Academic Press, 1971.

Boyce, C., A. Wood, J. Banks, A. Clark, and G. Brown, "Money, Well-Being, and Loss Aversion: Does an Income Loss Have a Greater Effect on Well-Being Than an Equivalent Income Gain," *Psychological Science*, 24(12), 2557-2562, 2013.

Buddelmeyer, H., and N. Powdthavee, "Can having internal locus of control insure against negative shocks? Psychological evidence from panel data," *Journal of Economic Behavior & Organization*, 122, 88-109, 2016.

Charness, G., and U. Gneezy, "Strong Evidence for Gender Differences in Risk Taking," *Journal of Economic Behavior & Organization*, 83(1), 50-58, 2012.

Clark, A., and Y. Georgellis, "Back to Baseline in Britain: Adaptation in the British Household Panel Survey," *Economica*, 80(319), 496-512, 2013.

Clark, A., E. Diener, Y. Georgellis, and R. Lucas, "Lags and Leads in Life Satisfaction: A Test of the Baseline Hypothesis," *Economic Journal*, 118(529), F222-F243, 2008.

Clark, A., E. Diener, Y. Georgellis, and R. Lucas, "Reexamining Adaptation and the Set Point Model of Happiness: Reaction to Changes in Marital Status," *Journal of Personality and Social Psychology*, 84(3), 527-539, 2003.

Corman, H., K. Noonan, N. E. Reichman, and O. Schwartz-Soicher, "Life Shocks and Crime: A Test of the 'Turning Point' Hypothesis," *Demography*, 50(6), 2227-2253, 2013.

Curtis, M. A., H. Corman, K. Noonan, and N. E. Reichman, "Life Shocks and Homelessness," *Demography*, 50(6), 2227-225, 2013.

De Neve, J.-E., G. Ward, F. De Keulenaer, B. Van Landeghem, G. Kavetsos, and M. I. Norton, "The Asymmetric Experience of Positive and Negative Economic Growth: Global Evidence Using Subjective Well-Being Data," *Review of Economics and Statistics*, 100(2), 362-375, 2018.

Di Tella, R., J. Haisken-DeNew, and R. MacCulloch, "Happiness Adaptation to Income and to Status in an Individual Panel," *Journal of Economic Behaviour & Organization*, 76, 834-852, 2010.

Dolan, P. and D. Kahneman, "Interpretations Of Utility And Their Implications For The Valuation Of Health," *Economic Journal*, 118(525), 215-234, 2008.

Easterlin, R., "Does Economic Growth Improve the Human Lot? Some Empirical Evidence," in: David, R., and R. Reder (eds), *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, New York: Academic Press, 1974.

Etilé, F., P. Frijters, D. Johnston, and M. Shields, "Modelling Heterogeneity in the Resilience to Major Socioeconomic Life Events," *PSE Working Papers*, 2017-09, 2017.

Frederick, S., and G. Loewenstein, "Hedonic Adaptation," in: Kahneman, D., E. Diener, and N. Schwartz (eds), *Well-Being: The Foundations of Hedonic Psychology*, New York: Russell Sage, 1999.

Frijters, P., D. Johnston, and M. Shields, "Life Satisfaction Dynamics with Quarterly Life Event Data," *Scandinavian Journal of Economics*, 113(1), 190-211, 2011.

Gardner, J., and A. Oswald, "Money and mental wellbeing: A longitudinal study of medium-sized lottery wins," *Journal of Health Economics*, 26, 49-60, 2007.

Johnston, D., M. Shields, and P. Siminski, "Long-term health effects of Vietnam-era military service: A quasi-experiment using Australian conscription lotteries," *Journal of Health Economics*, 45, 12-26, 2016.

Johnston, D., M. Shields, and A. Suziedelyte, "Victimisation, Well-being and Compensation: Using Panel Data to Estimate the Costs of Violent Crime," *Economic Journal*, 128(611), 1545-1569, 2018.

Kahneman, D., "Experienced Utility and Objective Happiness: A Moment-Based Approach," in: Kahneman, D., and A. Tversky (eds), *Choice, Values, and Frames*, New York: Cambridge University Press, 2000.

Kahneman, D., and A. Tversky, "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 47(2), 263-292, 1979.

Kahneman, D., P. Wakker, and R. Sarin, "Back to Bentham? Explorations of Experienced Utility," *Quarterly Journal of Economics*, 112(2), 375-405, 1997.

Kuhn, P., P. Kooreman, A. Soetevent, and A. Kapteyn, "The Effects of Lottery Prizes on Winners and Their Neighbors: Evidence from the Dutch Postcode Lottery," *American Economic Review*, 101(5), 2226-2247, 2011.

Lindeboom, M., F. Portrait, and G. van den Berg, "An econometric analysis of the mental-health effects of major events in the life of older individuals," *Health Economics*, 11(6), 505-520, 2002.

Lucas, R., "Time Does Not Heal All Wounds: A Longitudinal Study of Reaction and Adaptation to Divorce," *Psychological Science*, 16(12), 945-950, 2005.

Lucas, R., "Adaptation and the Set-Point Model of Subjective Well-Being: Does Happiness Change After Major Life Events?," *Current Directions in Psychological Science*, 16(2), 75-79, 2007.

Lucas, R., and C. Clark, "Do People Really Adapt to Marriage?," *Journal of Happiness Studies*, 7(4), 405-426, 2006.

Lucas, R., A. Clark, Y. Georgellis, and E. Diener, "Unemployment Alters the Set Point for Life Satisfaction," *Psychological Science*, 15(1), 8-13, 2004.

Menzel, P., P. Dolan, J. Richardson, and J. Olsen, "The role of adaptation to disability and disease in health state valuation: a preliminary normative analysis," *Social Science & Medicine*, 55(12), 2149-2158, 2002.

Mervin, M., and P. Frijters, "Is shared misery double misery," *Social Science & Medicine*, 107, 68-77, 2014.

Nordhaus, W., "The Political Business Cycle," *Review of Economic Studies*, 42(2), 169-190, 1975.

Nordhaus, W., A. Alesina, and C. Schultze, "Alternative Approaches to the Political Business Cycle," *Brookings Papers on Economic Activity*, 1989(2), 1-68, 1989.

Oswald, A., and J. Gardner, "Do divorcing couples become happier by breaking up?," *Journal of the Royal Statistical Society Series A: Statistics in Society*, 169(2), 319-336, 2006.

Oswald, A., and N. Powdthavee, "Does Happiness Adapt? A Longitudinal Study of Disability with Implications for Economists and Judges," *Journal of Public Economics*, 92(5-6), 1061-1077, 2008.

Sapienza, P., L. Zingales, and D. Maestripieri, "Gender differences in financial risk aversion and career choices are affected by testosterone," *Proceedings of the National Academy of Sciences*, 106(36), 15268-15273, 2009.

Schwandt, H., "Wealth Shocks and Health Outcomes: Evidence from Stock Market Fluctuations," *American Economic Journal: Applied Economics*, 10(4), 349-377, 2018.

