Deconstructing the Hedonic Treadmill: Is Happiness Autoregressive?

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Abstract

Affective habituation is well-documented in social sciences: people seem to adapt to many life events, ranging from lottery windfalls to terminal illnesses. We propose a subtle but critical difference: current happiness may depend directly on past happiness. We test our hypothesis running dynamic happiness regressions using panel data from the German Socio-Economic Panel Study, the British Household Panel Survey and the Swiss Household Panel. Contrary to the widespread prior among economists and non-economists, the coefficient on lagged happiness is positive and statistically significant. We discuss some explanations for the puzzle. Our favorite is that reported happiness is time-inconsistent, even within individuals. We test this conjecture by using a 52-days study. As expected, the coefficient on lagged happiness is negative and statistically significant. We find that changes in hedonic states bounce back 30% in only 5 days.

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1. Introduction

Brickman et al. (1971) coined the term "hedonic treadmill" to describe how people tend to adapt to good and bad events and then return to the same baseline level of happiness. Since then a number of papers in social sciences suggested that people adapt to particular life events, ranging from lottery windfalls (Brickman et al., 1978) to losing a limb to cancer (Tyc, 1992). We take a further step and argue that there may be a "general" habituation effect: people's general feeling of happiness may adapt just like the human olfactory system adapts to a continuous stimulus, so that the odor becomes unnoticed.

In other words, having experienced moments of happiness (unhappiness) in the present will make people prone to feelings of unhappiness (happiness) in the future, regardless of the original increase (decrease) in well-being being due to changes in income, health or love partners. Even though the difference between "specific" and "general" habituation is a central part in all the theoretical discussion on hedonic adaptation, this is the very first paper to address that empirically.[1]

Even though the differences between "specific habituation" and "general habituation" may seem subtle from the theoretical point of view, they are clear from an econometrician's perspective: in a happiness regression the effect of general habituation will be captured by the coefficient on lagged happiness, while the effect of income habituation will be captured by the coefficient on lagged income.

We test our hypothesis by running dynamic happiness regressions using individual-level panel data from the German Socio-Economic Panel Study, the British Household Panel Survey and the Swiss Household Panel. We propose a variety of models to overcome many identification challenges.

If there is general habituation, then the coefficient on lagged happiness should be negative. Contrary to that widespread prior among economists and non-economists, we find that the coefficient for lagged happiness is positive and statistically significant. We discuss some explanations for the puzzle.

[1] For example, Frederick et al. (1999) use the denomination "specific-domain hedonic adaptation." And in the same spirit Kahneman (2000) distinguishes between the "hedonic treadmill" and the "satisfaction treadmill."

The most likely explanation is the fact that self-report scales may undermine the study of happiness dynamics. We provide a test for this conjecture: happiness scores should be much more consistent during a 52-day study rather than during a 20-year study. Indeed, when we run the regressions using a daily panel the coefficient on lagged happiness is negative and significant.

The paper proceeds as follows: Section 2 briefly explains the difference between general and specific adaptation. Section 3 introduces the data and empirical strategy. The econometric results are detailed and discussed in Section 4. In Section 5 we discuss the intertemporal consistency of self-reported scores. In Section 6 we fit the model using daily data. The final section concludes.

2. Hedonic adaptation

There are a numerous studies in social sciences showing that people experience hedonic adaptation. We will denominate this theory "specific habituation": people adapt to particular life events, such as an increase in income, losing a job or getting married.

For instance, Brickman et al. (1978) show that state lottery winners reported only slightly higher levels of life satisfaction than a control group. Oswald et al. (2008) provide longitudinal evidence that people who become disabled exhibit a 30% to 50% recovery in mental well-being. Tyc (1992) found no difference in quality of life between young patients who had lost limbs to cancer compared with those who had not. In a study of prisoners, Wormith (1984) observed significant improvement in deviance, attitude, and personality measures. Some health studies involve burn victims (Patterson et al., 1993) and hemodialysis patients (Riis et al., 2005).

A few economists have shown interest in the measurement of affective habituation. In one of the first studies, Di Tella et al. (2007) used panel data on life satisfaction and concluded that 65% of the initial effect of an increase in income is lost over the ensuing four years. Clark et al. (2008) use panel data to find evidence of adaptation to life events such as unemployment, layoffs, marriage, and divorce. For more details about empirical and experimental evidence see Frederick et al. (1999).

Some psychologists and economists do agree that, for example, a current increase in permanent income has an effect on happiness that only lasts a few years.[2] However, there still is no consent about the actual mechanisms that make such adaptation happen (e.g. Kahneman, 2000). For instance, one theory suggests that such adaptation is the result of people updating their income aspirations. In other words, as soon as people get what they desire, they start desiring something better. Another theory suggests that the intrinsic reward centers in our brain adapt automatically. Regardless of our expectations, if you start drinking $50 wine bottles instead of $10 bottles, sooner or later the $50 wine will taste like a $15 or even $10 wine.

We propose another distinction, which can be tested empirically. In addition to habituation in specific life domains, there may be "general habituation" to happiness: having experienced moments of happiness (unhappiness) today may make people more prone to feelings of unhappiness (happiness) in the future, regardless of the source of the original increase (decrease) in well-being. Indeed, Rayo et al. (2005) and Perez Truglia (2009) show that from an evolutionary point of view we should expect the hedonic states to bounce back to normal levels in this way.

Nature created a homeostatic system that triggers adaptation whenever upper and lower thresholds are achieved. When such thresholds are reached the adaptation mechanisms are triggered regardless of whether the marginal change in happiness was the result of winning the lottery, getting divorced or being imprisoned.[3] We believe this effect can be represented by autoregressive happiness.

Even though the differences between specific habituation and general habituation may be subtle from a theoretical point of view, they are very clear from an econometrician's perspective. The effect of specific habituation (e.g. income) will be captured by the coefficients on lagged income, while the effect of general habituation will be captured by the coefficients on lagged happiness.

As a consequence, the effect on happiness from an increase in income will be twofold. On the one hand, higher income increases future income aspirations and, ceteris paribus,

[2] In a 2007 policy-views survey of a random sample of members of the American Economic Association less than half of the respondents agreed that economic growth in developed countries like the U.S. leads to greater levels of happiness (Whaples, 2009).

[3] For instance, Perez Truglia (2009) provides a model to explain the timing of the hedonic adaptation process inspired in the case of psychological defenses (e.g. Freud, 1937).

decreases future happiness (specific habituation). On the other hand, higher income increases present happiness and then makes the individual more prone to feelings of unhappiness tomorrow (general habituation).

Even though there are numerous papers studying specific-habituation, there is not a single paper measuring the general-habituation channel (i.e. happiness autoregressivity). We will see that it is important.

3. Econometric Model and Data

To test our hypothesis empirically, we will make use of the German Socio-Economic Panel Study[4] (GSOEP), the British Household Panel Survey[5] (BHPS) and the Swiss Household Panel[6] (SHP). In what follows we present the regressions results for the GSOEP, SHP and BHPS as A, B and C-Tables, respectively.

The challenge in estimating a dynamic model with fixed effects is that, for well-known reasons, it yields inconsistent estimates with large *N* but short *T*. The panel lengths are 22, 8 and 10 for the GSOEP, SHP and BHPS, respectively.[7] Since the GSOEP is the longest and largest panel, we will concentrate the discussion on results obtained form it. Nevertheless, results are quite robust between datasets.

The baseline linear[8] model is:

$$H_{i,t} = \sum_{q=1}^{Q} \gamma_q H_{i,t-q} + \sum_{r=0}^{R} \beta_r X_{i,t-r} + \alpha_i + \psi_t + \varepsilon_{i,t} \quad (1)$$

The dependent variable $H_{i,t}$ is self reported happiness, $X_{i,t}$ is a vector of time varying individual controls, Q and R are respectively the number of lags to be considered for each of the variables, η_i are individual fixed effects, ψ_t corresponds to year effects and $\varepsilon_{i,t}$ is the error term. If coefficient γ was negative (positive), then happiness would display

[4] Data was made available to us by the German Institute for Economic Research (DIW), Berlin.

[5] University of Essex. Institute for Social and Economic Research, *British Household Panel Survey: Waves 1-15, 1991-2006* [computer file]. *3rd Edition.* Colchester, Essex: UK Data Archive [distributor], June 2007. SN: 5151.

[6] Data has been collected in the "Living in Switzerland" project, which is based at the Swiss Foundation for Research in Social Sciences FORS, University of Lausanne (a project is financed by the Swiss National Science Foundation).

[7] However, there is a gap in the middle of the BHPS for data on happiness. This causes the loss of 2 periods (instead of one) for each lag introduced in the model.

[8] Using linear or ordered models for happiness regressions makes little difference as long as fixed effects are taken into account (Ferrer-i-Carbonell et al., 2004).

habituation (inertia): feelings of happiness this year would make an individual prone to feeling of unhappiness (happiness) during the next year.

For detailed information on all datasets along with descriptive statistics please refer to Appendix 1. Data definitions are available in Appendix 2. An individual's self reported happiness is obtained from the question: "How satisfied are you with your life, all things considered?" Responses range from 0 (completely dissatisfied) to 10 (completely satisfied). The measure of income used is the logarithm of net total annual household income, deflated to prices of a baseline year. Some of the control variables are: education, household composition, employment and marital status indicators. We always report standard errors clustered at the individual level.

As we will discuss below, the identification strategy for γ depends crucially on the error term not being persistent. Our strategy consists in controlling for as many covariates and semi-parametric controls as possible, such as the usual individual controls, time and fixed effects, region-specific time effects and individual-specific trends.[9]

Many control variables may be endogenous. For instance, there could be simultaneous causality between income and well being: i.e. happiness may help people make more money, and not just the other way around (Lyubomirsky et al., 2005). Controlling for as many covariates as possible is our strategy to minimize the potential biases. Our approach has the benefit of being applicable to many data sets, which will allow us to check the external validity. In the following section we will construct the analysis "from the bottom up", introducing models one by one.

4. Results

4.1. Specific Habituation

Suppose that happiness depends on present and past values of individual income[10,11] ($y_{i,t}$ and $y_{i,t-1}$, respectively):

[9] Including further control variables may cloud the interpretation for certain coefficients of interest. For instance, income improves life satisfaction through expenditures on health and education. If you include these variables you will downward bias the coefficient on income, since you will not be capturing its impact through health and education. In the presence of measurement error, the introduction of an additional variable may bias an otherwise unbiased estimate.

[10] Unfortunately, the data sets we work with only contain information on income and not consumption. Headey et al. (2004) used household economic panel data from five countries to find that in the two countries where

$$H_{it} = \theta_1 y_{i,t} + \theta_2 y_{i,t-1} + \alpha_i + \varepsilon_{i,t} \quad (1)$$

For the sake of expositional simplicity, we will not write down all of the covariates included in the regressions. Including lagged variables is also important if one is interested only in contemporary effects. Suppose, for instance, that income is autocorrelated: $y_{i,t} = \tau y_{i,t-1} + \upsilon_{i,t}$. If (1) was the Data Generating Process (DGP) and we did not include $y_{i,t-1}$ as a regressor, then the estimation of θ_1 would be seriously biased.

