Estimating the influence of life satisfaction and positive affect on later income using sibling fixed effects

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The question of whether there is a connection between income and psychological well-being is a long-studied issue across the social, psychological, and behavioral sciences. Much research has found that richer people tend to be happier. However, relatively little attention has been paid to whether happier individuals perform better financially in the first place. This possibility of reverse causality is arguably understudied. Using data from a large US representative panel, we show that adolescents and young adults who report higher life satisfaction or positive affect grow up to earn significantly higher levels of income later in life. We focus on earnings approximately one decade after the person's well-being is measured; we exploit the availability of sibling clusters to introduce family fixed effects; we account for the human capacity to imagine later socioeconomic outcomes and to anticipate the resulting feelings in current well-being. The study's results are robust to the inclusion of controls such as education, intelligence quotient, physical health, height, self-esteem, and later happiness. We consider how psychological well-being may influence income. Sobel–Goodman mediation tests reveal direct and indirect effects that carry the influence from happiness to income. Significant mediating pathways include a higher probability of obtaining a college degree, getting hired and promoted, having higher degrees of optimism and extraversion, and less neuroticism.

subjective well-being | personal earnings

The relationship between money and human happiness has generated a burgeoning cross-disciplinary literature. Virtually all published research on this matter has considered the effects of income upon subjective well-being (e.g., refs. 1–9). This study examines—and provides evidence of—the reverse. By using longitudinal information within families (exploiting so-called sibling fixed effects), it finds that happier people go on, many years later, to earn greater incomes. The results are suggestive of some form of causal relationship between well-being and income.

That the scholarly debate has mostly developed unidirectionally should probably not come as a surprise, given that it mirrors both our societal preoccupation with economic development and the conventional wisdom that human well-being follows from high income. The question of whether "money buys happiness" has not only dominated the investigation into the relationship between money and happiness, it has also taken on increasingly causal language because research showed positive (but marginally diminishing) effects of rising income on well-being, with some differences observed between life satisfaction and emotional well-being (1). However, relatively little attention has been paid to whether happier individuals perform better financially in the first place. This possibility of reverse causality is arguably understudied.

In this study, we therefore address the question of whether "happiness pays." We do so in a US representative panel of >10,000 individuals and explore the potential mediating pathways running from happiness to later income. This work does not intend to undermine the aforementioned literature on the effect of income on well-being. Rather, the goal is to make the case that the relationship between income and happiness is dynamic and that effects may run in both directions, thus complementing existing scholarship.

An effect running from subjective well-being to income could exist for a number of reasons. Happiness has various correlates such as health (10), social networks (11), and self-esteem (12) that, in turn, are known to positively influence labor market outcomes and that may thus play a mediating role. More recent neuroscientific research provides clues that greater subjective well-being is associated with particular neurological variation, which, in turn, is associated with improved cognitive skills and economic outcomes. Such neurological mediation pathways center on the role of positive emotions (reward) in stimulating the dopaminergic system and increasing cognitive capacity for memory tasks and attention span (13–16). These neuroscientific insights and aforementioned correlates provide some reason to believe that there could be an effect running from subjective well-being to economic outcomes.

A handful of studies have tried to estimate the influence of subjective well-being on later income. Diener et al. (17) found a positive correlation between "cheerfulness" measured in a sample of elite college students and their income levels some 19 y later. This association is particularly significant for those with below average levels of cheerfulness. Diener and colleagues later expanded on this finding to show that individuals who experience the highest levels of happiness do not necessarily perform best in terms of later income and that the "optimal" level of happiness for later income appears to be a moderately high level of happiness (18). Three other studies considered the broader effects of happiness on life events, including income, marriage, employment, and health (19, 20), as well as consumption and savings behavior (21). The panels used in these studies are the British Household Panel Study, Russia Longitudinal Monitoring Survey, German Socio-Economic Panel, and the De Nederlandsche Bank Household Survey in the Netherlands. In a laboratory setting, Oswald et al. (22) induced variation in positive mood and found that it is predictive of productivity in a laboratory task. The promising results from inquiries into the socioeconomic and productivity effects of happiness have led some to speak of a "happiness advantage" (23) in shaping career success (24) and provide further ground for why a deeper investigation is warranted.

Although the aforementioned studies are important because they point toward a potential role for happiness in shaping socioeconomic outcomes, they face a number of methodological difficulties. First, these studies continue to leave room for

alternative explanations: Cross-sectional results may be the result of genetic confounding and other omitted variables; longitudinal designs have so far not accounted for the human capacity to imagine later socioeconomic outcomes and anticipate the resulting feelings in current well-being (25, 26); and experimental designs are not in a position to evaluate longer-term effects outside the laboratory.

Second, previous work has separately considered measures of mood, happiness, life satisfaction, and mental health. The more recent literature, however, has argued that emotional well-being and satisfaction with life are two important yet different components of well-being (1). Emotional well-being refers to the frequency and intensity of everyday emotional experiences (both positive and negative). The positive emotions and the experience of feeling happy are commonly referred to as "positive affect." Life satisfaction, conversely, refers to a longer-term evaluation of one's life. Although measures of positive affect and life satisfaction correlate—and load onto a common genetic factor (27)—they show varying salience in different circumstances of people's lives, including in their relationship to income and age (1, 28, 29). None of the previous studies considered the dual effect of emotional well-being and life satisfaction on later income, even though Kahneman and Deaton (1) conclude that the effect of income on positive affect is less pronounced (and ceases beyond an annual income of ∼$75,000) compared with the effect of income on life satisfaction. It is therefore necessary to investigate whether a similar distinction can be made in the opposite direction, i.e., the effect running from well-being on income.