Stutzer, A., and B. Frey, "Does marriage make people happy, or do happy people get married?," *Journal of Socio-Economics*, 35(2), 326-347, 2006.

Vendrik, M., and G. Woltjer, "Happiness and loss aversion: Is utility concave or convex in relative income?," *Journal of Public Economics*, 91(7-8), 1423-1448, 2007.

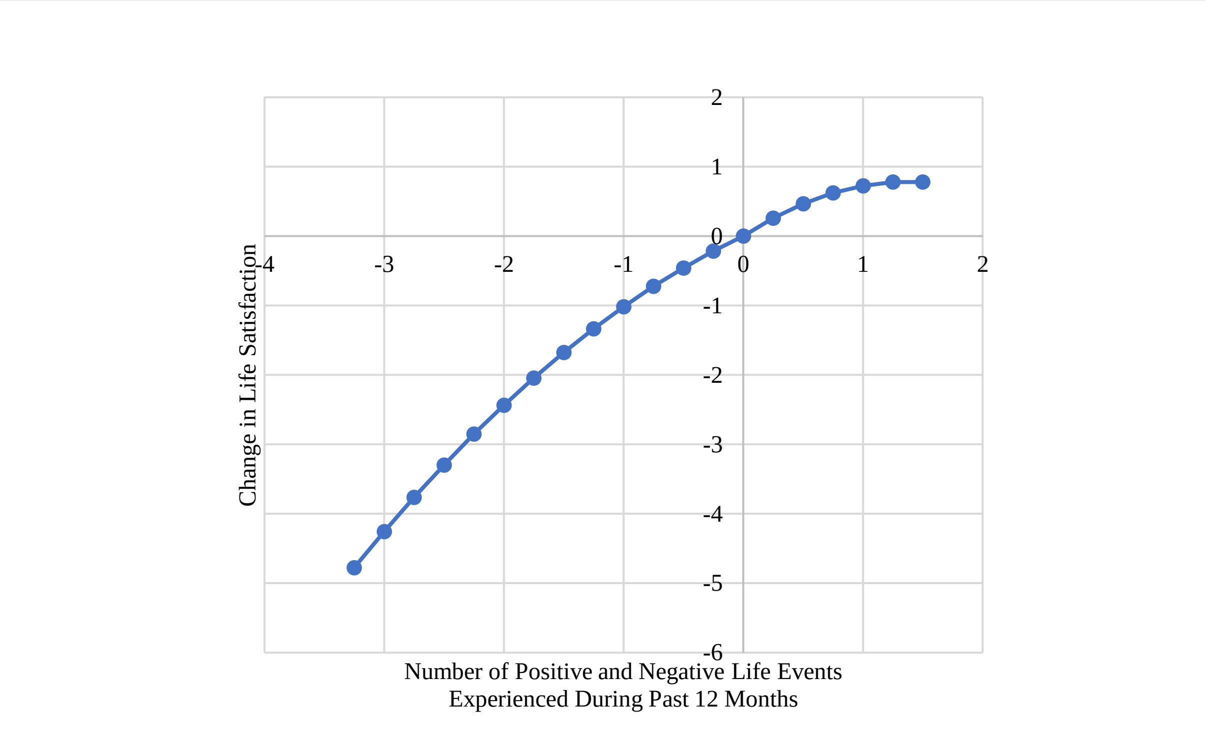
Ward, G., "Happiness and Voting: Evidence from Elections in Europe 1973-2014," *American Journal of Political Science*, forthcoming, 2019.

Ware, J., M. Kosinski, and S. Keller, *How to Score the SF12 Physical and Mental Health Summary Scales*, The Health Institute, New England Medical Center, 1998.

Wilson, T., and D. Gilbert, "Explaining Away: A Model of Affective Adaptation," *Perspectives on Psychological Science*, 3, 370-386, 2008.