We already mentioned that the habituation effects can be the result of different phenomenon. Suppose for example that happiness is a function of income (y_t) above the income aspiration (A_t):

$$H_t = \alpha(y_t - A_t) + \xi_t \quad (2)$$

Where A_t is determined at *t-1*. If we included A_t along with y_{t-1} as explanatory variables in a regression, the later would have a null coefficient. But we cannot observe A_t, so we estimate the following regression:

$$H_t = \beta_1 y_t + \beta_2 y_{t-1} + \varepsilon_t \quad (3)$$

Since A_t is formed at *t-1*, it probably is strongly correlated with y_{t-1}. The equation (3) would yield $\hat{\beta}_2 \neq 0$ because $\hat{\beta}_2$ is indirectly capturing the effect of aspirations. We do not care whether the true model is (2) or (3), as long as y_{t-1} is measuring an adaptation effect.[12]

Even though marginal utility from income is a parameter that is of special interest to economists, we want to measure adaptation to any specific life domain (e.g. getting married, becoming unemployed):

$$H_{i,t} = \sum_{r=0}^{R} \beta_r X_{i,t-r} + \alpha_i + \psi_t + \varepsilon_{i,t} \quad (2)$$

consumption data was available, non-durable consumption expenditure appeared to be at least as important to happiness as income. We do not observe wealth either. However, by construction fixed effects account for initial wealth and then only changes in wealth (income and consumption) matter.

[11] The distribution of income within the household does impact on individual happiness (e.g. Bonke et al., 2003). If we also control for individual income the results do not change. We focus only on household income for the sake of brevity.

[12] Notice that (3) is equivalent to a model consisting of changes in income: $H_{i,t} = a_1 y_{i,t} + a_2 (y_{i,t} - y_{i,t-1})$, $\beta_1 = a_1 + a_2$ and $\beta_2 = -a_2$. That is, β_1 would reflect the permanent effect plus the transitory effect, and β_2 would subtract the transitory effect in the subsequent period.

Results for this specification are presented in column (1) of Table 1A. The coefficients on current and past income are statistically significant, and some of the lags for control variables are significant as well.[13] The lags for most of our controls are of opposite sign to the current level's coefficient (and in the expected direction). For instance, losing a spouse today is associated with a coefficient of -0.6 that is statistically significant at the 1% level, but the lags (also statistically significant) are 0.31 and 0.29. In other words, reported happiness bounces back completely after two years.

For unemployment habituation is only 72% after 2 years. We found a similar pattern for marriage, divorce, and childbirth, among others. Some of the covariates and their respective lags are presented in Table 2. These findings are comparable to those found in other studies (Clark et al., 2008; Lucas et al., 2003; Diener et al., 2006).

4.2. General Habituation

Consider the following model:

$$H_{i,t} = \gamma H_{i,t-1} + \lambda X_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (3)$$

Where $X_{i,t}$ is a vector of "fundamentals" of happiness. Suppose such fundamentals are held constant at X_i^{ss}. The steady state of happiness is: $H_i^{ss} = \lambda X_i^{ss} / (1-\gamma)$. Therefore, the contemporaneous effect of changing the fundamentals is given by $\hat{\lambda}$, while the effect in the long run is $\hat{\lambda}/(1-\hat{\gamma})$. If we find a negative (positive) $\hat{\gamma}$, this would imply that the impact on the steady state is smaller (greater) than the contemporaneous effect.

[13] The sign of the coefficients on lagged income are not negative as obtained in Di Tella et al. (2007). We find negative coefficients when income is the only variable being lagged.

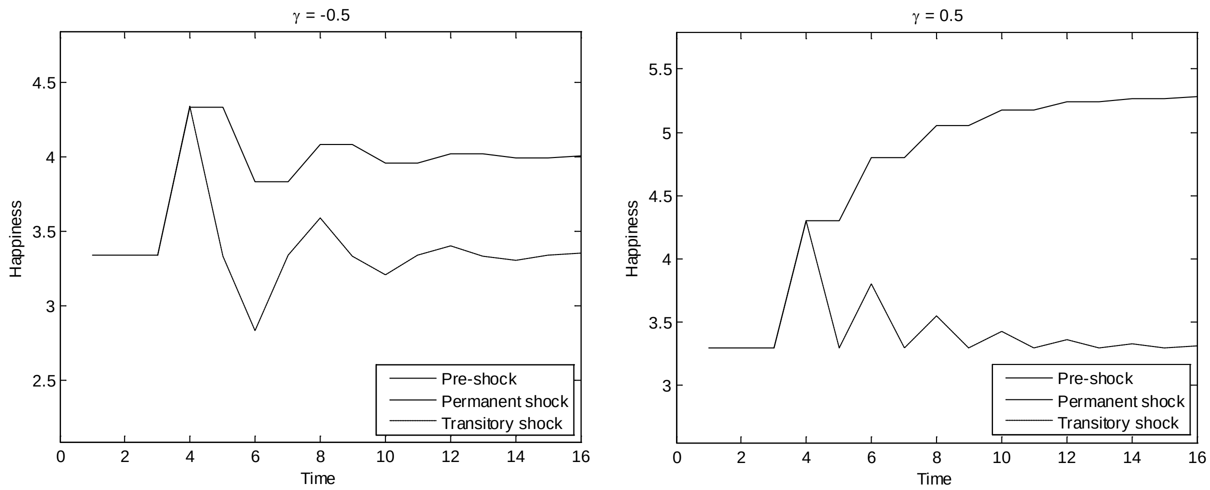

Figure 1

The dynamics for a negative γ are very simple: an increase from X_i^{ss} to $X_i^{ss}+\phi$ will initially increase happiness in $\lambda\phi$, next period happiness will drop by (the absolute value of) $\gamma\lambda\phi$, then it will increase by $\gamma^2\lambda\phi$, then drop by (the absolute value of) $\gamma^3\lambda\phi$, and so on (if γ is positive then those are all increments). Note that happiness oscillates when approaching the new steady state. Also, notice that $\gamma \to -1$ does not imply full habituation but half-adaptation (and it becomes unit-root). Figure 1 illustrates both habituation and inertia for positive transitory and permanent shocks on happiness.

Happiness probably depends on past realizations of the fundamentals as well:

$$H_{i,t} = \gamma H_{i,t-1} + \lambda_1 X_{i,t} + \lambda_2 X_{i,t-1} + \alpha_i + \varepsilon_{i,t} \quad (4)$$

The one-period effect would be $\hat{\lambda}_1$, the two-period effect would be $\hat{\lambda}_1+\hat{\lambda}_2$, and the long run effect would be $(\hat{\lambda}_1+\hat{\lambda}_2)/(1-\hat{\gamma})$. We will estimate the baseline model presented in (1) with one lag of happiness and 2 lags of controls.[14] If the controls were not included in the regression and the hypothesis of specific-habituation were true, the estimations of γ would be biased (since $X_{i,t-1}$ is correlated by construction with $H_{i,t-1}$).

It is well known that using the within transformation when estimating (4) would involve a considerable small-T bias (Nickell, 1981). We will consider the standard solutions. Using all of the available lags of the dependent variable as instruments in the particular

[14] Since the panels are significantly shorter for the SHP and BHPS, we only include 1 lag of controls for these cases. By introducing more lags we reduce sample size significantly, especially in the BHPS.

context of happiness regressions is not optimal. Intuitively, the relation between $(H_{i,t-1} - H_{i,t-2})$ and $H_{i,t-19}$ is undoubtedly weak and most probably noisy.

Angrist et al. (2008) illustrates this intuitively. Denote $F = \mathrm{R}/(\sigma_\xi^2 \cdot Q)$ the *F*-statistic for the joint significance of all regressors in the first stage regression, where Q is the number of instruments, σ_ξ^2 is the residual variance and R is the R-squared of the first stage. Then the bias can be approximately written as (Angrist et al., 2008, Chapter 4):

$$E\left[\hat{\beta}_{2SLS} - \beta\right] \approx \frac{\sigma_{\eta\xi}}{\sigma_\xi^2} \frac{1}{F+1}$$

Only as F gets large 2SLS does better than OLS. When the instruments are weak, the F-statistic itself varies inversely with the number of instruments. To see why, consider adding useless instruments to your 2SLS model, that is, instruments with no effect on the first-stage R-squared. The model's sum of squares and the residual variance will remain the same, but Q will go up. The *F*-statistic becomes smaller as a result. This is why the addition of many weak instruments increases bias. Additionally, when *T* is large many instruments are generated, which ultimately is worse for asymptotic results (Cameron and Trivedi, 2008).

Indeed, there is Monte Carlo evidence suggesting that Anderson-Hsiao (hereafter, HS) yields less bias than other methods such as Arellano-Bond and Arellano-Bover, and its efficiency compares favorably (e.g. Judson et al., 1999). Therefore, we will use HS as the baseline model (especially for expositional simplicity). However, we also present results for AB estimates. Coefficients and standard errors are quite similar between both methods.

In column (2) we show the autoregressive happiness model estimated by the within transformation. The estimate for the autoregressive term is positive and statistically different from zero.[15] If $|\gamma| < 1$ the sign of the small-T bias is negative, which in turn suggests that $\gamma > 0$. This is puzzling, because the widespread prior is that happiness displays habituation instead of inertia. From the within estimates we know that the positive coefficient is not the product of small-*T* bias: on the contrary, the estimated coefficient is positive *in spite of* the small-*T* bias.

Consider the first differences of equation (3):

[15] Note that for the SHP and BHPS the coefficient is negative, product of the small *T* bias.

$$\left(H_{i,t} - H_{i,t-1}\right) = \gamma\left(H_{i,t-1} - H_{i,t-2}\right) + \lambda\left(X_{i,t} - X_{i,t-1}\right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right) \quad (5)$$

The source of the bias is clear above: the term $\left(H_{i,t-1} - H_{i,t-2}\right)$ is correlated with the error term $\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)$ through $\varepsilon_{i,t-1}$. The HS estimator exploits the fact that $H_{i,t-2}$ can be used as an instrumental variable for $\left(H_{i,t-1} - H_{i,t-2}\right)$. The results for HS are presented in column (3). The $\hat{\gamma}$ is positive and statistically relevant at the 1% level.

For the following estimates we test the presence of weak instruments based on the Anderson-Rubin Wald test. The results are similar when using alternative tests. Under the null that the instrumental variables are weak and the over-identifying restrictions are valid, we reject can reject it at the 1% level. For the upcoming regressions we will not mention the weak instrument test unless we cannot reject the null.

Notice that the model in differences has first order autocorrelation by construction. However, if there was second order autocorrelation then the instrument variables would not be valid. Indeed, we reject the null hypothesis of no second order autocorrelation at the 1% level.