Finally, if income is indeed endogenous to happiness, it becomes important to study how happiness may influence income. To address these questions, this work studies whether life satisfaction and positive affect are predictive of later income—while tackling the endogeneity concerns that were hitherto unaddressed—and investigates potential mediating pathways.

Results

Fig. 1 illustrates the study's key result. It plots the (uncorrected) relationship between subjective well-being and later earnings in a large US representative panel study (Add Health). Reports of positive affect or life satisfaction in adolescence and young adulthood correlate significantly with income around age 29 (all between $r = 0.078$ and 0.090, with $P < 0.001$; Table S1). Income here is defined in the following way: "Now think about your personal earnings. In {2006/2007/2008}, how much income did you receive from personal earnings before taxes, that is, wages or salaries, including tips, bonuses, and overtime pay, and income from self-employment?" Similar to the findings on "cheerfulness" by Diener et al. (17), we observed that the relationship is particularly pronounced for those individuals with lower levels of happiness. In fact, reporting a profoundly unhappy adolescence is associated with an income around age 29 that is ∼30% less than average, whereas a very happy adolescence is associated with a later income that is ∼10% above average.

Regression analyses reported in Table 1 confirm this pattern. The predictive power of happiness on later earnings depends on the lag time between both variables; e.g., a 1 SD increase in life satisfaction at the age of 22 is associated with a 5% increase in earnings at the age of 29 (SD = 0.81 on a scale of 5). In absolute terms, a 1-point increase in life satisfaction at the age of 22 is associated with almost $2,000 higher earnings at the age of 29 (this dollar value is obtained in an empirical model identical to the one reported in Table 1 except for using income values instead of their natural logarithm).

The analyses reported here include the following covariants: age, sex, ethnicity, education, intelligence quotient (IQ), physical health, height, and self-esteem (for a detailed specification of these variables, see Table S2). Most of these covariates are standard. However, unlike previous longitudinal studies of the

effect of subjective well-being on later socioeconomic outcomes and life events (17–21), the richness of the dataset used here allows us to incorporate a measure of self-esteem that is surveyed at the same time as positive affect and life satisfaction. Self-esteem is a psychological construct distinct from happiness (12) and is an important driver of labor market outcomes (30). As such, it is an important variable to control for in a study of the effect of happiness on later outcomes because not doing so may otherwise bias the coefficients obtained on happiness (results in Table 2 indicate that self-esteem and subjective well-being have similarly significant effects on later earnings). Furthermore, introducing a measure of self-esteem may allow us to control for feelings that anticipate happiness related to individual expectations of socioeconomic outcomes. The human capacity to imagine later outcomes and anticipate the resulting feelings in current well-being is well-known (25, 26). Self-esteem may capture the confidence one has in later earnings potential and thus also account for the positive or negative feelings associated with the anticipated outcomes. Although longitudinal studies allow for measuring subjective well-being before the outcome of interest, they cannot prevent expectations about those later outcomes from being correlated with an earlier state of mind and thus introduce bias into the earlier measures of happiness. Introducing a concurrent measure of self-esteem alongside subjective well-being in adolescence and young adulthood may therefore also help account for anticipated feelings surrounding earnings potential.

Subjective well-being has an important latent or stable component that is considered to be contingent on genetic variation and certain personality traits (27, 31–34). To help distinguish variation in positive affect and life satisfaction—in adolescence and young adulthood—from variation in innate predispositions we also include in our analyses a measure of positive affect that is reported at the same time as income (around age 29). Doing so is important because it allows us to capture the influence of variation in subjective well-being beyond the latent dimensions specific to the individual.

Looking at models 1–3 in Table 1, we find that positive affect in 1994 (age 16) and 1996 (age 18), as well as life satisfaction in 2001 (age 22), each significantly predict later earnings (age 29). Model 4 jointly considers all these measures of subjective well-being over time and shows that the predictive power of variation in happiness on later income at those time points gradually rises as the time lag shrinks.

The analyses reported in Table 2 go one step further. They exploit the availability of sibling clusters in the data to introduce family fixed effects (for those individuals identified as twin pairs, full-siblings, half-siblings, or unrelated siblings raised together). The siblings' sample is similar in demographic composition to the full Add Health sample (35). The structure of these data allows us to compare siblings to each other while holding the family environment constant (as well as a substantial portion of the genetic variation in most cases), which, in turn, aids our interpretation of the relationship between well-being and income.