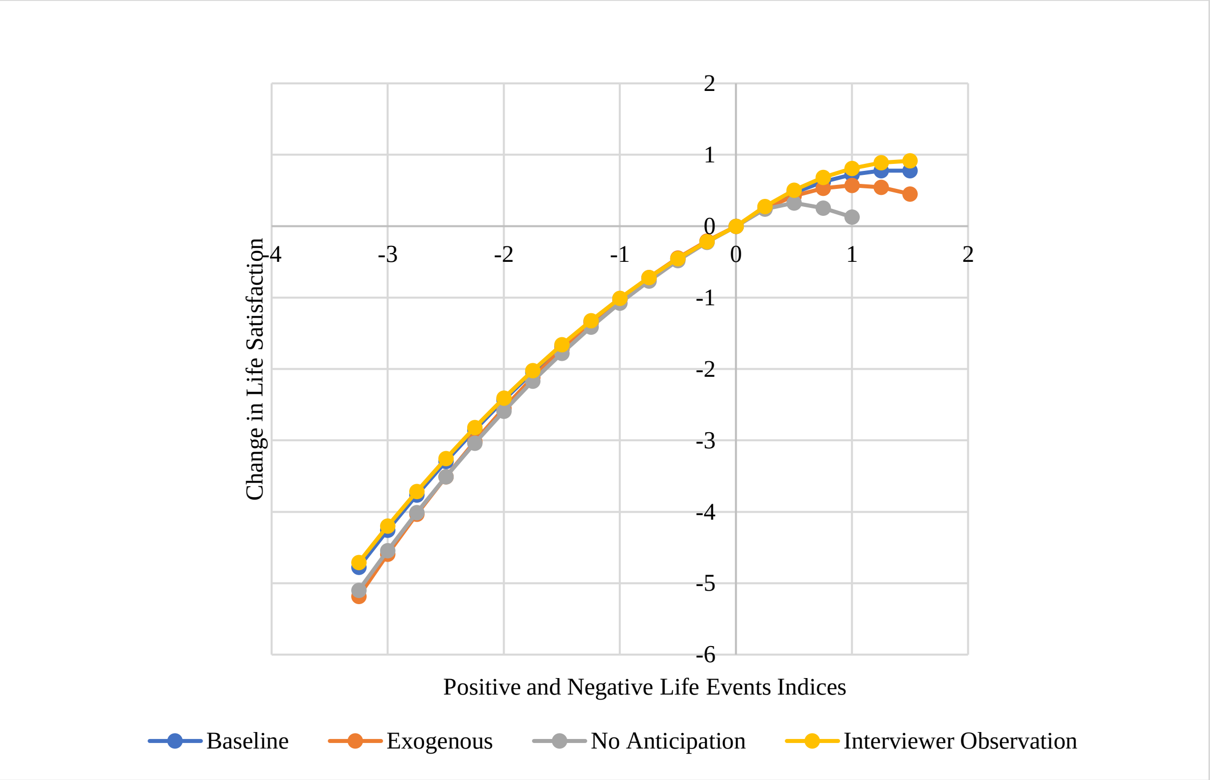
Figures

Figure 1: Baseline Results – Linear Model, Anticipation/Adaptation, Index



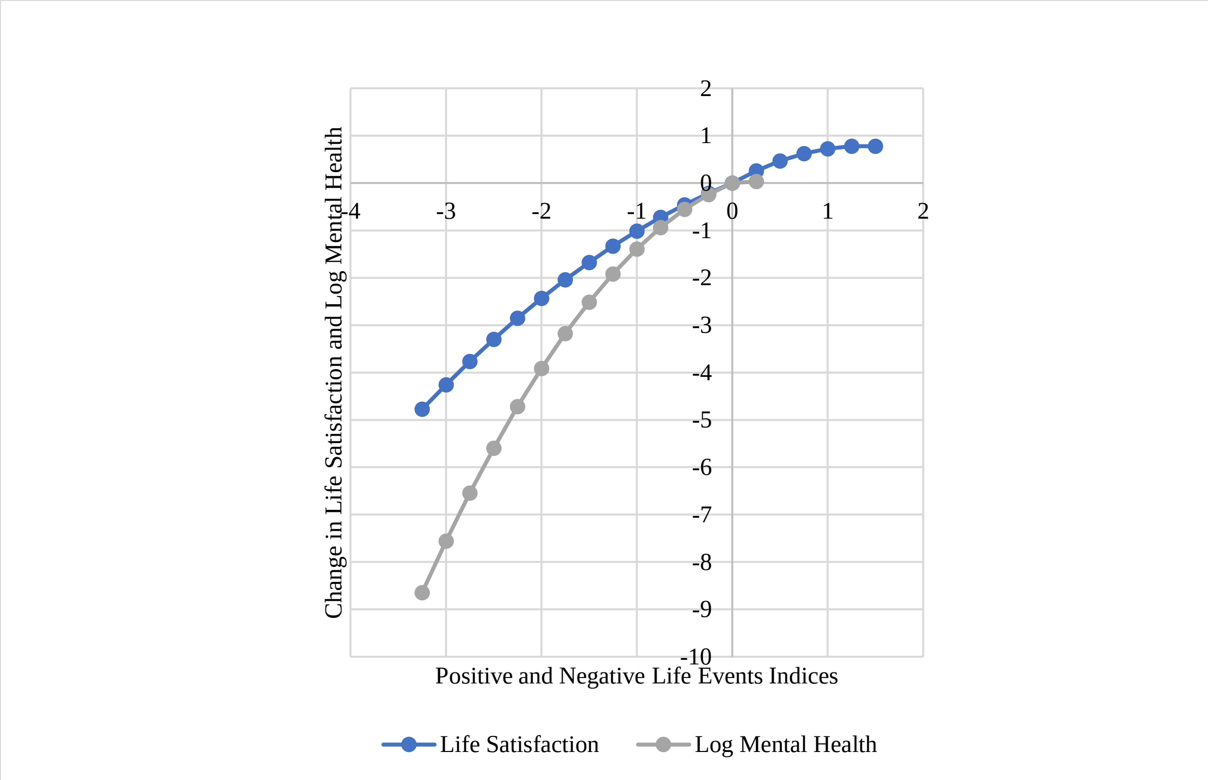
Notes: Figure plots life satisfaction predicted from estimates obtained when estimating Equation (3c.1) (Table 2 Column 3). Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure 2: Robustness Checks – Linear Model, Anticipation/Adaptation, Index



Notes: Figure plots life satisfaction predicted from estimates obtained when estimating Equation (3c.1) (Table 2 Column 3 for baseline; Table 4 Column 1 for exogenous, Colum 2 for no anticipation, and Column 3 for interviewer observation). Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure 3: Alternative Outcome: Log Mental Health – Linear Model, Anticipation/Adaptation, Index



Notes: Figure plots mental health relative to life satisfaction predicted from estimates obtained when estimating Equation (3c.1) (see Table 2 Column 3 for results on life satisfaction and Table 5 Column 1 for results on mental health). Mental Health is measured using fourteen items of the Short-Form (SF36) Health Survey, transformed to a zero-to-ten scale, and logged. Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Tables

Table 1: Summary Statistics by Life Event

		Means Conditional on Occurrence of Life Event			
Life Events	**Number of Occurrences**	**Life Events**	**Age**	**Years of Education**	**Log Household Income**
Panel A: Positive Life Events					
Birth or Adoption of a New Child	6,736	4.038	31.728	13.050	11.171
Major Improvements in Finance	5,536	3.620	44.920	12.790	11.046
Got Married	4,339	3.802	35.313	12.881	11.257
Got Promoted	11,448	4.102	33.778	13.224	11.448
Retired	4,040	2.945	60.820	11.661	10.341
Got Back Together with Spouse	1,781	3.665	34.997	12.196	10.715
Panel B: Negative Life Events					
Death of a Close Friend	18,566	9.849	52.412	11.79	10.467
Death of an Extended Family Member or a Relative	19,730	8.57	44.223	12.172	10.877
Death of a Spouse or a Child	1,171	10.003	54.836	11.397	9.855
Major Worsening in Finances	5,083	11.133	43.475	12.384	10.603
Made Redundant	5,091	8.819	37.795	12.356	11.038
Serious Illness or Injury of a Family Member	27,333	9.557	45.7	12.363	10.837
Serious Personal Illness or Injury	14,620	9.969	49.324	12.123	10.557
Family Member Detained in Jail	2,332	10.246	39.133	11.587	10.524
Detained in Jail	333	10.387	33.174	11.088	10.06
Victim of Property Crime	7,359	9	38.92	12.544	10.906
Victim of Physical Violence	2,496	11.047	32.834	11.875	10.485
Separated from Spouse	6,363	8.413	35.239	12.152	10.603

Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table 2: Baseline Results

Dependent Variable: Life Satisfaction (0/10)

	Linear Model No Anticipation/Adaptation		**Anticipation/Adaptation**	
	Continuous Measures	**Binary Measures**	**Linear Model Index**	**Non-Linear Model Index**
Variables of Interest	**(1)**	**(2)**	**(3)**	**(4)**
Number of Positive Life Events	0.074***			
	(0.017)			
Number of Positive Life Events Squared	0.017			
	(0.012)			
Number of Negative Life Events	-0.070***			
	(0.007)			
Number of Negative Life Events Squared	-0.015***			
	(0.003)			
Experienced 3 or More Positive Life Events		0.281*		
		(0.113)		
Experienced 2 Positive Life Events		0.212***		
		(0.022)		
Experienced 1 Positive Life Event		0.093***		
		(0.008)		
Experienced 1 Negative Life Event		-0.083***		
		(0.006)		
Experienced 2 Negative Life Events		-0.194***		
		(0.010)		
Experienced 3 Negative Life Events		-0.367***		
		(0.021)		
Experienced 4 Negative Life Events		-0.449***		
		(0.046)		

Experienced 5 Negative Life Events		-0.900***		
		(0.095)		
Experienced 6 or More Negative Life Events		-1.187***		
		(0.177)		
Positive Life Events Index			1.141***	
			(0.085)	
Positive Life Events Index Squared			-0.415	
			(0.259)	
Negative Life Events Index			0.816***	
			(0.058)	
Negative Life Events Index Squared			-0.201***	
			(0.060)	
Positive Life Events Index				0.359***
				(0.107)
Positive Life Events Index / (1 + Coefficient *|Positive Life Events Index|)				1.071
				(0.627)
Negative Life Events Index				-0.234***
				(0.063)
Negative Life Events Index / (1 + Coefficient *|Negative Life Events Index|)				-0.181***
				(0.025)
Controls	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes
R-Squared	0.017	0.0172	0.0711	0.0305
N	176,280	176,280	116,959	116,959