4.3. Second-order General Habituation

The most basic explanation for the second order autocorrelation in the difference model is that the model in levels should include two lags of happiness instead of one:

$$H_{i,t} = \gamma_1 H_{i,t-1} + \gamma_2 H_{i,t-2} + \alpha_i + \varepsilon_{i,t} \quad (6)$$

Take first differences:

$$(H_{i,t} - H_{i,t-1}) = \gamma_1 (H_{i,t-1} - H_{i,t-2}) + \gamma_2 (H_{i,t-2} - H_{i,t-3}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (7)$$

Where $H_{i,t-2}$ is as an instrumental variable for $\left(H_{i,t-1} - H_{i,t-2}\right)$ and $H_{i,t-3}$ for $(H_{i,t-2} - H_{i,t-3})$. The results are presented in column (4) of Table 1A. Both lags are positive and statistically significant, though the second lag is 1/3 the coefficient of the first lag. Now we cannot reject the null hypothesis of no second order autocorrelation.

The results for Arellano-Bond are reported in columns (4) and (6), respectively. The results are not substantially different from HS. We cannot reject the null of the Sargan test at 1% level in either case (though we can when shortening instrument matrix). In what follows we will explore whether the positive autoregressive coefficient is the product of model misspecification bias.

4.4. Lagged Unobservables

We know that happiness depends on unobservables (S_t):

$$H_{i,t} = \gamma H_{i,t-1} + \lambda_1 X_{i,t} + \lambda_2 X_{i,t-1} + \beta S_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (8)$$

Take first differences:

$$\begin{aligned} H_{i,t} - H_{i,t-1} = {} & \gamma(H_{i,t-1} - H_{i,t-2}) + \lambda_1(X_{i,t} - X_{i,t-1}) + \lambda_2(X_{i,t-1} - X_{i,t-2}) \\ & + \beta(S_{i,t} - S_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \end{aligned} \quad (9)$$

If (8) were true and (4) was estimated instead, the error term in the difference equation would be the whole second line in (9). Suppose that the unobservable is persistent (i.e. $S_{i,t-1}$ and $S_{i,t-2}$ are correlated). Since $H_{i,t-2}$ and $S_{i,t-2}$ are correlated by definition, using $H_{i,t-2}$ as an instrument for $(H_{i,t-1} - H_{i,t-2})$ would not be valid.

Persistence of omitted variables is probably the main source of bias in the dynamic framework. An example of an unobserved variable is the omitted variability in material standard of living, since we can only control for proxies (such as declared income and individual fixed-effects).

But the error-term autocorrelation may also be given by specific-habituation of an unobservable variable:

$$H_{i,t} = \gamma H_{i,t-1} + \lambda_1 X_{i,t} + \lambda_2 X_{i,t-1} + \beta_1 S_{i,t} + \beta_2 S_{i,t-1} + \alpha_i + \varepsilon_{i,t} \quad (10)$$

Where $S_{i,t}$ is not persistent in this case. Nevertheless, this type of bias is not that problematic at all: we would be confusing general habituation with specific habituation, but in the end we would be capturing genuine habituation. In summary, we need to control for unobserved variability in happiness that may be persistent.

4.5. Individual-Specific Time Trends

We imperfectly measure many aspects of life (e.g. marital status is a coarse proxy for love and relationships) and we completely omit some (e.g. intellectual achievements). Since we cannot use more time-varying controls than those available in the data, we explore a semi-parametric strategy.

The most reasonable step would be to include individual-specific time trends, since omitting them could generate substantial persistence in the error term. In order to see this clearly, consider a time series model without the autoregressive component, but with a linear trend:

$$H_t = \rho \cdot t + \xi_t \quad (11)$$

Where ξ_t is i.i.d. with mean zero and variance σ_ξ. Imagine that instead, we are estimating a dynamic model without a linear trend:

$$H_t = \gamma \cdot H_{t-1} + \varepsilon_t \quad (12)$$

OLS would yield:

$$plim\ \hat{\gamma} = 0 + \frac{Cov(H_{t-1}, \rho \cdot t + \xi_t)}{Var(H_{t-1})} = \frac{Cov(\rho \cdot t - \rho + \xi_{t-1}, \rho \cdot t + \xi_t)}{Var(H_{t-1})} \neq 0 \quad (13)$$

That is to say, if we did not account for time trends we would be estimating a "false" coefficient for the lagged dependent variable. Consider a model with both individual-specific linear time trend and individual-specific intercept:

$$H_{i,t} = \gamma H_{i,t-1} + \alpha_{1i} + \alpha_{2i} t + \varepsilon_{i,t} \quad (14)$$

Taking first differences does not solve the problem:

$$H_{i,t} - H_{i,t-1} = \gamma(H_{i,t-1} - H_{i,t-2}) + \alpha_{2i} + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (15)$$

If we denote $R_{i,t} = H_{i,t} - H_{i,t-1}$, it is clear that the equation above is a dynamic model with fixed effects, subject to the usual small-*T* bias. If we omitted α_{2i} as included regressor it would be part of the error term, and since α_{2i} is correlated to $H_{i,t-2}$ by construction, the latter would no longer be a valid instrument (also, notice that the bias would be positive).

To estimate the model with individual-specific trends, take differences once again:

$$(H_{i,t} - 2H_{i,t-1} + H_{i,t-2}) = \gamma(H_{i,t-1} - 2H_{i,t-2} + H_{i,t-3}) + (\varepsilon_{i,t} - 2\varepsilon_{i,t-1} + \varepsilon_{i,t-2}) \quad (16)$$

Now we can use $H_{i,t-3}$ as instrumental variable. Results are reported in column (7) of Table 1. Past happiness is still positive and statistically different from zero at the 1% level, but the coefficient is now about half of the coefficients obtained in the previous specifications. If we repeat the exercise using two lags of happiness, the second lag of happiness is not statistically significant anymore. Notice that by construction we now have autocorrelation of first and second order in the (second) difference equation. As needed, we cannot reject the null of no third-order autocorrelation.

Fixed effects control for certain things depending on the time horizon. For example, when the panel is just two-years long many things remain approximately fixed: career choice, family composition, income aspirations, the criteria used to answer to the happiness question, etc. But when we increase the time horizon further, practically everything becomes time-varying. That is to say, using a longer time horizon comes at a cost, since it introduces biases in potentially all coefficients. Using individual-specific time trends addresses this problem, since we can control not only for the within-individual variation that is constant, but also for that variation that evolves approximately as a linear trend.

4.6. Moving-Average Error Term

There is a more direct way to solve the problem of having a persistent error term. In the simplest scenario the error term follows a MA(1) (moving average), so the difference of the error term is MA(2). The convenient property of the MA(1) process is that the second- and higher-order autocorrelations are zero. As a consequence, if $\varepsilon_{i,t}$ is MA(1) in equation (5) then, even though H_{t-2} is no longer valid as an instrumental variable, H_{t-3} and longer lags remain valid.

This obviously comes at a price, since weak instrumental variables exacerbate the small-sample bias of the IV estimates. In column (9) of Table 1A we present the same regression presented in column (3) but using H_{t-3} as instrument instead. The coefficient for past happiness is 5 times larger than in previous specifications and statistically significant. This is not surprising since we suspect that the instrument is weak. Curiously, we cannot reject the null of presence of a weak instrument. As required, we cannot reject the null of no third-order autocorrelation.

On the contrary, if the error term in the model was AR(1), $\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \nu_{i,t}$, we would not be able to apply the same strategy, since $\varepsilon_{i,t}$ would be correlated to all of its past values. Nevertheless, we can still learn something. Consider the first difference:

$$(H_{it} - H_{i,t-1}) = \gamma(H_{i,t-1} - H_{i,t-2}) + (\rho\varepsilon_{i,t-1} - \rho\varepsilon_{i,t-2} + \nu_{it} - \nu_{i,t-1}) \quad (17)$$

If we use H_{t-2} as an instrument, the asymptotic bias would be:

$$plim\ \hat{\gamma} - \gamma = \frac{Cov(\varepsilon_{it} - \varepsilon_{i,t-1}, H_{i,t-2})}{Cov(H_{i,t-2}, H_{i,t-1} - H_{i,t-2})} \quad (18)$$

Under the habituation theory the denominator is negative. The sign of the numerator depends on the sign of the autocorrelation of the error term. If the error term is positively autocorrelated ($\rho > 0$), we could get $\hat{\gamma} > 0$ even if γ was negative.

We already pointed out that one source of error autocorrelation is specific-habituation in unobservables. However, such a thing would generate a negative bias instead of a positive one. A positive bias could be generated by unobserved determinants of happiness (without specific-habituation) that are positively correlated over time.

This is most likely explained by anticipatory feelings (e.g. Caplin et al., 2001). Basically, people act "as if" they maximize discounted lifetime utility. But some of the desire to delay consumption may be due to the fact that people actually derive present utility from thinking about future consumption.

Assume $A_{i,t}$ is some unobserved shock to happiness subject to one-period anticipatory feelings: $F(A_{i,t+1})$, where $F'(\cdot) > 0$ and $\operatorname{sgn} F(c) = \operatorname{sgn} c$ (i.e. if you anticipate something that will make you happier tomorrow, it must make you happier today). Then happiness would be:

$$H_{i,t} = \lambda X_{i,t} + \alpha_i + A_{i,t} + F(A_{i,t+1}) + \xi_{i,t} \quad (19)$$

Where $\varepsilon_{i,t} = A_{i,t} + F(A_{i,t+1}) + \xi_{i,t}$ is the error term. Even if $\xi_{i,t}$ and $A_{i,t}$ were i.i.d. and independent from each other, the error autocorrelation would not be zero:

$$Cov(\varepsilon_{i,t-1}, \varepsilon_{i,t}) = Cov(F(A_{i,t}), A_{i,t}) > 0 \quad (20)$$

That is, anticipatory feelings may help explain the puzzle. We can learn about the plausibility of this hypothesis by checking whether there is evidence of anticipatory feelings for the observable determinants of happiness. We ran many variants of the dynamic and static models adding the leads of all of the individual controls (e.g. marital status, income). Indeed, some of the coefficients on leads are statistically significative and have the same sign of the level-coefficients. Similar findings are reported in Clark et al. (2008), which favor anticipatory feelings at least as a partial explanation of the puzzle.

4.7. Robustness

The non-response rate for the life satisfaction question is quite low for the GSOEP and BHPS (8,9% and 0% respectively), and quite high for the SHP (24,4%). We estimated the probability of non-response for this question using first wave characteristics and did not find important predictors of non-response (they explained only 2% of the variation). Attrition is also an important issue in household panels, especially for the GSOEP given its length. By the last wave we only count with around half the households from the first wave. But there are many covariates (e.g. income, civil status) each with few missing values but that combined (take into consideration that the model includes lags for all the variables involved) make the mean number of observations per household drop significantly. For instance, in the GSOEP each individual contributes on average 9 observations (out of 22 waves).

From both theoretical results and Monte-Carlo applications we know that the small-T bias is more exacerbated the lower is T. We can run the regression for a subset of individuals that contributes (say) more than 15 observations each. This is valid as long as the censoring process is completely random, so there is a trade-off between selection-bias and small-T bias. We tried this with all of the regressions and the results are almost the same.