Table 2 shows that a 1 SD difference in life satisfaction compared with the family mean at age 22 is associated with a 6% difference in earnings compared with the family mean at age 29. In absolute terms, a 1-point difference in life satisfaction (on a scale of 5) compared with the family mean at age 22 is associated with an almost $4,000 difference in earnings compared with the family mean at age 29 (this dollar value is obtained in an empirical model identical to the one reported in Table 2, except for using income values instead of their natural logarithm). Looking at models 1–3 in Table 2, we find that measures of positive affect and life satisfaction in adolescence and early adulthood are positively associated with later earnings. Sibling fixed-effects model predicted values are plotted in Figs. S1–S2. Model 4 jointly considers all these measures of subjective well-being over time and obtains a significant coefficient for life satisfaction on later
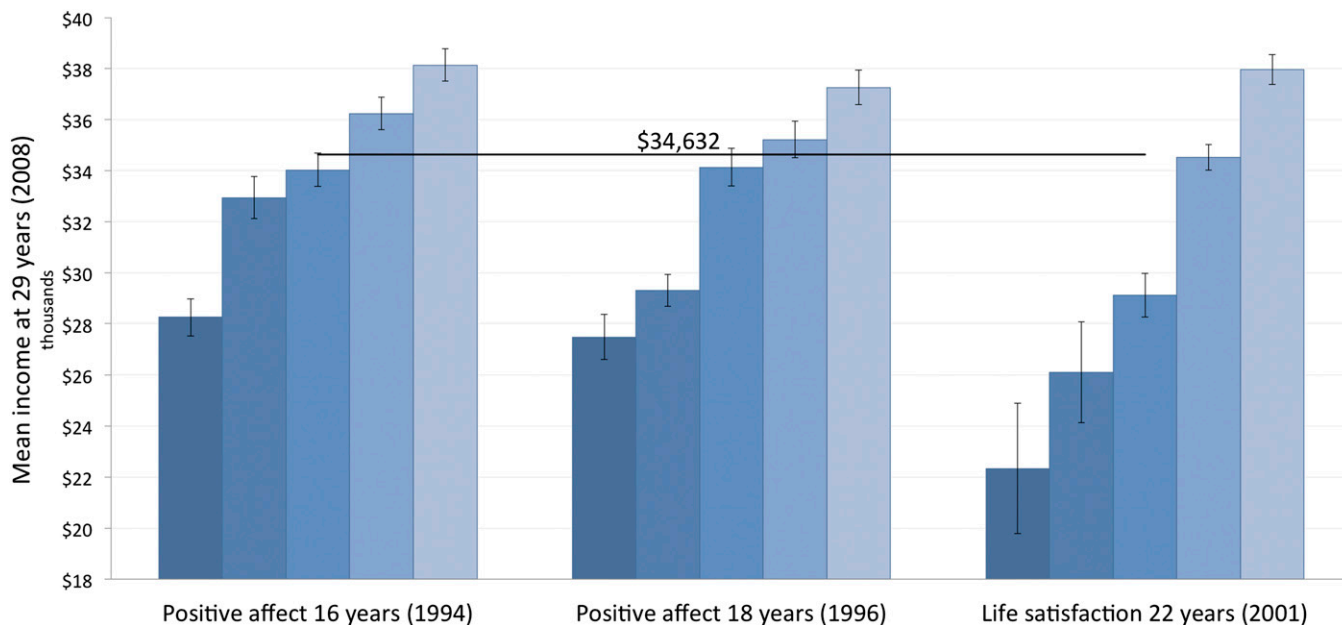
Fig. 1. The longitudinal relationship between subjective well-being (at ages 16, 18, and 22) and later earnings (at age 29). Response categories for positive affect (at ages 16 and 18) and life satisfaction (at age 22) are presented in relationship with their respective mean income levels at about age 29. Mean income across the sample is $34,632 at age 29. $N = 14,867$ for positive affect at age 16, $N = 11,253$ for positive affect at age 18, and $N = 12,415$ for life satisfaction at age 22. The original positive affect variable categories are reshaped to a 5-point scale for ease of comparison. Error bars (2 SEs) are shown.

income. The effect sizes of the well-being measures remain relatively stable between Table 1 (full panel) and Table 2 (sibling panel). The lower significance levels in Table 2 are presumably due to the reduced number of observations in the sibling panel as well as having accounted for family fixed effects.

Tables S7 and S8 present results for an individual fixed-effects model and a Granger causality analysis that use the available information on earnings in 2001 (age 22). Both model specifications obtain highly significant results for the effect of lagged

subjective well-being on earnings. However, we do not lend these results full credence, given that earnings at age 22 may not yet accurately represent individual income and also because these panel data allow for only one time interval, and the exogeneity assumption necessary for panel data models is unlikely to be satisfied.

If income is indeed endogenous to happiness, it becomes important to study *how* happiness comes to influence a person's income. Table 3 presents results for our investigation into potential mediating pathways. These univariate Sobel–Goodman

Table 1. Earnings equations: Linear regression models of log income at age 29 (2008) on lagged subjective well-being and covariates

