



# What Determines Emotional Well-Being? The Role of Adverse Experiences: Evidence Using Twin Data

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**Abstract** In this paper we use twin data from Australia to explore emotional well-being and its determinants. We aim to accomplish three things. First of all, using twin-fixed effects, and purging the estimates of common family environment and genetic similarities, we can test the robustness of previous findings in the well-being literature. We find that in the monozygotic twin-fixed effects estimations the marital status, health, years of education, and having low income preserve their significance, thus confirming the most pronounced stylized facts in the happiness literature. Second, using information about traumatic events, we test the validity of the adaptation hypothesis, according to which human beings can adapt to both positive and negative shocks and return to some setpoint level of life satisfaction. We find a strong negative effect of more recent traumatic events, such as being assaulted, being raped or being involved in an accident, which effects dissipate over time; thus, we confirm the validity of the adaptation hypothesis. Last but not least, we show that genetic dispositions are important for the within-pair variance of the emotional well-being.

**Keywords** Emotional well-being · Twin-fixed effects · Adaption · Traumatic events

## 1 Introduction

Though happiness has interested humans for centuries, only in recent decades have economists abandoned their firm belief that economic agents reveal their preferences solely through their choices. Things changed when Richard Easterlin conducted a seminal study in 1974, which demonstrated that growth in US income was not supplemented by growth in

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happiness. This revived economists' interest in well-being. After all, humans strive for things such as income, job security and job status for the happiness they derive from them.

Happiness, satisfaction with life and subjective well-being (SWB) are typically used interchangeably in economic studies mainly because the concepts are often confounded (Kahneman and Deaton 2010). This paper will focus on emotional well-being. Emotional well-being is usually defined as the emotional quality of everyday experiences, the positive and negative affect that makes one's life pleasant or unpleasant (Kahneman and Deaton 2010). In contrast to Kahneman and Deaton, we can only measure emotional well-being with a single self-reported question. It falls under the affective component of life evaluation (Veenhoven 2009). Veenhoven (2009) argues that the hedonic level of affect is a less problematic measure because it does not require a subjective evaluation of how well one feels. On the other hand, contentment with one's life is a deliberate cognitive process. As such, it requires assessment of one's quality of life according to his chosen criteria (i.e., how life is compared to how life should be). Whether the different concepts defining quality of life are interchangeable is established most clearly by comparing their determinants. Does income increase life satisfaction but not happiness and emotional well-being? Do other factors similarly affect different measure of SWB? This paper will conduct a validity check of the stylized facts in the literature concerning the determinants of SWB.

We employ data on Australian twins to perform our analysis. A number of twin studies in the field of happiness literature use their genetic similarities to evaluate the heritability of well-being. Tellegen et al. (1988) and Lykken and Tellegen (1996) maintain that common family environment does not significantly impact personality traits and SWB but that genes have a large effect. Interestingly, the authors find that monozygotic twins reared together and monozygotic twins reared apart display heritability of their well-being of around 0.8 and unshared environment must account for the remaining 20 % of the variance in the well-being. However, these authors employed rather small samples, so their estimates should be viewed with caution. Using a nationally representative sample of twins from the US, De Neve et al. (2012) revealed that genetic variation explains around 33 % of the variation in life satisfaction. Relying on a sample of Dutch adolescent twins and four different measures of well-being, Bartels and Boomsma (2009) found that there are underlying additive genetic and non-genetic factors that cause clustering in the measures of well-being. They found that the heritability of SWB ranges from 40 to 50 %.

These studies used twin data to test the hypothesis that happiness is a genetically determined trait. We also tested to what extent monozygotic versus dizygotic twins provide similar responses to the well-being question. Most importantly, we employ a twin fixed effects strategy, which to the best of our knowledge has not been used in previous studies of well-being. Such a strategy explains the within-pair difference in the dependent variable by the within-pair difference in the independent variables. In this way, all the unobserved common for the twins characteristics are removed even if they cannot be measured. This is likely to reduce the selectivity bias. Therefore, twin-fixed effect models potentially surpass correlational analysis.

Furthermore, our study represents the first attempt in economics (to the best of our knowledge) to test the validity of the adaptation hypothesis using a large number of traumatic events and applying econometric techniques. To test the validity of this theory, we will analyze the effect of a number of traumatic events that occurred in adulthood and more recently.