A second concern is that happiness scores may be too influenced by recent events. For instance, in Schwarz (1987) half of the people using a photocopier found a dime that had been randomly planted in the coin return. After copying, the individuals rated how happy they were with their entire lives on a 7-point scale: the individuals who found a dime scored 6.5 compared to 5.6 of the other group. Even though these "extremely recent" events are probably completely random, they generate a considerable attenuation bias in the autoregressive coefficient. Far from explaining it, this accentuates the puzzle.[16]

4.8. Summary

Contrary to the widespread prior among economists and non-economists, we found positive and significant coefficients on lagged happiness. In other words, happiness appears

[16] Also, the measurement error probably makes the specific-habituation variables capture part of the general-habituation effects.

to display inertia instead of habituation. The results are strongly robust among databases and identification strategies. This puzzle is probably driven by persistence of unobservable variables, like the case of anticipatory feelings. However, there is an alternative explanation: self-report scores may be simply inconsistent over time. We explore this argument in the next Section, and we test it in the subsequent Section.

5. The "scale treadmill"

It is true that some objective measures of hedonic states do correlate with self-reports, like smiling frequency (Ekman et al., 1990), peer reports, memory measures, and clinical ratings (Pavot et al., 1991), among many others. Some papers use alternative dependent variables: for instance, Luttmer (2004) uses measures of well-being like the incidence of depression and poor sleep and finds similar results as those obtained using standard happiness data.[17]

But even if happiness scores were consistent at a single point in time, it is possible that the happiness scale shifts over time. If that were the case, the results on hedonic adaptation would be invalidated to a large extent (Stevens, 1958). There have been occasional attempts to avoid the problems created by "scale-norming" in affective habituation studies. For instance, in a study of chronic dialysis patients Baron et al. (2003) found that making the scales more precise only reinforces the estimates of adaptation. And Kahneman et al. (2006) argue that other measures of current happiness (e.g. from the day reconstruction method) show even stronger hedonic adaptation than happiness scores (for more details see Frederick et al., 1999).

Even though people say that they frequently think about their happiness, the answer to the question "how happy are you?" is probably based to a large extent on heuristics. What we think of happiness is probably a synthesis of lots of biological processes taking place in the brain. After all, scientists are far from reaching an agreement on what happiness actually is (see Diener et al., 1991). Then it should not be that surprising that people interpret happiness scores in different ways. Similarly, since scientists change their interpretation of happiness over time, it is not that obvious that people have stable interpretation of the happiness scores from one decade to the following.

[17] We must be careful when interpreting results from reported happiness (see for example Wilkinson, 2007). For an analysis of more general problems with subjective survey data see Bertrand et al. (2001) and Schwarz (1999).

Even if individuals could indeed perceive their true happiness in a similar fashion and consistently over time, they possibly would not know how to measure such a thing. If we want someone to report height, we can simply give her a bar and she could go and measure different heights using that bar as a unit-measure.[18] But there is no way for us to show you a "*util*".

Happiness scores always involve a scale: e.g. from 1 to 10, where 1 is "very unhappy" and 10 is "very happy". We are implicitly letting each individual choose their own unit-measure. Some people may answer how happy they are compared to last year, other people answer how happy they are compared to how happy they could be if they had done things differently, and yet other people could answer how happy they are compared to their neighbors.

Indeed, Hagerty et al. (2003) argue that participants in self-reported happiness surveys do not all use the same internal standard for reporting their life satisfaction. He claims that life satisfaction judgments are highly labile and perspective dependent, and the way we answer a question about how satisfied we are with life as a whole will depend on the particular criteria that happens to be active at the time. The criteria may change so much during 10 or 20 years that any dynamic happiness regression would be simply invalid.

Different people choosing different measures is not a major problem, as long as they remain constant over time, since fixed effects will account for such differences. Indeed, maybe the greatest role of fixed effects in happiness regressions is to account for that. The good thing about happiness questions like "How are things compared to your parents?" is that the scale, even though differs notably between individuals, may be more consistent within individuals over time.

Happiness scores are not good or bad, but they are reasonably good for some applications and less good for other. For instance, running a regression using cross-section data seems much less reliable than using panel data with fixed effects. Intuitively, what Rose understands by "rather unhappy" can be very different from what Maria does, and then it would be misleading to compare their responses directly. But there is no such thing as a free lunch: once we use panel data, we need to assume that what Maria understands as "rather

[18] The idea of absolutes has always been in the minds of physicists. Our unit-measure for distance, for example, is indeed relative: one foot is the distance that a photon travels in one nanosecond.

unhappy" today is the same than she understood as "rather unhappy" 1, 5 and 20 years ago. As we look at longer panels the fixed effects control for less things, among them the criteria used to assess happiness.

The difference between what Maria understands as "happy" in the present and 20 years ago can be on average as large as the difference between what both Maria and Rose understand as "happy" today. That is to say, the very same principle that casts doubts on the internal validity when using cross-section regressions also casts doubts on the internal validity for long panels. In our dynamic happiness regressions we did control partially for this possibility: the model with individual-specific time trends let us control for a happiness scale that changes approximately linearly over time.

Assume that people use the same criteria for assessing happiness, and the only thing that may change over time is the scale associated to that criterion. For instance, a given individual always answers how happy he is compared to his neighbors, but the happiness of his neighbors may be changing over time.

Denote reported happiness $H_{i,t}^{r}$ and true happiness $H_{i,t}$. Define $Hj_{i,t}$ as the true happiness individual i should feel to answer $H_{i,t}^{r} = j$ in period t. Reported happiness would simply assign $H_{i,t}^{r}$ based on the cutoff values $H1_{i,t}$ to $HJ_{i,t}$. For example: $H_{i,t}^{r} = \Pi\left\{(H10_{i,t} - H_{i,t})/(H10_{i,t} - H1_{i,t})\right\}$, where the function $\Pi\{\}$ returns the integer closest to the argument. In the simplest case there are only two reference points, high happiness ($H10_{i,t}$) and low happiness ($H1_{i,t}$), and reported happiness is a measure of the relative position between those points. A larger $H1_{i,t}$ or $H10_{i,t}$ would imply a more "demanding" scale.

The missing piece of the puzzle is the way in which people update the reference points. Let's analyze first the criterion by which people compare their own feelings of happiness to those of their neighbors.[19] Let $G(i,t)$ denote the set of individuals in the reference group of individual i at period t. Then the reference point may be the happiness of the most unhappy and happy individuals in the reference group:

[19] Individuals do not necessarily have to "infer" how happy the rest of the people are, since there is evidence that people can directly measure other people's happiness, for example, through the Duchenne Smile (Ekman et al., 1990).

$$H1_{i,t} = \min\{H_{j,t}\}_{j\in G(i,t)} \quad \text{and} \quad H10_{i,t} = \max\{H_{j,t}\}_{j\in G(i,t)}$$

We can test this theory. Ask individual A and B (from different reference groups) how happy they are in a 1 to 10 scale. Then ask individual A (B) whether individual B (A) is happier than him. If the hypothesis is true, individual A and B may both report the same happiness score (e.g. 8), even though individual A declares to be happier than individual B and individual B declares to be less happy than individual A.

Indeed, Schkade et al. (1998) already performed this test. They found that students in California and in the Midwest rated exactly equal in overall life satisfaction even though they revealed a widespread expectation, shared by residents of both regions, that Californians are happier than Midwesterners.

This criterion for assessing happiness has profound consequences for the literature: intertemporal comparisons of reported happiness would be misleading. In a celebrated paper Easterlin (1974) noticed that happiness responses are flat since World War II in the United States, despite of considerable increases in average income and material standard of living. If $H1_{i,t}$ and $H10_{i,t}$ have been increasing at the same rate, increasing actual happiness would be perfectly consistent with stagnated reported happiness. [20]

Another possible criterion is using information on "hypothetical happiness." For instance, people could answer how happy they are compared to how happy they could be in some "reference situations." The $H10_{i,t}$ could be the hypothetical happiness of (ceteris paribus) winning the lottery and $H1_{i,t}$ could be the hypothetical happiness of (ceteris paribus) suffering a heart attack. The hypothetical situations (and their corresponding weights) change substantially over time, generating reported happiness that is (again) highly inconsistent over time.

More generally, suppose that the individual has a prior about the distribution of hedonic states in every state of nature next year (conditional on her following the optimal policy function). Denote $H(j)^{p}_{i,t}$ to the *j*-th decile of that distribution of potential hedonic

[20] If we want to take Easterlin's Paradox at face value, we should be able to show that what someone meant by "happy" just after the WWII reflects from an objective point of view the same things that people mean by happy today. On the contrary, when people are asked to report how well they are doing relative to their own and their parents' past, self-reported happiness levels rose dramatically (Hagerty, 2003). Reported happiness may be constant, but that does not necessarily mean that actual happiness has not been changing.

states. The individual could answer $H^r_{i,t} = j$ if actual happiness is to the left of the *j*-th decile of potential happiness: $H(j-1)^p_{i,t} < H(j-1)_{i,t} \leq H(j)^p_{i,t}$. For instance, our individual does not expect to get a promotion, and then his definition of "very happy" is "getting a promotion." If that same individual learns that it is more probable that he will get a promotion, then the scale will adjust accordingly and by the time he actually gets the promotion then "getting a promotion" will be the definition of just "happy."

Notice that the individual in the example is actually happier with the promotion than without the promotion. The problem has to do with people failing to reflect changes in actual happiness on changes in reported happiness. For instance, Gilbert et al. (1998) asked voters in the state of Texas how they would feel after the election if their favorite candidate lost. Respondents claimed they would be unhappy in that scenario, but when asked a month later, they reported to be just as happy whether their favorite candidate won or not.

The reference points may also be based on historical information on own happiness, such as the worst and best situations ever experienced[21]:

$$H1_{i,t} = \min\{H_{i,r}\}_{r \leq t} \quad \text{and} \quad H10_{i,t} = \max\{H_{i,r}\}_{r \leq t}$$

Notice that mean reversion in reported happiness is generated solely by the updating of the scales (i.e. "scale treadmill") and not due to actual hedonic adaptation. A great deal of the empirical challenge is to identify how much of the observed treadmill patterns in reported happiness are due to treadmill effects in actual happiness. Consider a very simple scale: $H^r_i(t) = H_i(t) - H1_i(t) - H10_i(t)$. Then:

$$\frac{dH^r_i(t)}{dt} = \underbrace{\left[1 - \frac{\partial H1_i}{\partial H_i}(t) - \frac{\partial H10_i}{\partial H_i}(t)\right]}_{\Lambda_i(t)} \frac{dH_i(t)}{dt}$$

If $\Lambda_i(t)$ was positive but close to zero, an increase in current happiness would not be reflected in reported happiness. That is to say, the "scale treadmill" is so strong that reported happiness may bounce back even when actual happiness is not (notice that this principle applies both to general-habituation and specific-habituation).

[21] We must then acknowledge people's limitations with affective memory: for instance, individuals usually under-estimate negative past experiences (Wilson et al., 2003).