Independent variable	Model 1		Model 2		Model 3		Model 4	
	Coeff.	P value	Coeff.	P value	Coeff.	P value	Coeff.	P value
Positive affect (1994)	0.033	0.002					0.014	0.314
Positive affect (1996)			0.044	0.000			0.030	0.037
Life satisfaction (2001)					0.051	0.000	0.047	0.000
Positive affect (2008)	0.092	0.000	0.089	0.000	0.086	0.000	0.074	0.000
Male	0.149	0.000	0.146	0.000	0.147	0.000	0.145	0.000
Age	0.089	0.000	0.084	0.000	0.088	0.000	0.085	0.000
College	0.210	0.000	0.216	0.000	0.212	0.000	0.201	0.000
IQ	0.038	0.001	0.037	0.004	0.043	0.000	0.030	0.022
Medication	0.013	0.174	0.013	0.253	0.013	0.197	0.014	0.211
Height	0.036	0.008	0.039	0.011	0.035	0.011	0.037	0.016
Self-esteem (1994)	0.057	0.000					0.041	0.003
Self-esteem (1996)			0.044	0.001			0.015	0.306
Self-esteem (2001)					0.054	0.000	0.030	0.017
Black	−0.068	0.000	−0.064	0.000	−0.063	0.000	−0.065	0.000
Hispanic	0.056	0.000	0.065	0.000	0.051	0.000	0.064	0.000
Asian	0.062	0.000	0.063	0.000	0.061	0.010	0.064	0.000
Intercept	10.15	0.000	10.14	0.000	10.15	0.000	10.14	0.000
N	11,080		8,620		11,086		8,585	
R^2	0.12		0.12		0.13		0.13	

Variable coefficients (Coeff.) are standardized, and *P* values are presented. Variable definitions are in Table S2.

Table 2. Earnings equations: Sibling fixed-effects models of log income at age 29 (2008) on lagged subjective well-being and covariates

	Model 1		Model 2		Model 3		Model 4	
Independent variable	Coeff.	*P* value	Coeff.	*P* value	Coeff.	*P* value	Coeff.	*P* value
Positive affect (1994)	0.060	0.044					0.018	0.575
Positive affect (1996)			0.048	0.110			0.035	0.264
Life satisfaction (2001)					0.062	0.026	0.069	0.015
Positive affect (2008)	0.071	0.010	0.062	0.028	0.066	0.016	0.043	0.132
Male	0.119	0.007	0.135	0.003	0.114	0.009	0.134	0.003
Age	0.129	0.000	0.115	0.000	0.127	0.000	0.115	0.000
College	0.166	0.000	0.176	0.000	0.158	0.643	0.162	0.000
IQ	0.003	0.960	0.018	0.660	0.022	0.573	0.017	0.685
Medication	−0.008	0.772	−0.015	0.582	−0.08	0.753	−0.015	0.586
Height	0.081	0.082	0.081	0.082	0.093	0.042	−0.080	0.087
Self-esteem (1994)	0.033	0.271					0.011	0.737
Self-esteem (1996)			0.035	0.244			0.016	0.610
Self-esteem (2001)					0.061	0.042	0.039	0.179
Intercept	10.14	0.000	10.14	0.000	10.13	0.000	9.981	0.000
N	3,216		3,029		3,217		3,017	
R^2	0.11		0.13		0.11		0.13	

Variable coefficients are standardized, and *P* values are presented. Variable definitions are in Table S2.

mediation tests consider potentially mediating variables that may carry some of the effect from happiness onto income (36). We chose a number of standard socioeconomic variables, as well as psychological constructs such as personality traits, optimism, and self-esteem. Only measures in 2008 are used—to reduce confounding with the earlier measures of subjective well-being. Table 3 shows that most of the chosen variables are correlated with earlier measures of positive affect and life satisfaction and also carry some part of their influence onto income. The most significant mediating pathways include obtaining a college degree, getting hired and promoted, higher degrees of optimism and extraversion, and less neuroticism. These variables each partially mediate the observed association with income and may represent an indirect effect as large as ~38% in the case of positive affect (around age 18) and obtaining a college degree. These results provide support for causal mechanisms running

from subjective well-being to later income. Table S9 presents the results for a multivariate mediation analysis that considers these mediating variables jointly. The total mediated effect for these variables is estimated to be between 68% and 78%, thus revealing an important combined indirect effect, in addition to a direct effect, that carries the influence from happiness to income. These results suggest a relationship that is pleiotropic in nature, with psychological well-being having an independent effect on both income and the mediating variables.

Discussion

This study reverses one of the famous questions of social science. It is an attempt to explore the influence not of income upon well-being but instead of well-being upon income. As Fig. 1 illustrates, the linkages are estimated to be long and the empirical consequences large.

Table 3. Univariate Sobel–Goodman mediation tests on log income at age 29 (2008)

	Independent variable								
Mediating variable (data are from 2008)	Positive affect (1994)			Positive affect (1996)			Life satisfaction (2001)		
	Coeff.	*P* value	%	Coeff.	*P* value	%	Coeff.	*P* value	%
Job	0.017	0.000	15	0.025	0.000	22	0.019	0.000	18
Supervision	0.006	0.000	5	0.006	0.000	5	0.006	0.000	6
College	0.039	0.000	36	0.043	0.000	38	0.032	0.000	28
Married	0.004	0.000	4	0.004	0.000	4	0.014	0.000	12
Optimism	0.032	0.000	29	0.036	0.000	32	0.029	0.000	25
Self-esteem	0.017	0.000	15	0.018	0.000	16	0.005	0.000	4
Openness	0.004	0.003	4	0.005	0.010	4	−0.000	0.651	0
Conscientiousness	0.003	0.000	3	0.003	0.000	3	0.004	0.000	3
Extraversion	0.006	0.000	5	0.006	0.000	5	0.004	0.000	4
Agreeableness	−0.001	0.181	−1	−0.002	0.126	−2	−0.000	0.672	0
Neuroticism	0.028	0.000	25	0.031	0.000	27	0.028	0.000	25