## 1.1 Determinants of Emotional Well-Being: Covariates We Include

Based on several studies in the happiness literature, our analysis includes three categories of factors.<sup>1</sup> The first one, which accounts for the life situation, includes *demographic, personal and familial characteristics*. Such variables account for the gender, age, marital status, educational level of the respondent, religiousness and self-reported health. We can explicitly control for some personality traits (life abilities)—whether someone is extroverted or neurotic—following the short-form revised Eysenck’s personality traits questionnaire. A second category of characteristics includes *economic factors*. That group contains an indicator variable for being unemployed, and two variables for reporting income in the highest and lowest quartiles of the income distribution.

The last category of factors consists of *traumatic experiences* throughout one’s life (life history), including variables for physical abuse (that occurred when the respondent was between 6 and 13), for sexual abuse (either by a family member or an outsider), and for neglect. It also includes information about whether the respondent has been arrested, has spent time in jail, or has ever done something for which he/she could have been arrested, though they were not arrested. Although criminal behaviour is highly endogenous, an experience like spending time in jail could potentially have longlasting effects on one’s emotional well-being. Among traumatic experiences in adulthood, we know whether the interviewee has been in an accident, has experienced a natural disaster, has been assaulted (which lead to physical injuries), has been raped, has been held captive, has witnessed someone else being seriously injured (or murdered), or has observed a close person who has experienced something traumatic.

## 2 Materials and Methods

### 2.1 Data

We use data from the second wave from the Younger Cohort of the Australian Twin Register, the so called Semi-Structured Assessment for the Genetics of Alcoholism. Data were gathered between 1996 and 2000. We included some personality trait information from the first wave, collected between 1989 and 1990. Altogether we have 6265 single observations, of which 5530 form complete twin pairs. Among them, 2332 are monozygotic twins (1166 pairs) and 3198 are dizygotic twins (1599 pairs).

Our outcome variable was constructed based on the following question:

“How would you describe your emotional well-being? Would you say it is excellent, good, fair or poor?”

- 1-Poor,
- 2-Fair,
- 3-Good,
- 4-Excellent”

This question refers to the subjective evaluation of the respondents’ emotional experience. As such it inquires about their assessment of cumulative positive and negative affect. Therefore, it refers to the hedonic level of one’s well-being and does not necessarily

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<sup>1</sup> A detailed review of the effect of different characteristics on the subjective well-being that we conducted is available upon request.

presume a cognitive element (Veenhoven 1984). We acknowledge that this scale and a question about life evaluation could diverge because overall life evaluation is a global summary of one's life, whereas the hedonic evaluation consists of ongoing reactions to events (Diener 1994; Andrews and Withey 1976; Stock et al. 1986). Furthermore, we note that some subjects could have misinterpreted the question. Instead of understanding the question as relation to their overall assessment of feeling good or not (the affective component of happiness), they could have interpreted it as an inquiry about their mental health, which in itself is a component of happiness but is not equivalent to happiness.

No consensus exists in social science, however, about the best and most complete definition of well-being. Some argue that focusing on the affective component is less problematic because it does not require subjective awareness of how well one fares (Veenhoven 2009). Others argue that there is a difference between the hedonic and eudaimonic approaches to well-being as the latter focuses on the process of living well (Ryan et al. 2008). In future research, a more global definition should be implemented, i.e. one that includes physical, emotional, mental, social and spiritual well-being.<sup>2</sup> Such a scale would be particularly important when applied to twins as it would enable researchers to compare the within-twin variation within each of these dimensions and the correlations among the different dimensions.

However, we have only a single question available in this paper. We acknowledge its potential limitations and do not claim it can settle the debate in the literature. Instead, we follow the agnostic economic approach. Economists largely assume that though not unproblematic, the scales are reasonably comparable because different measures correlate and are likely to be confounded (Easterlin 2004; Diener 1994; Kahneman and Deaton 2010). In this way, we also perform a stylized check on the literature by comparing the effect of different factors on our measure of well-being versus other measures.

Only about 14 % of our sample rated their emotional well-being as *Poor* or *Fair*. Everyone else reports either *Good*, or *Excellent* (and the modal response being 3, i.e. *Good*). This accords with findings from other studies, which establish that people usually tend to rate their happiness or life satisfaction rather high, or in other words, there is bunching towards the top of the scale (Diener et al. 1999; Clark et al. 2008).