In our paper we found a positive autoregressive coefficient on reported happiness. The question is whether that may be consistent with a negative autoregressive coefficient on actual happiness. That would be possible as long as $\Lambda_i(t)$ was negative. That is, if an increase in actual happiness increases more than one-to-one the implicit scale of reported happiness.

This hypothesis is plausible in light of the recent test by Smith et al. (2006). They elicited current levels of happiness from people with colostomies and those whose colostomies had been reversed. Both groups reported identical happiness. However, they also asked each group how happy they had been in the past. Those with colostomies recalled being significantly happier than they currently were. On the other hand, those with reversed colostomies recalled being significantly less happy. Also, neither group believed that people with colostomies were about as happy as people whose colostomies had been reversed. For more details see Loewenstein et al. (2008), where they discuss similar results for dialysis patients and happiness across age groups.

In Table 3 we present the autoregressive coefficient for other hedonic states: satisfaction with health, household income, work and spare time (i.e. equivalent variables for the three databases). We use our favorite specification, given by column (7) from Table 1A. Even though all hedonic states are expected to be adaptive, we always find positive autoregressive coefficients.[22] One possibility is that the positive coefficients are an artifact of ever-changing self-reported scales, or maybe one year is too long of a period to identify adaptation. In the following Section we will address both possibilities by using daily data.

6. Daily happiness

Even though the criteria to assess self-reported happiness may not be consistent through 20 years, it should be very consistent during 52 days. This fact will allow us to test whether the temporal inconsistency of happiness scores can be the explanation for the puzzle.

Notwithstanding, there are further advantages from using daily as opposed to yearly data. From an econometric point of view more frequent data means very good news, since it

[22] Perez Truglia (2009) shows that each reward system should have its own (relatively independent) adaptation process.

eliminates the bias related to small-T in dynamic panels. In addition, happiness dynamics may be much stronger in shorter periods. Habituation to income takes years (e.g. Di Tella et al., 2007), and burn victims reported similar levels of satisfaction to the control group one year after the accident (Patterson et al., 1993). Since the fundamentals of daily happiness may be much more volatile, we should expect them to adapt more rapidly.

We will use the database from the first study in Oishi et al. (2001).[23] The participants were 79 male and 73 female undergraduate students at the University of Illinois. They were instructed to complete the daily report in the evening before they went to bed, and turn in each report the following day. For more details see Oishi et al. (2001).

For the dependent variables, participants responded to statements on a ten-point scale about multiple feelings, such as contempt, happiness, anger, sadness, etc. Because of obvious space limitations, we report only the results for some selected variables, including a composite score on positive feelings (the sum of contempt, happiness, joy and pride). The results are similar for the scores that are not reported.

Since they are practically constant on a daily basis, the covariates that we have been using so far (e.g. income, civil status) cannot be used anymore. On a daily basis we expect hedonic states to be influenced mainly by sex, food, social interactions, etc. Indeed, the study measures those fundamentals. Firstly, daily pleasure is measured by asking the respondent "how frequently did you experience physical pleasure such as sex and food today?" each day on a seven-point scale, ranging from 1 (never) to 7 (always) with a midpoint value of 4 (about half of the time). Secondly, social life satisfaction is measured by asking participants to indicate how satisfied they are with their social lives that day on a ten-point scale, where 1 is "not at all" and 10 is "extremely". Table A2 provides some descriptive statistics.

The model is the same we have been working on:

$$H_{i,t}^{j} = \sum_{q=1}^{Q} \gamma_q H_{i,t-q}^{j} + \sum_{r=0}^{R} \beta_r X_{i,t-r} + \alpha_i + \psi_t + \varepsilon_{i,t}$$

Where $H_{i,t}^{j}$ is the *j-th* measure of well being, and Q is the number of lags of the dependent variable included as explanatory variable. The $X_{i,t}$ includes the variables on

[23] We thank Shigehiro Oishi and his coauthors Ulrich Schimmack and Ed Diener for making the database available to us.

pleasure and social satisfaction, and R is the number of lags included. The time effects are denoted ψ_t, and α_i are the individual fixed effects. In the regressions we use Q=R=5, but the results are bout the same for greater values (because of space constraints, we do not report all of the lags).

The estimates for γ_q are positive (and decreasing in q), as shown in column (1) of Table 4. Because of the same argument we presented for the yearly data, the estimates become negative once we control for individual-specific linear trends plus individual-specific week effects, as shown in column (2).

The coefficients on lagged sex, food and social activity are positive for an obvious reason: those stimuli have delayed rewards. In fact, according to our estimates there is no specific adaptation and all the adaptation takes place through the general-adaptation channel.[24] Moreover, the general-adaptation channel is quantitatively sizable: 30% of any change in happiness is reverted in the subsequent 5 days.[25]

In the yearly data we found a positive autoregressive coefficient and we wondered whether it could be the result of a positively-correlated error term. Now we have to wonder whether the negative coefficients may be the product of a negatively-correlated error term. If the error term is MA(1), then we could still use $H^j_{i,t-s-1}$ as instrumental variable for $H^j_{i,t-s}$. Unfortunately, all the IV regressions that we tried suffer serious problems of weak instruments and under-identification. Having data on more individuals would have helped a lot.

6.1. Elation Theory

Perez Truglia (2009) shows that, from an evolutionary point of view, some rewards and punishments must be expectation-based. Even though this perspective is not common among economists, it is widespread in fields such as psychology and neuroscience. For instance, physiological work identified dopaminergic neurons in primates whose fluctuating output signals changes or errors in the predictions of future salient and rewarding events (e.g. Schultz et al., 1997). Intuitively, bursts of impulse activity mean that the reward is more

[24] Rigorously, we can only say that the delayed rewards more than cancel out the specific habituation (if any).

[25] Many economists estimate that the effect of income on happiness is very small. Since most individual panels are yearly, it can be simply the result that adaptation to income and consumption is taking place in a matter of months.

than expected, a pause means that the reward is less than expected and no change means reward is just as expected.

Kimball et al. (2006) offer a great terminology to address this. They define elation as the component of happiness due to recent news (i.e. deviations with respect to expectations). If expectations are rational, news is unpredictable and furthermore it does not stand as news for very long: the initial burst of elation dissipates once the full import of news is emotionally and cognitively processed.

We cannot observe either "expectations" or "deviations from expectations." Notwithstanding, yesterday's happiness may work as a great proxy: high happiness would indicate good news (elation), while low happiness would indicate bad news (dismay). A negative γ_q would then simply indicate that part of happiness is due to elation. The greater γ_q, the greater the share due to elation. And we can even learn how long it takes to cognitively and emotionally process news on average: according to our estimates, around five days.

6.2. Summary

Contrary to the yearly database, the autoregressive coefficients in the daily regressions are negative and statistically significant. This supports our theory that self-reported scores may not be time-consistent in yearly data. However, it is also possible that the error term is just less positively autocorrelated in daily than in yearly data. Or happiness may take much less than a year to habituate.

Life satisfaction is a complex subject, and we need to combine perspectives from economics, psychology, philosophy, and so on. On the contrary, daily hedonic states are more about friends, enemies, sex, food, accidents, finding a dime, and other things that are easier to understand and measure. With daily panels we can (feasibly) randomize treatments, avoid attrition, get objective measures of the hedonic states, and more. Even though life satisfaction is closer to the notion of welfare implied by economists, we can use daily data as an intermediate step to advance our research agenda.[26]

[26] For instance, we may be interested in studying asymmetric adaptation or leads in happiness. But such a thing would be very complicated in yearly data, because we have to deal with the problem of small-T bias. A further advantage of using daily data is that the "savings" in econometric complexity can be invested in exploring models that are richer from an economic point of view.

7. Conclusions

We argued that happiness regressions may be dynamic. The first inquiry is whether using dynamic instead of static regressions modifies the estimates on the (static and dynamic) coefficients of the most common variables in the happiness literature. As shown in Table 2, the coefficients are roughly the same, specially taking into consideration the great loss of efficiency and sample size associated with running the autoregressive regressions.

Contrary to the prior among economists and non-economists, using yearly panels we found that the coefficient on lagged happiness is positive and statistically significant. The results are strongly robust between databases, despite of two of the panels being very short. One possible explanation of the puzzle is the presence of unobservable determinants of happiness that are positively correlated through time: e.g. anticipatory feelings.

However, there is a deeper explanation: self-report scores may not be consistent through time, not even within individuals. Even though we cannot test this hypothesis directly, we do know that subjective scores must be much more consistent through 52 days than through 20 years. As a matter of fact, when we estimate the model using a daily panel, the coefficients on lagged happiness are negative and statistically significant. The results are strongly robust between different subjective scores.

Happiness regressions are still far from being taken at face value, especially in more complex models like that of hedonic adaptation. We need novel empirical strategies to solve some of the empirical challenges we have been discussing. For instance, we need data with different frequencies to learn differences in the timing of hedonic adaptation. And we need sources of exogenous variability in happiness, either from randomization (e.g. Cruces et al., 2009), from Natural Experiments (e.g. Becchetti et al., 2007), or from controlled lab experiments (e.g. Charness et al., 2001; McBride, 2007).

If we want to use yearly data, we need to learn how to distinguish between the effects of reported happiness and actual happiness. We should at least use alternative happiness scores to test whether the treadmill effects are in fact an artifact.

There is an aura of nihilism surrounding the hedonic adaptation theory. On the contrary, nearly all people believe (or would like to believe) that they can move in an "upward spiral" toward ever greater happiness (Sheldon et al., 2001). All in all, if happiness autocorrelation were indeed positive, that would mean that at least some people found the way to put the hedonic treadmill in reverse.