Presented are the Sobel test coefficient, *P* value, and the proportion of the total effect that is mediated (%). All variable coefficients are standardized. Variable definitions are in Table S2. To test for mediation we use the Sobel–Goodman method available in the Stata package that follows the logic described in Baron and Kenny (36). A variable is considered a mediator (*M*) if it caries some part of the effect from an independent variable (*X*), here positive affect and life satisfaction, onto a dependent variable (*Y*), in our case later earnings. Mediation occurs if (*i*) X significantly predicts *M*; (*ii*) X significantly predicts *Y* in the absence of *M*; (*iii*) *M* significantly predicts *Y* controlling for *X*; and (*iv*) the effect of *X* on *Y* shrinks upon addition of *M*.

The paper's contribution is partly substantive and partly methodological. By the nature of its data, the study is able to introduce sibling fixed effects to account for much potential omitted-variable bias (family-related covariates, including a significant part of genetic endowment). Compared with individual fixed effects, sibling fixed effects allows for making inferences about the lagged effects of well-being at particular time points (such as adolescence and young adulthood) instead of having to consider variation between time intervals. This work also applies mediation analysis and may thus help to uncover the mechanisms running from well-being to later income. The most significant mediating pathways include obtaining a college degree, getting hired and promoted, and having higher degrees of optimism and extraversion and less neuroticism. Including current happiness in this longitudinal study allows us to better control for variation in latent well-being predisposition. This enables an examination of the consequences of variation in life satisfaction and positive affect at adolescence and young adulthood above and beyond any variation in the stable component of well-being. The use of a large US representative panel on this question also distinguishes this research from prior work that looked at the economic benefits of psychological well-being, as does offering a joint analysis of life satisfaction and positive affect. Finally, the study also attempts to account for a person's "anticipated happiness" in this kind of longitudinal analysis (through its use of proxy measures of current self-esteem). This should help to prevent a person's conscious or subconscious expectations about their future earnings from introducing bias into the estimate of the consequences of current psychological well-being.

For researchers who study human well-being, the message of the paper is that well-being regression equations cannot be expected to be estimated in a reliable way unless allowance is made for the endogeneity of income. This study also points to long time lags between psychological well-being in year T and people's incomes in year $T + 10$ and beyond. Greater knowledge of the underlying causes of these remarkable lags, and their reach in social and economic processes, will be needed. Research that considers the potential benefits of variation in life satisfaction or positive affect is part of a fairly new avenue in the study of human well-being. Although most research in this literature has studied the determinants of happiness, recently there has been growing interest in the broader benefits that happiness may induce (10, 29, 37). For policymakers, the existence of these mechanisms raises the possibility that a happier society may be one that intrinsically generates higher incomes for its citizens. Traditional thinking has focused upon the opposite.

Although, in this paper, human well-being is considered instrumental or as a means—rather than an end in itself—it needs to be emphasized that this is not with a view to putting money center-stage at the expense of happiness. To the contrary, the results indicate that happiness and income are connected by a two-way relationship, and that human well-being can itself be a source of economic dynamism.

Materials and Methods

Data are from the restricted-use National Longitudinal Study of Adolescent Health (Add Health) sample available by contractual agreement (38). Add Health was started in 1994 to explore the health-related behavior of adolescents in grades 7–12. By now, four waves of data collection have taken place and participating subjects were around 30 y old in Wave IV (2008). The first wave of the Add Health study (1994–1995) selected 80 high schools from a sampling frame of 26,666 schools. The schools were selected based on their size, school type, census region, level of urbanization, and percent of the population that was white. Participating high schools were asked to identify junior high or middle schools that served as feeder schools to their school. This resulted in the participation of 145 middle, junior high, and high schools. From those schools, 90,118 students completed a 45-min questionnaire, and each school was asked to complete at least one School Administrator questionnaire. This process generated descriptive information about

each student, the educational setting, and the environment of the school. From these respondents, a core random sample of adolescents in grades 7–12 were drawn plus several oversamples, bringing the total for Wave I to 20,745 adolescents. These students and their parents were administered in-home surveys. Wave II (1996) was comprised of another set of in-home interviews of 14,738 students from the Wave I sample. Wave III (2001–2002) consisted of an in-home interview of 15,197 Wave I participants. Finally, Wave IV (2008) consisted of an in-home interview of 15,701 Wave I participants. The result of this sampling design is that Add Health is a nationally representative study. Women make up 49% of the study's participants, Hispanics 12%, Blacks 16%, Asians 3%, and Native Americans 2%. Participants in Add Health also represent all regions of the US.

In Wave I of the Add Health study, researchers screened for sibling pairs including all adolescents that were identified as twin pairs, full siblings, half siblings, or unrelated siblings raised together. The sibling-pairs sample is similar in demographic composition to the full Add Health sample (35). Consequently, in all regression models we cluster the SEs of our estimates to better account for the fact that a subset of our observations is not independent. The structure of this data also allows us to compare siblings to each other while holding the family environment constant, which aids our interpretation of the relationship between well-being, childhood context, and income as an adult.