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table 3: Heterogeneous Effects – Linear Model, Index

Dependent Variable: Life Satisfaction (0/10) *Variables of Interest*	**Male** **(1)**	**Female** **(2)**	**< High School** **(3)**	**>= High School** **(4)**	**< 40 Years** **(5)**	**>= 40 Years** **(6)**	**Extro-verted** **(7)**	**Intro-verted** **(8)**
Positive Events Index	1.203***	0.957***	1.097***	1.033***	1.043***	1.289***	0.997***	1.162***
	(0.139)	*(0.077)*	*(0.113)*	*(0.064)*	*(0.105)*	*(0.118)*	*(0.105)*	*(0.100)*
Positive Events Index Squared	-0.569	0.232	-0.225	-0.274	-0.051	-0.812***	0.106	-0.471*
	(0.382)	*(0.230)*	*(0.296)*	*(0.233)*	*(0.268)*	*(0.295)*	*(0.344)*	*(0.277)*
Negative Events Index	0.658***	0.872***	0.900***	0.709***	0.804***	0.808***	0.853***	0.766***
	(0.074)	*(0.077)*	*(0.065)*	*(0.078)*	*(0.074)*	*(0.071)*	*(0.070)*	*(0.097)*
Negative Events Index Squared	-0.366***	-0.147*	-0.117*	-0.321***	-0.228***	-0.197***	-0.168**	-0.230**
	(0.078)	*(0.080)*	*(0.066)*	*(0.074)*	*(0.080)*	*(0.067)*	*(0.073)*	*(0.100)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.0763	0.0641	0.0528	0.0659	0.0753	0.0576	0.0613	0.0663
N	55,036	61,923	79,919	37,040	63,287	53,672	62,318	45,359

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table 4: Robustness Checks – Linear Model, Index

Dependent Variable: Life Satisfaction (0/10) *Variables of Interest*	**Exogenous Events Only** **(1)**	**Events Without Significant Anticipation** **(2)**	**Balanced Panel** **(3)**	**Including Interviewer Observation Controls** **(4)**
Positive Events Index	1.118***	1.279***	0.985***	1.121***
	(0.169)	*(0.133)*	*(0.085)*	*(0.085)*
Positive Events Index Squared	-0.546	-1.252**	0.101	-0.400
	(0.634)	*(0.499)*	*(0.348)*	*(0.258)*
Negative Events Index	0.766***	0.857***	0.809***	0.812***
	(0.065)	*(0.104)*	*(0.075)*	*(0.056)*
Negative Events Index Squared	-0.255***	-0.219***	-0.232***	-0.196***
	(0.070)	*(0.063)*	*(0.088)*	*(0.057)*
Controls	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes
R-Squared	0.0619	0.0104	0.0627	0.0734
N	116,959	116,959	41,074	116,931

Robust standard errors clustered at individual level in parentheses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table 5: Alternative Outcome: Log Mental Health

Dependent Variable: Log Mental Health		
	Anticipation/Adaptation	
	Linear Model	**Non-Linear Model**
	Index	**Index**
Variables of Interest	**(1)**	**(2)**
Positive Life Events Index	1.085***	
	(0.120)	
Positive Life Events Index Squared	-3.920	
	(2.451)	
Negative Life Events Index	0.834***	
	(0.054)	
Negative Life Events Index Squared	-0.562***	
	(0.206)	
Positive Life Events Index		0.191
		(0.540)
Positive Life Events Index / (1 + Coefficient *|Positive Life Events Index|)		15.071
		(38.584)
Negative Life Events Index		-0.188***
		(0.069)
Negative Life Events Index / (1 + Coefficient *|Negative Life Events Index|)		-0.501***
		(0.169)
Controls	Yes	Yes
Individual Fixed Effects	Yes	Yes
R-Squared	0.0888	0.0569
N	115,618	115,618

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Mental Health is measured using fourteen items of the Short-Form (SF36) Health Survey, transformed to a zero-to-ten scale, and logged. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table 6: Estimation Procedure: Two-Step Versus One-Go

Dependent Variable: Life Satisfaction (0/10)		
	Anticipation/Adaptation	
	Two-Step	**One-Step**
	Linear Model	**Linear Model**
	Index	**Index**
Variables of Interest	**(1)**	**(2)**
Positive Life Events Index	1.141***	1.141***
	(0.085)	*N/A*
Positive Life Events Index Squared	-0.415	-0.588***
	(0.259)	*N/A*
Negative Life Events Index	0.816***	0.816***
	(0.058)	*N/A*
Negative Life Events Index Squared	-0.201***	-1.644***
	(0.060)	*N/A*
Controls	Yes	Yes
Individual Fixed Effects	Yes	Yes
R-Squared	0.0711	0.0752
N	116,959	116,959

Robust standard errors clustered at individual level in parentheses.

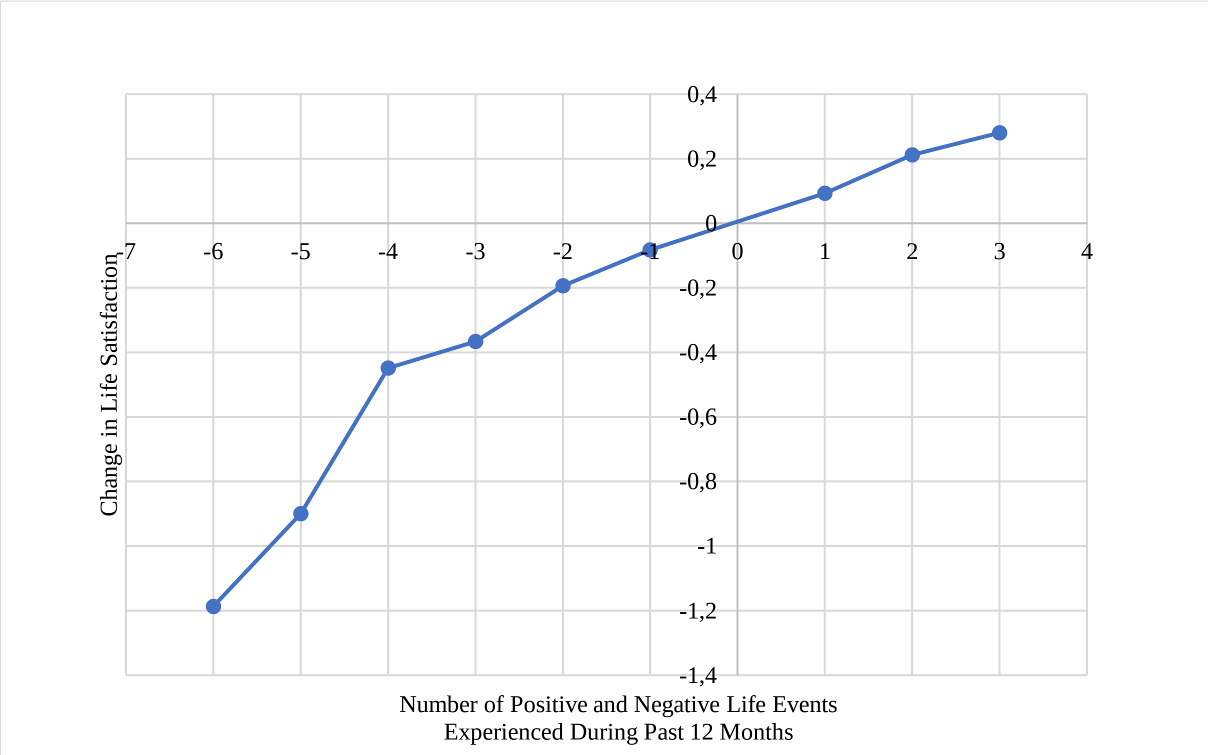
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Appendix