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Table 1A

Autoregressive Happiness Estimates - GSOEP

	(1) Within	(2) Within	(3) HS	(4) AB	(5) HS	(6) AB	(7) HS	(8) AB	(9) HS	(10) AB
Happiness t-1		0.13	0.098	0.108	0.14	0.141	0.046	0.037	0.538	0.339
		[0.005]***	[0.007]***	[0.006]***	[0.008]***	[0.008]***	[0.012]***	[0.011]***	[0.077]***	[0.042]***
Happiness t-2					0.041	0.044				
					[0.006]***	[0.006]***				
Log Household Income t	0.13	0.121	0.066	0.067	0.062	0.063	0.033	0.034	0.036	0.052
	[0.017]***	[0.016]***	[0.019]***	[0.019]***	[0.019]***	[0.019]***	[0.028]	[0.028]	[0.024]	[0.018]***
Log Household Income t-1	0.04	0.02	0.003	0.001	-0.006	-0.006	-0.018	-0.016	-0.042	-0.021
	[0.014]***	[0.014]	[0.017]	[0.017]	[0.018]	[0.017]	[0.028]	[0.027]	[0.022]*	[0.017]
Log Household Income t-2	0.025	0.026	0.02	0.021	0.011	0.012	0.013	0.014	0.013	0.019
	[0.013]*	[0.013]**	[0.016]	[0.016]	[0.017]	[0.017]	[0.026]	[0.025]	[0.021]	[0.017]
Observations	118137	117473	98550	98550	97992	97992	82668	82668	97992	98550
Number of Individuals	13258	13221	11922	11922	11876	11876	10693	10693	11876	11922
Order 1 Autocorrelation Test (P-Value	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Order 2 "	-	-	<0.001	<0.001	0.927	0.3747	<0.001	<0.001	<0.001	<0.001
Order 3 "	-	-	0.6219	0.594	0.0104	0.0017	0.6789	0.7985	0.6732	0.7818
Sargan (P-Value)	-	-	-	<0.001	-	<0.001	-	0.1507	-	0.0013
Weak Instruments (P-Value)	-	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-

Notes: All columns include 2 lags of control variables, time and individual fixed effects. Time-varying controls include household composition, marital status, employment status, health proxies. Columns 1 and 2 are estimated using the within transformation. All odd numbered columns after are estimated using Anderson-Hsiao (HS); all even numbered columns are estimated using Arellano-Bond (AB). Columns 7 and 8 present estimates for individual specific time trend model transformation. Columns 9 and 10 suppose persistent error term following a MA(1), a farther lag is used as instrument in this case. All standard errors are clustered at the individual level. 1% ***; 5% **; 10%

Table 1B

Autoregressive Happiness Estimates - SHP

	(1) Within	(2) Within	(3) HS	(4) AB	(5) HS	(6) AB	(7) HS	(8) AB	(9) HS	(10) AB
Happiness t-1		-0.123	0.111	0.106	0.146	0.107	0.071	0.056	0.623	0.232
		[0.012]***	[0.024]***	[0.024]***	[0.040]***	[0.040]***	[0.049]	[0.047]	[0.348]*	[0.272]
Happiness t-2					0.045	0.029				
					[0.023]*	[0.023]				
Log Household Income t	0.089	0.09	0.06	0.061	0.102	0.102	0.153	0.153	0.099	0.057
	[0.049]*	[0.050]*	[0.050]	[0.049]	[0.056]*	[0.056]*	[0.073]**	[0.072]**	[0.072]	[0.053]
Log Household Income t-1	0.024	0.034	0.025	0.026	-0.013	-0.011	0.096	0.096	-0.021	0.026
	[0.032]	[0.036]	[0.052]	[0.051]	[0.056]	[0.055]	[0.064]	[0.063]	[0.073]	[0.057]
Observations	21454	17620	12214	12214	9136	9136	8098	8098	9136	12214
Number of Individuals	5232	4841	4014	4014	3443	3443	3090	3090	3443	4014
Order 1 Autocorrelation Test (P-Valu	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001
Order 2 "	-	-	0.4378	0.3456	0.7949	0.3456	<0.001	<0.001	0.1966	0.51
Order 3 "	-	-	0.3727	0.3114	0.6642	0.3114	0.8527	0.7847	0.8284	0.3062
Sargan (P-Value)	-	-	-	0.143	-	0.143	-	0.2861	-	0.0921
Weak Instruments (P-Value)	-	-	<0.001	-	<0.001	-	0.132	-	0.0154	-

Notes: All columns include 1 lag of control variables, time and individual fixed effects. Time-varying controls include household composition, marital status, employment status, health proxies. Columns 1 and 2 are estimated using the within transformation. All odd numbered columns after are estimated using Anderson-Hsiao (HS); all even numbered columns are estimated using Arellano-Bond (AB). Columns 7 and 8 present estimates for individual specific time trend model transformation. Columns 9 and 10 suppose persistent error term following a MA(1), a farther lag is used as instrument in this case. All standard errors are clustered at the individual level. 1% ***; 5% **;

Table 1C

Autoregressive Happiness Estimates - BHPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Within	Within	HS	AB	HS	AB	HS	AB	HS	AB
Happiness t-1		-0.044	0.067	0.065	0.141	0.13	-0.016	-0.018	1.384	-0.266
		[0.006]***	[0.011]***	[0.011]***	[0.025]***	[0.024]***	[0.025]	[0.025]	[0.692]**	[0.171]
Happiness t-2					0.051	0.045				
					[0.015]***	[0.014]***				
Log Household Income t	0.033	0.035	0	0.001	0.014	0.015	-0.017	-0.017	-0.027	0.014
	[0.010]***	[0.010]***	[0.012]	[0.012]	[0.017]	[0.017]	[0.019]	[0.019]	[0.040]	[0.013]
Log Household Income t-1	-0.005	-0.004	-0.018	-0.018	0.005	0.006	-0.014	-0.014	-0.007	-0.009
	[0.009]	[0.009]	[0.012]	[0.012]	[0.017]	[0.016]	[0.020]	[0.020]	[0.034]	[0.012]
Observations	70956	70956	45077	45077	24739	24739	24562	24562	24739	45077
Number of Individuals	16265	16265	14884	14884	13681	13681	13581	13581	13681	14884
Sargan (P-Value)	-	-		<0.001		0.186		0.0114		0.0187
Weak Instruments (P-Value	-	-	<0.001		<0.001		0.5258		<0.001	

Notes: All columns include 1 lag of control variables, time and individual fixed effects. Autocorrelation tests are ommited since they could not be calculated thanks to the fact that there is a gap in the middle of the panel, reducing observations significantly when introducing lags. Time-varying controls include household composition, marital status, employment status, health proxies. Columns 1 and 2 are estimated using the within transformation. All odd numbered columns after are estimated using Anderson-Hsiao (HS); all even numbered columns are estimated using Arellano-Bond (AB). Columns 7 and 8 present estimates for individual specific time trend model transformation. Columns 9 and 10 suppose persistent error term following a MA(1), a farther lag is used as instrument in this case. All standard errors are clustered at the individual level. 1% ***; 5% **; 10% *.

Table 2
Specific-Habituation Estimates

	GSOEP		SHP		BHPS	
	(1)	(2)	(1)	(2)	(1)	(2)
	Within	HS	Within	HS	Within	HS
Happiness t-1		0.046		0.071		-0.016
		[0.012]***		[0.049]		[0.025]
Log Household Income t	0.13	0.033	0.089	0.153	0.033	-0.017
	[0.017]***	[0.028]	[0.049]*	[0.073]**	[0.010]***	[0.019]
Log Household Income t-1	0.04	-0.018	0.024	0.096	-0.005	-0.014
	[0.014]***	[0.028]	[0.032]	[0.064]	[0.009]	[0.020]
Log Household Income t-2	0.025	0.013				
	[0.013]*	[0.026]				
No. of Children in t	0.055	0.08	0.045	-0.05	0.07	0.026
	[0.050]	[0.081]	[0.033]	[0.084]	[0.016]***	[0.040]
No. of Children in t-1	-0.018	-0.188	-0.022	-0.155	-0.063	-0.053
	[0.048]	[0.073]**	[0.033]	[0.095]	[0.017]***	[0.042]
No. of Children in t-2	-0.003	-0.089				
	[0.048]	[0.074]				
Married in t	0.221	-0.075	0.323	-0.084	0.153	0.088
	[0.040]***	[0.078]	[0.080]***	[0.190]	[0.039]***	[0.092]
Married in t-1	-0.163	-0.294	-0.143	-0.115	-0.136	0.029
	[0.042]***	[0.067]***	[0.072]**	[0.163]	[0.038]***	[0.091]
Married in t-2	-0.147	-0.139				
	[0.038]***	[0.074]*				
Widowed in t	-0.597	-0.407	-0.74	-0.758	-0.333	-0.15
	[0.094]***	[0.185]**	[0.391]*	[0.652]	[0.094]***	[0.181]
Widowed in t-1	0.314	0.425	0.196	-1.154	0.133	0.11
	[0.101]***	[0.160]***	[0.399]	[0.984]	[0.088]	[0.202]
Widowed in t-2	0.292	0.183				
	[0.088]***	[0.185]				
Not Employed in t	-0.348	-0.411	-0.458	-0.399	-0.265	-0.288
	[0.027]***	[0.047]***	[0.104]***	[0.239]*	[0.037]***	[0.068]***
Not Employed in t-1	0.103	0.08	-0.139	0.019	0.063	-0.006
	[0.027]***	[0.049]	[0.094]	[0.231]	[0.033]*	[0.062]
Not Employed in t-2	0.057	-0.013				
	[0.027]**	[0.046]				
Observations	118137	82668	21454	6939	70956	24562
Number of Individuals	13258	10693	5232	2662	16265	13581

Notes: Columns for GSOEP include 2 lags of control variables (1 lag for other panels), time and individual fixed effects. Time-varying controls include household composition, marital status, employment status, health proxies. Column 1 presents select control variables used in the first column of Tables 1. Columns 2 presents estimates for the individual-specefic time trends specification in columns 7 of Tables 1. Columns 1 are estimated using within transformation, columns 2 are estimated using Anderson-Hsiao (HS). All standard errors are clustered at the individual level. 1% ***; 5% **; 10% *.

Table 3
Other Subjective Outcomes

	GSOEP		SHP		BHPS	
Satisfaction with:	(1)	(2)	(1)	(2)	(1)	(2)
Health	0.082	0.025	0.07	0.022	0.098	0.056
	[0.006]***	[0.012]**	[0.018]***	[0.034]	[0.010]***	[0.026]**
Observations	98823	82997	14734	10227	44726	24309
Household Income	0.104	0.032	0.11	0.014	0.132	0.082
	[0.006]***	[0.012]***	[0.017]***	[0.032]	[0.010]***	[0.028]***
Observations	96944	81105	16299	11458	44682	24279
Leisure Time	0.106	0.052	-	-	0.078	0.043
	[0.006]***	[0.012]***			[0.010]***	[0.030]
Observations	98138	82269			45077	24562
Work	0.101	0.047	-	-	0.088	0.081
	[0.009]***	[0.017]***			[0.013]***	[0.039]**
Observations	50793	40064			45077	24562

Notes: Each coefficient belongs to a separate regression. Estimates for GSOEP include 2 lags of control variables (1 lag otherwise), time and individual fixed effects. Time-varying controls include household composition, marital status, employment status, health proxies. Column 1 presents select estimates for Anderson-Hsiao (HS) identical to those presented in column 3 in Tables 1 (changing the dependent variables of course). Columns 2 present HS estimates for the individual specific time trend models presented in columns 7 in Tables 1. All standard errors are clustered at the individual level. 1% ***; 5% **; 10% *.