In all four interview waves of Add Health the subjects were asked about their subjective well-being. In particular, in waves I and II, the positive affect subscale of the Center for Epidemiologic Studies Depression Scale(CES-D) index (39) was administered. The CES-D index asks how often certain statements were true during the last week. The positive affect subscale is additively composed of the responses to the following four particular statements: "You enjoyed life," "You were happy," "You felt hopeful about the future," and "You felt that you were just as good as other people." The detailed question and answer structure for the four questions that make up this positive affect scale are given in Table S2. The life satisfaction question was surveyed in wave III only and asked: "How satisfied are you with your life as a whole?" Distribution tables for the positive affect and life satisfaction variables used in this research are presented in Tables S3–S6. Income in wave IV was reported as personal earnings before taxes and the mean income in the Add Health sample was approximately $35,000. The measure for self-esteem was derived from the answer to "Compared with other people your age, how intelligent are you?" which was surveyed in all interview waves. Precise variable descriptions and descriptive statistics, as well as distribution scales for the well-being measures, are given in Table S2 for all variables used in this paper. A correlation matrix for the well-being measures across all interview waves and income in wave IV is also given in Table S1.

The analyses are run using linear regression models with clustering on SEs to better account for the fact that a subset of the Add Health observations are not independent. We also leverage the sibling clusters in the Add Health data by introducing family fixed effects (Table 2). The empirical framework here follows a standard specification where income (in 2008) is regressed on earlier subjective well-being measures and a set of other characteristics. With family fixed effects the empirical model takes the following form:

$$Y_{ij} = \beta_0 + \beta_1 (SWB_{ij}) + \beta_k (Z_{kij}) + \mu_j + \varepsilon_{ij},$$

where i and j index individual and family, respectively, and Y_{ij} is earnings. Z_k is a matrix comprised of variables that may differ between siblings (sex, age, height, self-esteem, etc.). To control for common family attributes, family fixed effects are introduced (μ_j), and ε_{ij} represents an individual-specific error. Such family fixed-effect analyses are equivalent to differencing all equation variables within sibling pairs to account for family-related unobservables. For a discussion of assumptions involved see Griliches (40) and more recent surveys. Compared with individual fixed effect panel studies, the advantage of a family fixed effects model is that it allows for the study of longer-term effects of subjective well-being at a particular time period, here in adolescence and young adulthood.

To test for mediation, we used the Sobel–Goodman method available in the STATA package that follows the logic described in Baron and Kenny (35). A variable is considered a mediator (M) if it carries some part of the effect from an independent variable (X), here positive affect and life satisfaction, onto a dependent variable (Y), in our case later earnings. Mediation occurs if (i) X significantly predicts M; (ii) X significantly predicts Y in the absence of M; (iii) M significantly predicts Y controlling for X; and (iv) the effect of X on Y shrinks upon addition of M. Description and references for the multivariate mediation test are provided in Table S9.

Information on how to obtain the Add Health data is available on the Add Health website (www.cpc.unc.edu/addhealth).

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Supporting Information

De Neve and Oswald 10.1073/pnas.1211437109
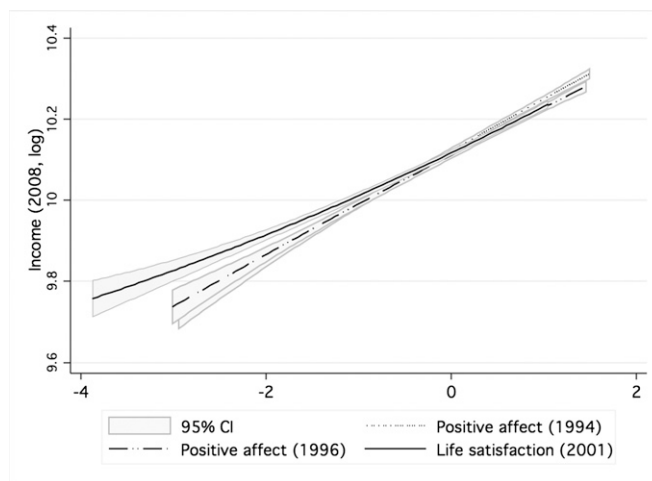
Fig. S1. Sibling fixed-effects model (Table 2) predicted values. Quadratic fits with 95% confidence intervals.
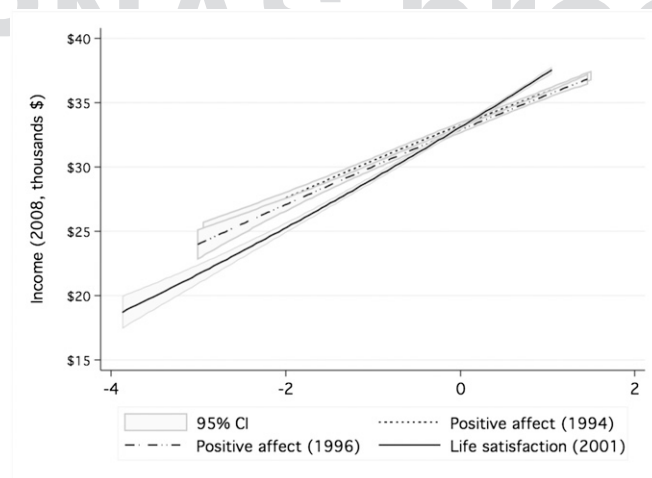
Fig. S2. Sibling fixed-effects model predicted values using identical specification as in Table 2 except taking absolute income values instead of natural log. Quadratic fits are presented with 95% confidence intervals.