Table 1 below summarizes of the outcome variable by gender and zygosity of the twins. The average is 3.16. The second row of Table 1 displays the intra-class correlation in the emotional well-being report between dizygotic and monozygotic twins, obtained with a oneway analysis of variance (ANOVA) using random effects. This allowed us to determine what portion of the variance in the EWB is due to between-twin difference compared to within-twin difference. We computed that the within-pair correlation for dizygotic (DZ) twins is 0.08, and that for monozygotic (MZ) twins is 0.24. This means that among MZ twins, around 24 % of the overall variation in EWB comes from between twin variation. In general, the larger the intra-class correlation, the less variation comes from within the pair relative to the means between the pairs. Therefore, MZ twins are much more similar to each other than are DZ twins in their reporting of EWB. Similar to other studies (De Neve et al. 2012; Hans-Peter Kohler et al. 2005), we find higher correlations for MZ twins than for DZ ones (our numbers, in fact, come quite close to those of Hans-Peter Kohler et al. 2005 who found an intra-class correlation of 0.21 for younger MZ twins and 0.24 for older ones). This indicates the presence of genetic dispositions in the variation of EWB, and a smaller relevance for shared environment.

<sup>2</sup> An anonymous referee made this suggestion.

**Table 1** Summary of emotional well-being

	All	DZ twins	MZ twins	Males	Females
Emotional well-being [1, 2, 3, 4]	3.16 [0.7]	3.15 [0.71]	3.19 [0.68]	3.21 [0.69]	3.12 [0.71]
Intra-class correlation		0.08 [0.03]	0.24 [0.03]		
Observations	6265	3198	2332	2803	3462

Standard deviations are given in brackets

According to the remaining covariates (the full table can be obtained from the author upon request), the average level of education is around 12 years, the average age of the respondents is around 30, and 64 % of them reported to be married or cohabiting with someone at the time of the interview, while around 7 % are divorced or separated. Around 4 % reported that they are unemployed, and almost 70 % reported to be religious. The self-reported health is, overall, predominantly high. The scale for rating the health is similar to the one used to assess the EWB [ranging from poor (1) to excellent (4)]. Around 41 % reported physical abuse, and 11 %—sexual abuse. From the traumatic experiences, being involved in an accident and seeing someone else seriously injured or killed was reported by most of the respondents (19 and 23 %, respectively). Around 5 % reported rape, and around 10 % have been assaulted.

It is important to compare the prevalence rates of traumatic events in our sample to the general incidence rates for Australia. According to statistics by the Australian government, around 17 % of women 18 and older and 4 % of the men reported sexual assault, in most cases by a perpetrator they knew; around 18 % of women reported being sexually abused before the age of 16, and around 4 % of the women in the sample reported forced intercourse over their lifetime. Various studies of the prevalence of sexual abuse in Australia indicate that the rates range from around 10 % (Mamun et al. 2007) to 16 % (Dunne et al. 2003) for males and from 12 % (Dunne et al. 2003) to 42 % (Mazza et al. 2001) for females. Thus, sexual abuse reported in our study represented around 11 % of the entire population (15 % among women only), and 5 % of rape (8 % among women) are in the same ballpark as these official prevalence rate statistics.

Separating by gender, we found that overall, men and women are similar along many characteristics with a few substantial differences. Males reported higher emotional well-being, higher rates of physical abuse, lower rates of sexual abuse, lower extroversion and neuroticism scores, and higher frequencies for all of the traumatic experiences, except for rape.

Those reporting to be in poor versus those in excellent EWB differ in many characteristics.<sup>3</sup> Those with excellent well-being more frequently reported to be married, have higher education, better health; those with poor EWB are more often unemployed, divorced or separated, or have income in the lowest quartile. Interestingly, those with an excellent EWB did not report more frequently income in the highest quartile of the distribution in comparison to those with a poor one. This already signals the weak association between high income and emotional well-being (similar to Kahneman and Deaton 2010). Furthermore, respondents with poor emotional well-being reported more frequently physical and sexual abuse and neglect, more often have spent time in jail or done something for which they could be arrested. Lastly, this group also more frequently indicated involvement in an accident, assault, rape, captivity or having someone close to them who had been through a traumatic experience.

<sup>3</sup> Results available from the author upon request.