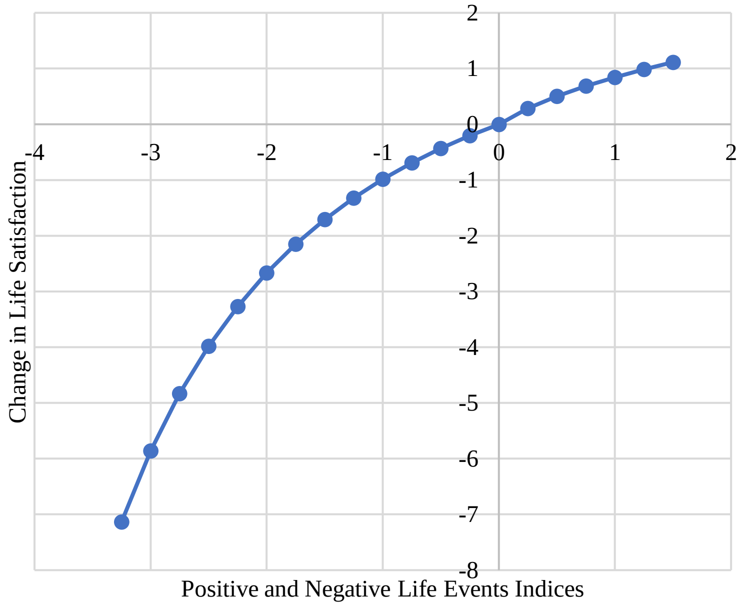
Figures

Figure A1: Baseline Results – Linear Model, No Anticipation/Adaptation, Binary Measures



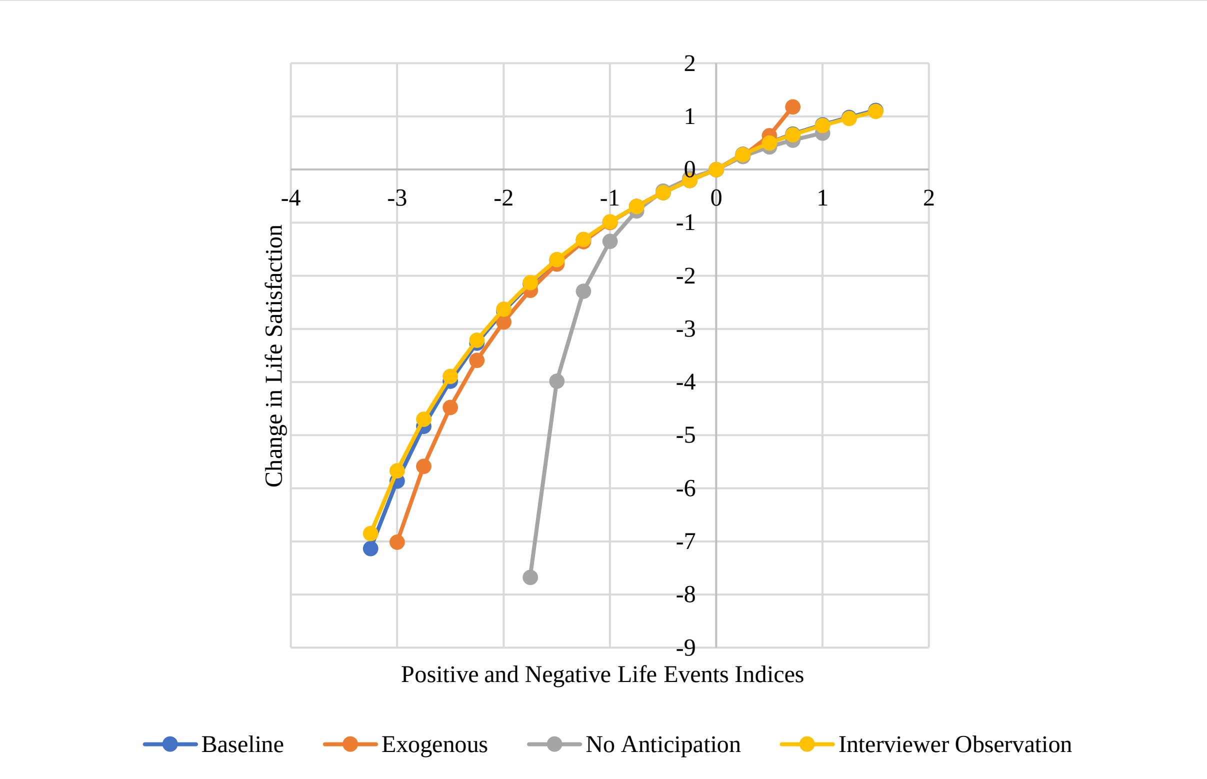
Notes: Figure plots life satisfaction predicted from estimates obtained when estimating Equation (3b) (Table 2 Column 2). Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure A2: Baseline Results – Non-Linear Model, Anticipation/Adaptation, Index