Table S1. Correlations table for income and subjective well-being in Add Health data

	Income	PA1994	PA1996	LS2001	PA2008
Income (2008)	1.0000				
Positive affect (1994)	0.0777	1.0000			
	0.0000				
Positive affect (1996)	0.0905	0.4892	1.0000		
	0.0000	0.0000			
Life satisfaction (2001)	0.0856	0.1357	0.1730	1.0000	
	0.0000	0.0000	0.0000		
Positive affect (2008)	0.0950	0.2529	0.2887	0.2505	1.0000
	0.0000	0.0000	0.0000	0.0000	

Significance levels (*P* value) are given below correlation coefficients.

Table S2. Variable descriptions

Variable	Source	Range	N	Mean	SD
Income (2008)	Now think about your personal earnings. In {2006/2007/2008}, how much income did you receive from personal earnings before taxes, that is, wages or salaries, including tips, bonuses, and overtime pay, and income from self-employment?	$0 – $920,000	14,914	34,632	38,284
Positive affect (1994)	CES-D subindex additively composed of: How often was each of the following true during the last week? You felt that you were just as good as other people You felt hopeful about the future You were happy You enjoyed life	0. Never or rarely 1. Sometimes 2. A lot of the time 3. Most of the time or all of the time Additive index 0–12	20,648	7.96	2.70
Positive affect (1996)	Idem	Idem	14,698	8.08	2.69
Life satisfaction (2001)	How satisfied are you with your life as a whole?	1. Very satisfied 2. Satisfied 3. Neither satisfied n or dissatisfied 4. Dissatisfied 5. Very dissatisfied	15,157	4.15	0.81
Positive affect (2008)	CES-D subindex additively composed of: How often was each of the following true during the last week? You felt that you were just as good as other people You were happy You enjoyed life ["You felt hopeful about the future" is not available]	0. Never or rarely 1. Sometimes 2. A lot of the time 3. Most of the time or all of the time additive index 0–9	15,687	6.67	2.06
Male		Dummy	20,743	0.49	0.50
Age (2001)		18–27	15,170	22.0	1.77
White		Dummy	20,704	0.62	0.49
Black		Dummy	20,704	0.23	0.42
Hispanic		Dummy	20,745	0.17	0.38
Asian		Dummy	20,704	0.08	0.27
Job (2008)	Are you currently working for pay at least 10 h a week?	Dummy	13,016	0.78	0.41
Supervision (2008)	Thinking about your official job duties, which of the following statements best describes your supervisory responsibilities at your (current/ most recent) primary job?	0. I (do/did) not supervise anyone 1. I (supervise/supervised) other employees 2. I (supervise/supervised) other employees, some of whom (supervise/supervised) others	15,447	0.46	0.67
Married (2008)	What is the current status of your marriage to {initials}? 1. Living together 2. Living apart because of legal separation 3. Living apart because of other reason such as career, military service, family illness, etc. 4. Legitimate skip	Dummy (loading respondents of categories 1 and 3)	15,216	0.42	0.49
College (2008)	College degree or higher	Dummy	15,697	0.32	0.46
Medication (2001)	In the past 12 mo, have you taken any prescription medication—that is, a medicine that must be prescribed by a doctor or nurse?	Dummy	15,150	0.61	0.49
Optimism (2008)	LOT-R Optimism index additively composed of: 1. I'm always optimistic about my future* 2. I hardly ever expect things to go my way 3. Overall, I expect more good things to happen to me than bad* 4. I rarely count on good things happening to me	1. Strongly agree 2. Agree 3. Neither agree nor disagree 4. Disagree 5. Strongly disagree Additive index 4–20	15,672	14.88	2.45

Table S2.   Cont.

Variable	Source	Range	N	Mean	SD
Self-esteem (1994)	Compared with other people your age, how intelligent are you?	1. Moderately below average 2. Slightly below average 3. About average 4. Slightly above average 5. Moderately above average 6. Extremely above average	20,644	3.85	1.10
Self-esteem (1996)	Idem	Idem	14,704	3.94	1.10
Self-esteem (2001)	Idem	Idem	15,121	3.96	1.07
Openness (2008)	Openness to experience index additively composed of: I have a vivid imagination* I am not interested in abstract ideas I have difficulty understanding abstract ideas I do not have a good imagination	1. Strongly agree 2. Agree 3. Neither agree nor disagree 4. Disagree 5. Strongly disagree Additive index 4–20	15,509	14.50	2.45
Conscientiousness (2008)	Conscientiousness index additively composed of: I get chores done right away* I often forget to put things back in their proper place I like order* I make a mess of things	Idem	15,657	14.64	2.70
Extraversion (2008)	Extraversion index additively composed of: I am the life of the party* I don't talk a lot I talk to a lot of different people at parties* I keep in the background	Idem	15,634	13.22	3.06
Agreeableness (2008)	I sympathize with others' feelings* I am not interested in other people's problems I feel others' emotions* I keep in the background	Idem	15,644	15.24	2.41
Neuroticism (2008)	I have frequent mood swings* I am relaxed most of the time I get upset easily* I seldom feel blue	Idem	15,652	10.45	2.74

*Reverse coded.