Table 4A

Autoregressive Happiness Estimates - 52-Day Study

Dependent Variable:	Contempt		Happiness		Positive Feelings	
	(1)	(2)	(1)	(2)	(1)	(2)
Dependent t-1	0.208***	-0.110***	0.209***	-0.084***	0.271***	-0.044**
	(0.015)	(0.019)	(0.017)	(0.022)	(0.016)	(0.018)
Dependent t-2	0.075***	-0.169***	0.075***	-0.141***	0.103***	-0.111***
	(0.014)	(0.019)	(0.014)	(0.018)	(0.014)	(0.018)
Dependent t-3	0.036**	-0.171***	0.022	-0.152***	0.041***	-0.139***
	(0.016)	(0.018)	(0.016)	(0.018)	(0.015)	(0.017)
Dependent t-4	0.052***	-0.125***	0.016	-0.150***	0.040***	-0.121***
	(0.014)	(0.017)	(0.012)	(0.017)	(0.015)	(0.017)
Dependent t-5	0.045***	-0.114***	0.035***	-0.122***	0.045***	-0.115***
	(0.012)	(0.016)	(0.011)	(0.016)	(0.012)	(0.017)
Social Satisfaction t	0.233***	0.223***	0.281***	0.275***	0.213***	0.205***
	(0.016)	(0.016)	(0.014)	(0.016)	(0.010)	(0.012)
Social Satisfaction t-1	0.006	0.072***	0.012	0.088***	-0.009	0.050***
	(0.011)	(0.014)	(0.011)	(0.015)	(0.008)	(0.009)
Social Satisfaction t-2	-0.003	0.063***	-0.027***	0.053***	-0.019***	0.036***
	(0.010)	(0.012)	(0.010)	(0.014)	(0.007)	(0.009)
Social Satisfaction t-3	0.004	0.064***	-0.017	0.043***	-0.014*	0.033***
	(0.012)	(0.014)	(0.011)	(0.014)	(0.007)	(0.009)
Social Satisfaction t-4	-0.008	0.046***	0.005	0.056***	-0.009	0.031***
	(0.010)	(0.013)	(0.008)	(0.010)	(0.006)	(0.007)
Social Satisfaction t-5	-0.021**	0.014	-0.020**	0.023**	-0.022***	0.011
	(0.010)	(0.011)	(0.009)	(0.011)	(0.007)	(0.008)
Pleasure t	0.131***	0.122***	0.163***	0.149***	0.129***	0.122***
	(0.019)	(0.019)	(0.018)	(0.020)	(0.013)	(0.014)
Pleasure t-1	-0.001	0.045***	-0.010	0.025	-0.0159*	0.022*
	(0.013)	(0.017)	(0.014)	(0.020)	(0.009)	(0.012)
Pleasure t-2	-0.011	0.030*	-0.020	0.009	-0.004	0.027**
	(0.013)	(0.018)	(0.014)	(0.018)	(0.008)	(0.011)
Pleasure t-3	-0.012	0.022	0.006	0.0320*	-0.013	0.018
	(0.014)	(0.019)	(0.014)	(0.018)	(0.009)	(0.012)
Pleasure t-4	-0.001	0.016	-0.005	0.024	-0.002	0.018*
	(0.013)	(0.014)	(0.013)	(0.017)	(0.009)	(0.010)
Pleasure t-5	-0.010	0.012	-0.0226*	0.014	-0.007	0.021*
	(0.014)	(0.018)	(0.013)	(0.017)	(0.008)	(0.011)
Individual-specific time trends and week-effects	-	Yes	-	Yes	-	Yes
Observations	7926	7926	7919	7919	7837	7837
Nr of Individuals	178	178	178	178	178	178
R-squared	0.21	0.47	0.26	0.48	0.37	0.57

Note: Individual fixed effects are included in all specifications. Columns (2) include individual-specific linear time trends and week-effects. All standard errors are clustered at the individual level. 1% ***; 5% **; 10% *.

Table 4B

Autoregressive Happiness Estimates - 52-Day Study

Dependent Variable:	Pride		Unhappiness		Sadness	
	(1)	(2)	(1)	(2)	(1)	(2)
Dependent t-1	0.231***	-0.068***	0.207***	-0.085***	0.172***	-0.120***
	(0.018)	(0.023)	(0.016)	(0.018)	(0.018)	(0.022)
Dependent t-2	0.128***	-0.084***	0.044***	-0.162***	0.070***	-0.138***
	(0.016)	(0.021)	(0.013)	(0.016)	(0.014)	(0.017)
Dependent t-3	0.045***	-0.132***	0.017	-0.165***	0.013	-0.157***
	(0.015)	(0.018)	(0.015)	(0.017)	(0.017)	(0.018)
Dependent t-4	0.043***	-0.114***	0.031**	-0.122***	0.001	-0.152***
	(0.015)	(0.019)	(0.014)	(0.015)	(0.014)	(0.017)
Dependent t-5	0.035**	-0.111***	0.009	-0.120***	0.021*	-0.112***
	(0.015)	(0.020)	(0.013)	(0.017)	(0.012)	(0.015)
Social Satisfaction t	0.142***	0.131***	-0.202***	-0.204***	-0.147***	-0.150***
	(0.013)	(0.015)	(0.012)	(0.014)	(0.011)	(0.013)
Social Satisfaction t-1	-0.013	0.025**	0.000	-0.062***	0.013	-0.037***
	(0.009)	(0.011)	(0.009)	(0.013)	(0.009)	(0.012)
Social Satisfaction t-2	-0.009	0.021*	0.009	-0.044***	-0.001	-0.041***
	(0.009)	(0.011)	(0.009)	(0.013)	(0.007)	(0.011)
Social Satisfaction t-3	-0.016	0.014	0.008	-0.041***	-0.004	-0.042***
	(0.010)	(0.011)	(0.009)	(0.011)	(0.007)	(0.011)
Social Satisfaction t-4	-0.006	0.016	0.009	-0.036***	0.011	-0.024**
	(0.008)	(0.012)	(0.009)	(0.011)	(0.009)	(0.012)
Social Satisfaction t-5	-0.018**	0.004	0.008	-0.026**	0.000	-0.025***
	(0.009)	(0.011)	(0.008)	(0.012)	(0.007)	(0.009)
Pleasure t	0.086***	0.086***	-0.065***	-0.055***	-0.037***	-0.034***
	(0.017)	(0.020)	(0.011)	(0.013)	(0.010)	(0.013)
Pleasure t-1	-0.001	0.022	0.018	0.004	0.014	-0.001
	(0.013)	(0.017)	(0.012)	(0.016)	(0.010)	(0.013)
Pleasure t-2	0.014	0.039**	0.000	-0.014	0.007	-0.006
	(0.012)	(0.016)	(0.011)	(0.014)	(0.010)	(0.015)
Pleasure t-3	-0.004	0.0268*	-0.014	-0.030**	-0.002	-0.014
	(0.011)	(0.016)	(0.010)	(0.015)	(0.009)	(0.012)
Pleasure t-4	0.013	0.036**	0.003	-0.011	-0.001	-0.006
	(0.013)	(0.017)	(0.012)	(0.015)	(0.008)	(0.011)
Pleasure t-5	-0.005	0.027	0.019*	0.001	0.011	0.005
	(0.012)	(0.018)	(0.010)	(0.012)	(0.010)	(0.012)
Individual-specific time trends and week-	-	Yes	-	Yes	-	Yes
Observations	7930	7930	7919	7919	7837	7837
Nr of Individuals	178	178	178	178	178	178
R-squared	0.18	0.43	0.26	0.48	0.37	0.57

Note: Individual fixed effects are included in all specifications. Columns (2) include individual-specific linear time trends and week-effects. All standard errors are clustered at the individual level. 1% ***; 5% **; 10% *.

Appendix 1: Data description

German Socio-Economic Panel Study (GSOEP)

The GSOEP is a longitudinal data set which is representative of the German population. It began randomly sampling households for the west states of the Federal Republic of Germany in 1984. The original sample size was around 6000 households yielding a sample of above 12,000 individuals. With the fall of the Berlin Wall in 1989, Germany was reunited and the sample was expanded to represent Germany as a whole. For more detailed information on the history of the GSOEP please refer to Wagner et al. (2007).

Due to the empirical nature of this work we use the original sample (West Germany only) covering the years 1984 to 2005 in order to maximize panel length.[1] This results in an average of 9 waves per respondent. Our dependant variable (happiness) is defined as the individual's overall life satisfaction. In the survey, this question is only responded by individuals age 16 and over. Our variable for household income is taken from the Cross-National Equivalent File (1984-2005) where it is defined as "Real Household Post-Government Income". This variable corresponds to total household income (i.e. labor income, pensions, etc.) after taxes and other transfers (combines payments of all household members). Data on CPI was taken from OECD.

British Household Panel Survey (BHPS)

The BHPS is a random representative sample of the population of the United Kingdom. It began in 1991 surveying some 5,500 households and additional household were incorporated in 1999 and 2001 yielding a sample of over 10,000 household containing over 24,000 individuals aged 15 onwards. Individuals who left their original household to form a new one were followed and all adults were consequentially interviewed. We make use of data from wave 6 to 15 due to the fact that questions on life satisfaction were introduced as of wave 6.

In wave 11 the question on life satisfaction was dropped from the survey because space constraints in Self Completion Schedule, and replaced by the Quality of Life module

[1] For instance, Di Tella et al. (2007) undertake the same strategy. Results are robust to including whole sample.

(introduced every 5 years). Data for wave 11 then has missing values for happiness. This yields a panel with a maximum length of 10 waves and a mean of 7 waves per respondent. Data on CPI was taken from the UK Office of National Statistics.

Swiss Household Panel (SHP)

Not widely used in Economics of Happiness literature, the SHP is a relatively new longitudinal data set which was started in 1999. It is surveyed annually covering more than 5000 representative households, with a sample size of over 13000 respondents. All individuals over the age of 14 in the household are surveyed. In comparison to the BHPS or GSOEP, the SHP collects data on a wider variety of topics which are of interest in social science. For more information on the SHP refer to Budowski et al. (2001).

We use data covering waves 1 through 8 (1999 to 2006) with a mean of 5 waves per respondent. Questions on life satisfaction were included as of the year 2000. Data on CPI was taken from OECD.