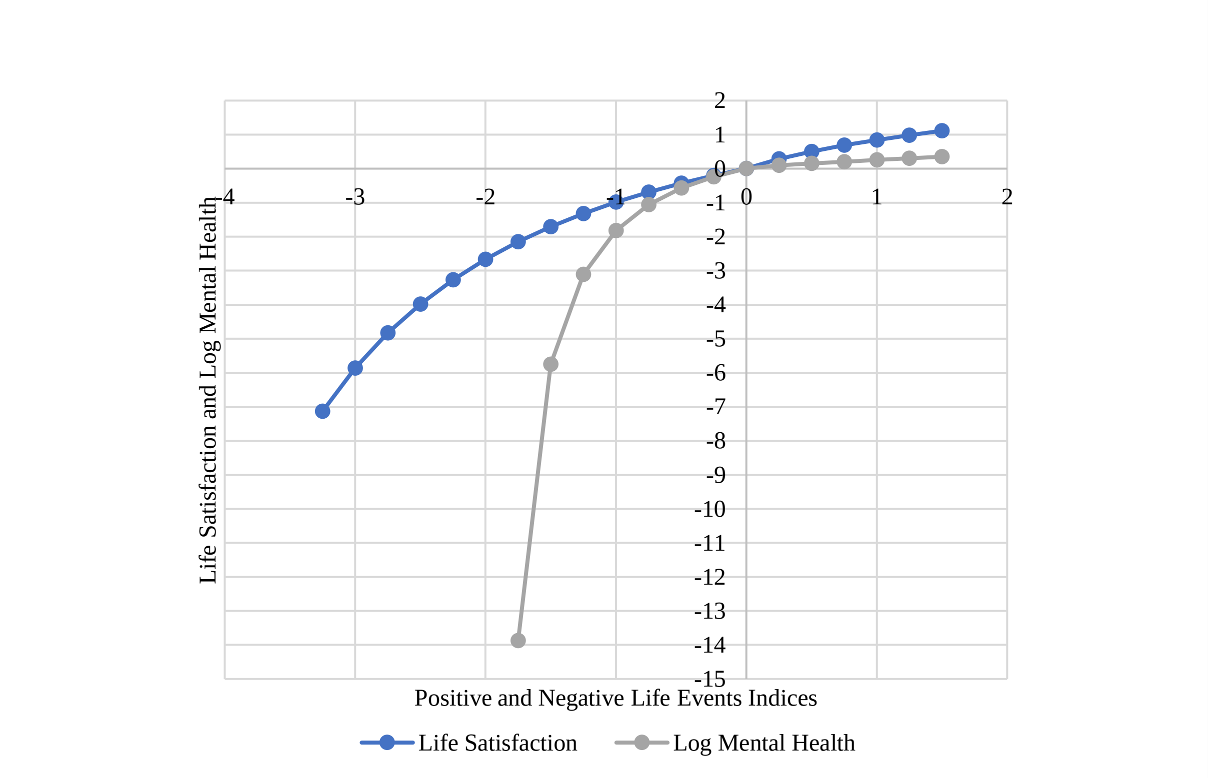
Notes: Figure plots life satisfaction predicted from estimates obtained when estimating Equation (3c.2) (Table 2 Column 4). Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure A3: Robustness Checks – Non-Linear Model, Anticipation/Adaptation, Index



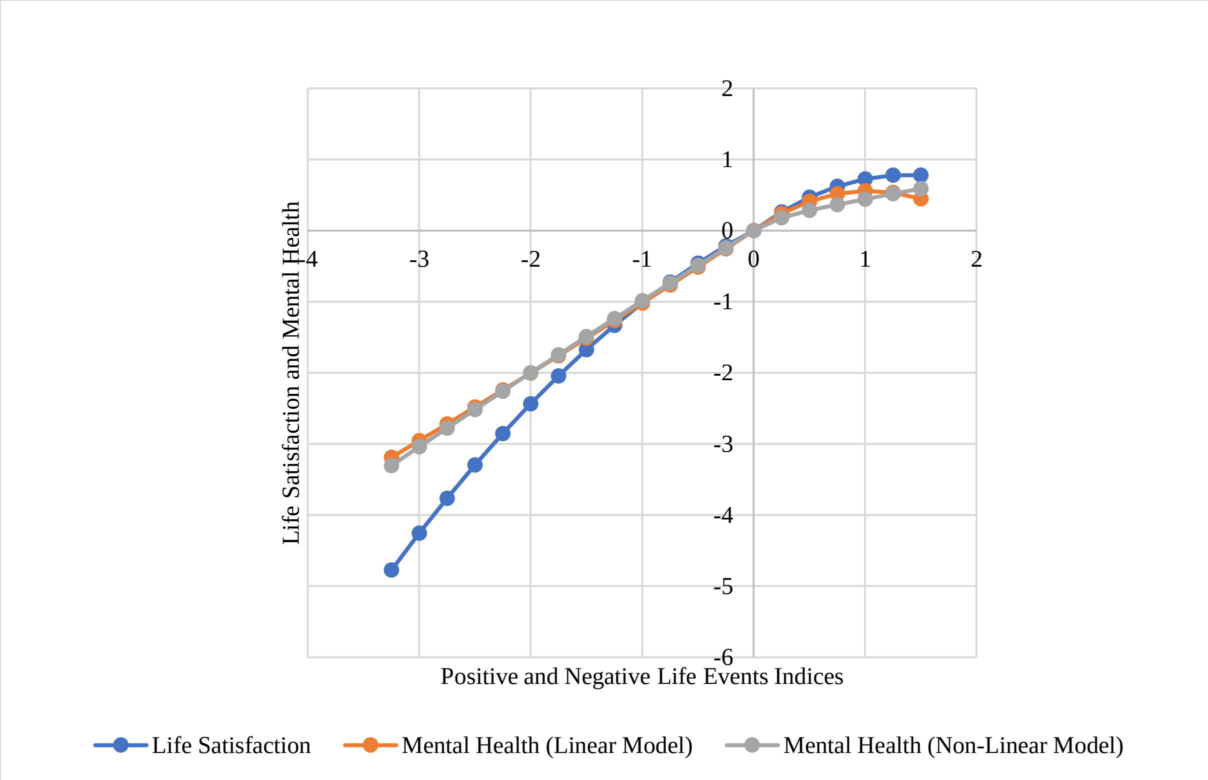
Notes: Figure plots life satisfaction predicted from estimates obtained when estimating Equation (3c.2) (see Table 2 Column 4 for baseline; Table A4 Column 1 for exogenous, Column 2 for no anticipation, and Column 3 for interviewer observations). Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure A4: Alternative Outcome: Log Mental Health – Non-Linear Model, Anticipation/Adaptation, Index



Notes: Figure plots mental health relative to life satisfaction predicted from estimates obtained when estimating Equation (3c.2) (see Table 2 Column 4 for results on life satisfaction and Table 5 Column 2 for results on mental health). Mental Health is measured using fourteen items of the Short-Form (SF36) Health Survey, transformed to a zero-to-ten scale, and logged. Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Figure A5: Alternative Outcome: Mental Health (0/10) – Linear and Non-Linear Model, Anticipation/Adaptation, Index



Notes: Figure plots mental health relative to life satisfaction predicted from estimates obtained when estimating Equation (3c.1) (see Table 2 Column 3 for results on life satisfaction and Table 5 Column 1 for results on mental health). Mental Health is measured using fourteen items of the Short-Form (SF36) Health Survey, transformed to a zero-to-ten scale. Life satisfaction is measured on a zero-to-ten scale. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A1: Distribution of Life Events in Last 12 Months

Number of Events Experienced in Last 12 Months	Counts of Person-Year Observations
Experienced 3 or More Positive Events	178
Experienced 2 Positive Events	2,760
Experienced 1 Positive Event	27,135
Experienced 1 Negative Event	50,025
Experienced 2 Negative Events	18,380
Experienced 3 Negative Events	5,260
Experienced 4 Negative Events	1,335
Experienced 5 Negative Events	421
Experienced 6 or More Negative Events	178
	178,965

Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A2a: Anticipation and Adaptation to Positive Life Events

Dependent Variable: Life Satisfaction (0/10)