Table S3.   Distribution table positive affect

Positive affect	Frequency	Percent	Cumulative frequency
0	84	0.41	0.41
1	127	0.62	1.02
2	308	1.49	2.51
3	661	3.20	5.71
4	1,268	6.14	11.86
5	1,563	7.57	19.43
6	2,167	10.49	29.92
7	2,405	11.65	41.57
8	2,810	13.61	55.18
9	2,659	12.88	68.06
10	2,270	10.99	79.05
11	2,103	10.19	89.23
12	2,223	10.77	100.00
Total	20,648	100.00	

Data are from 1994.

Table S4. Distribution table positive affect

Positive affect	Frequency	Percent	Cumulative frequency
0	34	0.23	0.23
1	108	0.73	0.97
2	198	1.35	2.31
3	421	2.86	5.18
4	867	5.90	11.08
5	1,092	7.43	18.51
6	1,423	9.68	28.19
7	1,641	11.16	39.35
8	2,080	14.15	53.50
9	1,906	12.97	66.47
10	1,662	11.31	77.78
11	1,543	10.50	88.28
12	1,723	11.72	100.00
Total	14,698	100.00	

Data are from 1996.

Table S5. Distribution table life satisfaction

Life satisfaction	Frequency	Percent	Cumulative frequency
1	92	0.61	0.61
2	534	3.52	4.13
3	1,908	12.59	16.72
4	7,097	46.82	63.54
5	5,526	36.46	100.00
Total	15,157	100.00	

Data are from 2001.

Table S6. Distribution table positive affect

Positive affect	Frequency	Percent	Cumulative frequency
0	48	0.31	0.31
1	95	0.61	0.91
2	306	1.95	2.86
3	1,019	6.50	9.36
4	1,156	7.37	16.73
5	1,552	9.89	26.62
6	2,694	17.17	43.79
7	2,410	15.36	59.16
8	2,186	13.94	73.09
9	4,221	26.91	100.00
Total	15,687	100.00	

Data are from 2008.

Table S7. Individual fixed-effects models of log income on lagged subjective well-being and covariates

	FE		Prais (Cochrane-Orcutt)	
	Coeff.	P value	Coeff.	P value
SWB (lagged)	0.50	0.000	0.136	0.000
Intercept	7.55	0.000	9.66	0.000
N	20,436		7,035	
N groups	13,401			
R^2	0.12		0.12	
Durbin–Watson	0.82			

Note that this time series only covers two time periods for which earnings are available (2001 and 2008). Subjective well-being variables are transformed into 5-point scales.

Table S8. Granger causality tests

	Log income (2008)		Positive affect (2008)	
	Coeff.	P value	Coeff.	P value
Log income (lagged, 2001)	0.033	0.000	0.002	0.643
Life satisfaction (lagged, 2001)	0.113	0.000	0.262	0.000
Intercept	9.92	0.000	−0.00	0.000
N	9,090		10,024	
R^2	0.02		0.07	
F-test Life satisfaction (P value)	0.000			
F-test Log income (P value)			0.643	

Granger causality tests analyze whether lagged observations of income (2001) and life satisfaction (2001) have incremental forecasting power when added to a univariate autoregressive representation of income (2008) and positive affect (2008).

Table S9. Multivariate mediation test on log income (2008)

	Independent variable					
	Positive affect (1994)		Positive affect (1996)		Life satisfaction (2001)	
Mediating variables	Coeff.	P value	Coeff.	P value	Coeff.	P value
Job (2008)	0.013	0.000	0.020	0.000	0.017	0.000
Supervision (2008)	0.005	0.000	0.005	0.000	0.004	0.001
College (2008)	0.032	0.000	0.036	0.000	0.026	0.000
Married (2008)	0.002	0.001	0.003	0.002	0.011	0.000
Optimism (2008)	0.010	0.000	0.009	0.006	0.008	0.001
Self-esteem (2008)	0.004	0.012	0.005	0.014	0.001	0.040
Openness (2008)	−0.001	0.624	−0.000	0.812	−0.000	0.998
Conscientiousness (2008)	0.001	0.283	0.005	0.537	0.001	0.248
Extraversion (2008)	0.005	0.000	0.005	0.001	0.003	0.001
Agreeableness (2008)	−0.008	0.000	−0.009	0.000	−0.003	0.001
Neuroticism (2008)	0.013	0.002	0.015	0.000	0.014	0.000
Proportion of total effect that is mediated, %	68		77		78	

Multivariate mediation tests for multiple potentially mediating variables considered jointly that may partially carry the effect from lagged SWB to Log income. Presented are the mediation test coefficient, P value, and the proportion of the total effect that is mediated (%). All variable coefficients are standardized. Descriptive statistics are provided in Table S2. The mediated (indirect) effect is tabulated using the product of the coefficients method that multiplies the regression coefficients from the IV on MV and MV on DV regressions. These sets of coefficients and their SEs are obtained using "seemingly unrelated regression" (sureg in Stata). The mediated effect is obtained by multiplying the coefficients using the "non-linear combination" command (nlcom in Stata) and these single mediated effects are considered additively when tabulating the total indirect or mediated effect (also using nlcom in Stata). For a detailed description and example, see www.ats.ucla.edu/stat/stata/faq/mulmediation.htm.