Table A1
Summary Statistics for the GSOEP

Variable		Mean	Std. Dev.	Min	Max	No. of Obs.
Happiness (0 - 10 Scale)		7.052	1.822	0	10	N=118137
	Between		1.428	0	10	n=13258
	Within		1.292	-1.632	14.353	T (avg)= 8.9
Household Income (In Euros)		31621.2	17961.5	0	405045.4	N=125665
	Between		15854.4	54.06642	278905.9	n=14015
	Within		10361.6	-170819.9	240819.4	T= 8.9
Household Size		2.966	1.422	1	17	N=125665
	Between		1.316	1	11	n=14015
	Within		0.712	-4.034	11.216	T= 8.9
Days in Hospital		1.892	9.292	0	365	N=125665
	Between		6.614	0	280	n=14015
	Within		8.151	-88.108	321.267	T= 8.9
Full-time Employment		0.463	0.499	0	1	N=125665
	Between		0.427	0	1	n=14015
	Within		0.285	-0.487	1.413	T= 8.9
Not Employed		0.381	0.486	0	1	N=125665
	Between		0.401	0	1	n=14015
	Within		0.308	-0.569	1.331	T= 8.9
Marital Status: Married		0.672	0.469	0	1	N=125665
	Between		0.448	0	1	n=14015
	Within		0.219	-0.278	1.622	T= 8.9
Marital Status: Single		0.185	0.389	0	1	N=125665
	Between		0.408	0	1	n=14015
	Within		0.159	-0.765	1.135	T= 8.9
Registered Disabled		0.116	0.320	0	1	N=125665
	Between		0.264	0	1	n=14015
	Within		0.168	-0.834	1.066	T= 8.9

Table A2
Summary Statistics for the SHP

Variable		Mean	Std. Dev.	Min	Max	No. of Obs.
Happiness (0 - 10 Scale)		8.018	1.390	0	10	N=21454
	Between		1.211	0	10	n=5232
	Within		0.828	0.418	13.418	T (avg)= 4.3
Household Income (In Euros)		103327.3	68221.8	0	2142253	N=22538
	Between		59889.9	4742.857	1280684	n=5314
	Within		35040.8	-1017967	1320615	T= 4.2
Household Size		2.904	1.408	1	10	N=22538
	Between		1.356	1	9	n=5314
	Within		0.401	-2.896	7.104	T (avg)= 4.2
No. of Doctor Consultations		3.447	7.819	0	365	N=22538
	Between		6.729	0	216	n=5314
	Within		5.504	-164.6	287.6	T (avg)= 4.2
Full-time Employment		0.735	0.441	0	1	N=22538
	Between		0.414	0	1	n=5314
	Within		0.192	-0.122	1.592	T (avg)= 4.2
Unemployed		0.012	0.110	0	1	N=22538
	Between		0.079	0	1	n=5314
	Within		0.087	-0.738	0.869	T (avg)= 4.2
Marital Status: Married		0.651	0.477	0	1	N=22538
	Between		0.471	0	1	n=5314
	Within		0.125	-0.206	1.508	T (avg)= 4.2
Marital Status: Divorced		0.076	0.266	0	1	N=22538
	Between		0.254	0	1	n=5314
	Within		0.073	-0.781	0.934	T (avg)= 4.2

Table A3
Summary Statistics for the BHPS

Variable		Mean	Std. Dev.	Min	Max	No. of Obs.
Happiness (0 - 7 Scale)		5.229	1.287	1	7	N=70956
	Between		1.084	1	7	n=16265
	Within		0.772	0.086	9.514	T (avg)= 4.4
Household Income (In GB Pounds)		28398.1	22833.5	0	1205210	N=70956
	Between		19010.5	0	347694.2	n=16265
	Within		13458.7	-305247.9	1012130	T (avg)= 4.4
Household Size		2.758	1.324	1	13	N=70956
	Between		1.278	1	12.66667	n=16265
	Within		0.489	-2.9	8.2	T (avg)= 4.4
Days in Hospital		0.905	5.785	0	280	N=70956
	Between		4.148	0	104.5	n=16265
	Within		4.524	-74.8	190.9	T (avg)= 4.4
Full-time Employment		0.527	0.499	0	1	N=70956
	Between		0.450	0	1	n=16265
	Within		0.234	-0.330	1.384	T (avg)= 4.4
Unemployed		0.027	0.163	0	1	N=70956
	Between		0.125	0	1	n=16265
	Within		0.121	-0.830	0.884	T (avg)= 4.4
Marital Status: Married		0.590	0.492	0	1	N=70956
	Between		0.473	0	1	n=16265
	Within		0.163	-0.267	1.447	T (avg)= 4.4
Marital Status: Divorced		0.086	0.280	0	1	N=70956
	Between		0.263	0	1	n=16265
	Within		0.104	-0.771	0.943	T (avg)= 4.4

Table A4

Summary Statistics for 52-Day Study

Variable		Mean	Std. Dev.	Min	Max	No. of Obs.
Happy (1 - 9 Scale)		4.194	1.476	1	9	N=9063
	Between		1.051	1.365	6.942	n=180
	Within		1.044	-0.518	9.194	T (avg)= 50.3
Social Satisfaction (1 - 10 Scale		6.535	1.570	1	10	N=9052
	Between		0.975	2.891	8.731	n=180
	Within		1.229	-0.330	11.977	T (avg)= 50.3
Daily Pleasure (1-7 Scales)		2.323	1.287	1	7	N=9067
	Between		0.902	1.038	6	n=180
	Within		0.975	-1.500	7.563	T (avg)= 50.3
Content (1 - 8 Scale)		3.955	1.598	1	8	N=9066
	Between		1.200	1.288	6.981	n=180
	Within		1.055	-1.929	9.205	T (avg)= 50.3
Sadness (1-8 Scale)		1.790	0.975	1	8	N=9058
	Between		0.613	1.038	4.462	n=180
	Within		0.774	-0.891	7.117	T (avg)= 50.3

Appendix 2: Data Definitions

British Household Panel Survey

Happiness / Satisfaction with Life: Individual response to question: "How satisfied or dissatisfied are you with your life overall?" [1 Not satisfied at all] - [7 Fully satisfied]

Satisfaction with Household Income: Individual response to question: " How satisfied or dissatisfied are you with the income of your household?" [1 Not satisfied at all] - [7 Fully satisfied]

Household Income: Household Gross Income deflated to prices of 2005 using information on CPI from UK Statistics. Including all income perceived by household: labor, transfers, welfare, etc. Income value is reported in GB Pounds.

Equivalence corrected Income: elasticity to household size correction for income, using equivalence scale elasticity obtained by regressing variables against satisfaction with household income.

No. of Serious Accidents: number of accidents which require medical treatment by a doctor or a hospital visit.

Health Satisfaction: respondent's answer to the question: "*How dissatisfied or satisfied are you with your health?*" [1 Not satisfied at all] - [7 Fully satisfied]

Satisfaction with Social Life: respondent's answer to the question: "*How dissatisfied or satisfied are you with your social life?*" [1 Not satisfied at all] - [7 Fully satisfied]

Control Variables:

Household Composition variables: includes number of children, employed, retired individuals in household.

Household Size: number of people in household.

Employment state: set of dummies for different employment states derived from the following question: "Which best describes your current situation?" [1 Self Employed], [2 Paid Employment], [3 Unemployed], [4 Retired], [5 Maternity Leave], [6 Looking After Family], [7 Attending Classes], [8 Sick or Disabled] and [9 Government Training]. Plus dummy for having a second job.

Age: age in years derived from date of interview and individual responses to the question about the birth dates.

Marital State: set of dummies (Married, Separated, Divorced, Widowed and Never Married) obtained from question: "What is your legal marital status? [1 Married], [2 Separated, [3 Divorced], [4 Widowed] and [5 Never married]

Education: set of dummy variables derived from individual responses to the question: "Which is the highest qualification he/she has got? [1 Training Certificate], [2 Trade Apprenticeship], …, [11 University Diploma], …, [13 University Higher Degree]".

Health State: a set of dummies on diverse health problems obtained from question: "Have any of the health problems listed on this card? (i.e. difficulty seeing, diabetes, breathing problems, etc.)"

Smokes: a dummy variable derived from the individual responses to the question: "Do you smoke cigarettes? [1 Yes] [2 No]".

No of Cigarettes: derived from question: "How many cigarettes did you smoke in the last 7 days?"

Days in Hospital: number of days respondent spent in hospital derived from question: "Since (date), in all, how many days have you spent in a hospital or clinic as an in –patient?"

German Socio-Economic Panel Study

Happiness / Satisfaction with Life: Individual response to question: "*How satisfied are you with your life, all things considered?*" [0 Completely Dissatisfied] - [10 Completely Satisfied]

Satisfaction with Household Income: Individual response to question: "*How satisfied are you with your household income?*" [0 Completely Dissatisfied] – [10 Completely Satisfied]

Household Income: "Real Household Post-Government Income" from the CNEF. It includes all income perceived by ALL household members (i.e. labor income, pensions, windfalls, etc.). Since all income data is reported as monthly average, the data has been annualized. Government tax burdens were estimated by the DIW using calculation routines developed by Schwarze. Values reported are in EURO deflated to prices of the year 2000 using data from the OECD.

Equivalence corrected Income: elasticity to household size correction for income, using equivalence scale elasticity obtained by regressing variables against satisfaction with household income.

Health Satisfaction: respondent's answer to the question: "*How satisfied are you with your health?*" [0 Completely Dissatisfied] - [10 Completely Satisfied]

Satisfaction with Spare Time: respondent's answer to the question: "*How satisfied are you with your spare time?*" [0 Completely Dissatisfied] - [10 Completely Satisfied]

Control Variables:

Household Composition variables: number of children, household size (number of individuals in household).

Age: in years and age squared.

Employment state: set of dummies for different employment states derived from a generated variable by the DIW using data on labor force participation and non-employment characteristics.

Hours worked: annual. Constructed by DIW using information on employment status, average number of hours worked per week and the number of months worked in the previous year. No corrections for vacations were made.

Marital State: set of dummies (Married, Separated, Divorced, Widowed, Single, Not living with a partner) derived from variable constructed in CNEF where categories indicate legal marital status.

Education: number of years. Variable constructed by assigning years according to type of education. For example: Individuals with a school leaving degree are assigned a minimum of between 9 and 12.

Days Spent in Hospital: Individuals were asked: "*How many nights in total did you spend in the hospital last year?*". Since this question was not included in the questionnaire for years 1990 and 1993, this control is not included in results presented in order to maximize panel length. Regardless, results are robust to including this variable.

Swiss Household Panel

Happiness / Satisfaction with Life: Individual response to question: "*In general, how satisfied are you with your life if 0 means "not at all satisfied" and 10 means "completely satisfied"?*"

Satisfaction with Household Income: Individual response to question: "*Overall how satisfied are you with the financial situation of your household. If 0 means "not at all satisfied" and 10 "completely satisfied"?*"

Household Income: "Yearly Household Income, Net" variable constructed in the SHP. It includes all income perceived by ALL household members (i.e. labor income, pensions, windfalls, etc.) after deduction of social security contributions. Taxes not deducted. Values reported are in EURO deflated to prices of the year 2000 using data from the OECD.

Equivalence corrected Income: elasticity to household size correction for income, using equivalence scale elasticity obtained by regressing variables against satisfaction with household income.

Robbed: respondent's answer to "*Since [last interview] with your household, was your accommodation (house) burglured?*" Yes or No.

Health Satisfaction: respondent's answer to "*How satisfied are you with your state of health, if 0 means 'not satisfied at all' and 10 'completely satisfied'?*"

Free Time Satisfaction: respondent's answer to "*How satisfied are you with the amount of free time you have, if 0 means 'not satisfied at all' and 10 'completely satisfied'?*"

Control Variables:

Household Composition variables: number of children, household size (number of individuals in household).

Age: in years and age squared.

Hours worked: individual response the question: "*How many hours do you usually work each week for your main job?*"

Employment State: set of dummies for different employment states derived from variable generated by SHP from diverse question on employment.

Marital State: set of dummies (Married, Separated, Divorced, Widowed, Never Married) indicating actual civil status in year of interview.

Education: set of dummy variables indicating respondent's highest level of education achieved: ranging from incomplete compulsory school to university, higher specialized school.

Health State: set of dummies indicating different health problems such as: back problems, weakness/weariness, sleeping problems, headaches, chronic illness or long-term health problem.