Variables of Interest	**Birth or Adoption of a New Child (1)**	**Major Improvements in Finance (2)**	**Got Promoted (3)**	**Got Married (4)**	**Retired (5)**	**Got Back Together with Spouse (6)**
< -24 Months	-0.060***	0.059***	0.076**	0.013	0.091***	0.034
	(0.017)	*(0.017)*	*(0.028)*	*(0.011)*	*(0.023)*	*(0.041)*
-24 to -18 Months	-0.05	0.123***	0.090*	-0.012	0.142***	0.123
	(0.026)	*(0.030)*	*(0.035)*	*(0.020)*	*(0.037)*	*(0.090)*
-18 to -12 Months	-0.025	0.067*	0.106**	0.021	0.149***	0.029
	(0.026)	*(0.027)*	*(0.039)*	*(0.018)*	*(0.044)*	*(0.069)*
-12 to -6 Months	0.091***	0.145***	0.156***	0.001	0.083*	0.206**
	(0.027)	*(0.031)*	*(0.035)*	*(0.022)*	*(0.040)*	*(0.077)*
-6 to 0 Months	0.141***	0.187***	0.224***	0.063***	0.07	0.038
	(0.026)	*(0.026)*	*(0.040)*	*(0.018)*	*(0.043)*	*(0.066)*
0 to 6 Months	0.124***	-0.049	0.141***	0.008	-0.044	0.022
	(0.028)	*(0.028)*	*(0.042)*	*(0.019)*	*(0.042)*	*(0.070)*
6 to 12 Months	0.156***	-0.031	0.212***	0.008	0.045	-0.019
	(0.026)	*(0.033)*	*(0.036)*	*(0.023)*	*(0.039)*	*(0.097)*
12 to 18 Months	0.061*	-0.016	0.102*	0.054**	0.004	-0.091
	(0.027)	*(0.028)*	*(0.045)*	*(0.020)*	*(0.039)*	*(0.076)*
18 to 24 Months	0.04	-0.032	0.119**	-0.031	0.017	0.049
	(0.028)	*(0.033)*	*(0.037)*	*(0.024)*	*(0.040)*	*(0.094)*
Controls			Yes			
Individual Fixed Effects			Yes			
R-Squared			0.0726			
N			116,959			

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A2b: Anticipation and Adaptation to Negative Life Events

Dependent Variable: Life Satisfaction (0/10)

Panel A: Negative Life Events 1 to 6	**Death of a Close Friend (1)**	**Death of an Extended Family Member or Relative (2)**	**Death of a Spouse or a Child (3)**	**Major Worsening of Finances (4)**	**Made Redundant (5)**	**Serious Illness or Injury to a Family Member (6)**
< -24 Months	-0.01	0.006	-0.097*	-0.059**	0.009	0.004
	(0.008)	*(0.010)*	*(0.048)*	*(0.021)*	*(0.022)*	*(0.008)*
-24 to -18 Months	-0.016	0.009	-0.161*	-0.190***	-0.057	-0.022
	(0.020)	*(0.017)*	*(0.081)*	*(0.044)*	*(0.037)*	*(0.015)*
-18 to -12 Months	-0.004	-0.002	-0.144	-0.136**	-0.003	0.008
	(0.015)	*(0.016)*	*(0.080)*	*(0.042)*	*(0.034)*	*(0.013)*
-12 to -6 Months	-0.054**	-0.018	-0.498***	-0.580***	-0.064	-0.028
	(0.020)	*(0.016)*	*(0.110)*	*(0.050)*	*(0.040)*	*(0.015)*
-6 to 0 Months	-0.017	-0.011	-0.381***	-0.487***	-0.082*	-0.030*
	(0.015)	*(0.015)*	*(0.095)*	*(0.044)*	*(0.033)*	*(0.013)*
0 to 6 Months	0.013	-0.021	-0.139	-0.125**	0.036	0.024
	(0.015)	*(0.015)*	*(0.077)*	*(0.047)*	*(0.032)*	*(0.013)*
6 to 12 Months	0.001	-0.01	-0.246*	-0.235***	-0.056	-0.006
	(0.021)	*(0.017)*	*(0.100)*	*(0.049)*	*(0.038)*	*(0.016)*
12 to 18 Months	0.028	-0.001	-0.118	-0.105*	0.036	-0.009
	(0.015)	*(0.016)*	*(0.078)*	*(0.046)*	*(0.034)*	*(0.013)*
18 to 24 Months	-0.017	-0.007	0.035	-0.149**	-0.038	0.037*
	(0.021)	*(0.018)*	*(0.098)*	*(0.049)*	*(0.040)*	*(0.017)*

Panel B: Negative Life Events 7 to 12	**Serious Personal Illness or Injury (7)**	**Family Member Detained in Jail (8)**	**Detained in Jail (9)**	**Victim of Property Crime (10)**	**Victim of Physical Violence (11)**	**Separated or Divorced from Spouse (12)**
< -24 Months	-0.059***	-0.03	-0.025	0.006	-0.087*	0.025
	(0.012)	*(0.025)*	*(0.112)*	*(0.018)*	*(0.037)*	*(0.023)*

-24 to -18 Months	-0.102***	-0.027	-0.175	-0.042	-0.103	-0.142***
	(0.023)	*(0.072)*	*(0.293)*	*(0.033)*	*(0.073)*	*(0.037)*
-18 to -12 Months	-0.063**	-0.037	0.071	0.006	-0.165**	-0.087*
	(0.020)	*(0.050)*	*(0.191)*	*(0.026)*	*(0.059)*	*(0.040)*
-12 to -6 Months	-0.236***	-0.062	-0.134	-0.084*	-0.272***	-0.298***
	(0.024)	*(0.066)*	*(0.254)*	*(0.033)*	*(0.073)*	*(0.038)*
-6 to 0 Months	-0.192***	-0.075	-0.188	-0.065*	-0.339***	-0.355***
	(0.020)	*(0.050)*	*(0.195)*	*(0.026)*	*(0.062)*	*(0.044)*
0 to 6 Months	-0.005	-0.028	-0.294	0.008	-0.233***	-0.041
	(0.020)	*(0.056)*	*(0.205)*	*(0.028)*	*(0.070)*	*(0.041)*
6 to 12 Months	-0.074**	0.049	0.146	0.016	-0.105	-0.272***
	(0.024)	*(0.069)*	*(0.265)*	*(0.037)*	*(0.080)*	*(0.040)*
12 to 18 Months	0.024	-0.088	0.059	-0.022	-0.02	-0.004
	(0.020)	*(0.058)*	*(0.196)*	*(0.029)*	*(0.067)*	*(0.044)*
18 to 24 Months	-0.004	-0.049	0.295	0.034	-0.115	-0.056
	(0.023)	*(0.066)*	*(0.175)*	*(0.040)*	*(0.093)*	*(0.037)*
Controls			Yes			
Individual Fixed Effects			Yes			
R-Squared			0.0726			
N			116,959			

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A3: Heterogeneous Effects – Non-Linear Model, Indices

Dependent Variable: Life Satisfaction (0/10)	**Male** (1)	**Female** (2)	**< High School** (3)	**>= High School** (4)	**< 40 Years** (5)	**>= 40 Years** (6)	**Extro-verted** (7)	**Intro-verted** (8)
Positive Life Events Index	0.276	0.242	0.321	0.127	0.332	0.208	0.181	0.188
	(0.307)	*(0.248)*	*(0.282)*	*(0.236)*	*(0.249)*	*(0.233)*	*(0.232)*	*(0.276)*
Positive Life Events Index / (1 + Coefficient *|Positive Life Events Index|)	0.586	0.672	0.812	0.221	0.666	0.043	0.257	0.573
	(1.307)	*(1.180)*	*(1.368)*	*(0.859)*	*(1.037)*	*(0.613)*	*(0.952)*	*(1.146)*
Negative Life Events Index	-0.259***	-0.144	-0.104	-0.302***	-0.218**	-0.164**	-0.221***	-0.241**
	(0.075)	*(0.095)*	*(0.086)*	*(0.092)*	*(0.091)*	*(0.084)*	*(0.083)*	*(0.114)*
Negative Life Events Index / (1 + Coefficient *|Negative Life Events Index|)	-0.199***	-0.134***	-0.132***	-0.176***	-0.166***	-0.130***	-0.161***	-0.172***
	(0.015)	*(0.044)*	*(0.050)*	*(0.020)*	*(0.053)*	*(0.013)*	*(0.032)*	*(0.056)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.0381	0.0314	0.0303	0.0431	0.0383	0.0336	0.0339	0.0322
N	55,036	61,923	79,919	37,040	63,287	53,672	62,318	45,359

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A4: Robustness Checks – Non-Linear Model, Indices

Dependent Variable: Life Satisfaction (0/10) *Variables of Interest*	**Exogenous Events Only** **(1)**	**Events Without Significant Anticipa-tion** **(2)**	**Balanced Panel** **(3)**	**Including Interviewer Observa-tion Con-trols** **(4)**
Positive Life Events Index	-0.170	0.196	0.434	0.348***
	(0.231)	*(0.365)*	*(0.603)*	*(0.138)*
Positive Life Events Index / (1 + Coefficient *|Positive Life Events Index|)	-0.621	1.041	2.372	1.086
	(0.448)	*(2.378)*	*(6.369)*	*(1.416)*
Negative Life Events Index	-0.260***	-0.480***	-0.152	-0.228***
	(0.069)	*(0.134)*	*(0.111)*	*(0.062)*
Negative Life Events Index / (1 + Coefficient *|Negative Life Events Index|)	-0.205***	-0.454***	-0.189***	-0.176***
	(0.027)	*(0.003)*	*(0.071)*	*(0.027)*
Controls	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes
R-Squared	0.0204	0.0113	0.0414	0.0327
N	116,959	116,959	41,074	116,931

Robust standard errors clustered at individual level in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Life satisfaction is measured on a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

Table A5: Alternative Outcome: Mental Health (0/10)

Dependent Variable: Mental Health (0/10)		
	Anticipation/Adaptation	
	Linear Model	**Non-Linear Model**
	Index	**Index**
Variables of Interest	**(1)**	**(2)**
Positive Life Events Index	1.082***	
	(0.096)	
Positive Life Events Index Squared	-0.524	
	(0.392)	
Negative Life Events Index	1.032***	
	(0.042)	
Negative Life Events Index Squared	0.016	
	(0.027)	
Positive Life Events Index		0.273
		(0.886)
Positive Life Events Index / (1 + Coefficient *|Positive Life Events Index|)		4.869
		(18.758)
Negative Life Events Index		-0.024
		(0.067)
Negative Life Events Index / (1 + Coefficient *|Negative Life Events Index|)		-0.012
		(0.044)
Controls	Yes	Yes
Individual Fixed Effects	Yes	Yes
R-Squared	0.0943	0.0544
N	115,626	115,626

Robust standard errors clustered at individual level in parentheses.

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Notes: Mental Health is measured using fourteen items of the Short-Form (SF36) Health Survey, transformed to a zero-to-ten scale. Controls include age, age squared divided by 100, years of education, and log household income. See Section 2 for a description of the data and Section 3 for the procedure to create positive and negative life events indices.
Source: HILDA, 2002 to 2017, individuals aged 15 and above; own calculations.

CENTRE FOR ECONOMIC PERFORMANCE
Recent Discussion Papers

1679	Antoine Dechezleprêtre David Hémous Morten Olsen Carlo Zanella	Automating Labor: Evidence from Firm-Level Patent Data
1678	Michael Amiior	The Contribution of Immigration to Local Labor Market Adjustment
1677	Swati Dhingra Silvana Tenreyro	The Rise of Agribusiness and the Distributional Consequences of Policies on Intermediated Trade
1676	Jeffrey Grogger Ria Ivandic Tom Kirchmaier	Comparing Conventional and Machine-Learning Approaches to Risk Assessment in Domestic Abuse Cases
1675	Mary Amiti Stephen J. Redding David E. Weinstein	Who's Paying for the U.S. Tariffs? A Longer-Term Perspective
1674	Cheng Chen Claudia Steinwender	Import Competition, Heterogeneous Preferences of Managers and Productivity
1673	Stefano Bolatto Alireza Naghavi Gianmarco Ottaviano Katja Zajc Kejzar	Intellectual Property and the Organization of the Global Value Chain
1672	Timothy Besley Isabel Roland John Van Reenen	The Aggregate Consequences of Default Risk: Evidence from Firm-Level Data
1671	Jan-Emmanuel De Neve Daisy Fancourt Christian Krekel Richard Layard	A Local Community Course That Raises Mental Wellbeing and Pro-Sociality

1670	Tommaso Sonno	Globalization and Conflicts: The Good, the Bad and the Ugly of Corporations in Africa
1669	Michael Amior	Immigration, Local Crowd-Out and Undercoverage Bias
1668	Antoine Berthou John Jong-Hyun Chung Kalina Manova Charlotte Sandoz Dit Bragard	Trade, Productivity and (Mis)allocation
1667	Holger Breinlich Elsa Leromain Dennis Novy Thomas Sampson	Exchange Rates and Consumer Prices: Evidence from Brexit
1666	Fabrice Defever Michele Imbruno Richard Kneller	Trade Liberalization, Input Intermediaries and Firm Productivity: Evidence from China
1665	Philippe Aghion Antonin Bergeaud Richard Blundell Rachel Griffith	The Innovation Premium to Soft Skills in Low-Skilled Occupations
1664	Filip Gesiarz Jan-Emmanuel De Neve Tali Sharot	The Motivational Cost of Inequality: Pay Gaps Reduce the Willingness to Pursue Rewards
1663	Felix Koenig	Technical Change and Superstar Effects: Evidence From the Roll-Out of Television
1662	Enrico Moretti Claudia Steinwender John Van Reenen	The Intellectual Spoils of War? Defense R&D, Productivity and International Spillovers

The Centre for Economic Performance Publications Unit
Tel: +44 (0)20 7955 7673 Email info@cep.lse.ac.uk
Website: http://cep.lse.ac.uk Twitter: @CEP_LSE