For a sample of twins, within-twin variation is especially important, as it enables us to perform our twin-fixed effects estimations. We have analyzed the proportion of families (among the whole sample of twins and among MZ ones) in which the response of one of the twins differs from that of his/her co-twin. We found a high degree of within-pair variation in the variables of interest, especially so in the traumatic events.<sup>4,5</sup>

## 2.2 Empirical Strategy

We began our analysis with a simple model in which we pooled the samples and treated the respondents as individual observations. In this way, we could compare our results with findings from other studies. We first explained the emotional well-being with different personal characteristics and economic factors, and later estimated it with reports about traumatic events in childhood and in recent years. We focused on a cardinal linear relationship.<sup>6</sup> Thus, we estimated an equation of the following form:

$$Y_i = \beta_1 + \beta_2 X_i + \varepsilon_i \quad (1)$$

where  $Y_i$  is our measure of well-being and it is equal to 1 if the respondent rates his emotional well-being as “poor”, 2, as “fair”, 3 as “good”, and 4 as “excellent”. In our vector of personal characteristics  $X_i$  we include our three groups of factors—personal and familial characteristics, economic factors and traumatic experiences;  $\varepsilon_i$  is an error term.

Since we did not have a random assignment into treatment, a simple OLS would fail to allow causal interpretation. Most probably, OLS results would be afflicted by an omitted variables bias stemming from unobserved heterogeneity. To reduce this bias, we proceeded to exploit the twin nature of the data by estimating a twin-fixed effects model. With twin-fixed effects, we removed common family and genetic factors (even if we cannot observe/measure them). The equation we estimated consists of the following form:

$$Y_{ij} = \alpha + \gamma X_{ij} + \mu_{ij} + u_{ij} \quad (2)$$

where  $Y_{ij}$  is the self-reported emotional well-being of twin  $i$  in family  $j$ . We again focused on a cardinal relationship.<sup>7</sup>  $X_{ij}$  is a vector of characteristics that vary within the twin pair.  $\mu_{ij}$  captures the common family environment and genes. Note that dizygotic twins are on

<sup>4</sup> Full results available from authors upon request.

<sup>5</sup> One could be concerned about where this within variation stems from in some of the cases. Whereas traumatic experiences are quite often a negative shock, out of the control of the individual, it is more difficult to justify the difference in the child abuse reports. The sexual abuse very often stems from an outsider and so is again often a negative exogenous event. The physical abuse is an interesting phenomenon and social science studies propose as an explanation a “single child” targeting where the parents would abuse only one of the children in the family. This could be due to some characteristics of the child (his gender, idiosyncratic behavior, physical and mental problems), or to some parental characteristics (mental disorders, abuse of alcohol, drugs, etc.) (see Jaffee et al. 2004).

<sup>6</sup> We estimated an ordinal logit model as well but obtained very similar results. Ferrer-i-Carbonell and Frijters (2002) show that whether one assumes cardinality or ordinality would not lead to different results. For ease of interpretation of the coefficients (especially so with the fixed effects) we stick to a cardinal relationship.

<sup>7</sup> No simple transformation is available that will purge the ordered response from the within-pair fixed effects. There are some attempts to consistently estimate an ordered logit (there are no such attempts in the ordered probit), where researchers attempt to collapse  $J$  different categories into two classes (see Winkelman and Winkelman, 1998; Baetschmann et al. 2011), which are later estimated with a conditional maximum likelihood (Chamberlain 1980). However, the coefficients derived with such approaches are very difficult to interpret.

average as much alike as any other siblings. Therefore, only in the identical twin estimates (apart from the shared background) we remove the effect of common genes. In this way, the unobserved heterogeneity bias is likely to be lower. Therefore, monozygotic twin estimates would be most reliable.

An advantage of Eq. (2) over panel data studies is that time-invariant personal covariates would be eliminated with longitudinal data. Many important observable characteristics (such as education level, marital status, number of children, gender, etc.) do not vary or vary very little over time and their effect on the SWB cannot be estimated. With our approach of twin-fixed effects such time-invariant characteristics would not be eliminated. However, twin-fixed effects is not necessarily a superior approach to longitudinal fixed-effects models. Each approach naturally has its shortcomings, and each gives us an idea of the relevance and size of a different type of omitted variables bias.

One might be concerned that differences in important observed characteristics within twin pairs are not random, which would lead to a bias in our estimation results. For instance, in the case of schooling, if a family is likely further the education of the twin who shows most promise, estimates of the effect of schooling on the EWB will be biased upwards. But if the family is trying to reduce the inequality and invests more in the worse performing twin, estimates will be downward biased (Ashenfelter and Krueger 1994). This could hold for the differences in many of the other variables. Unfortunately, we cannot know in which direction omitted variables may affect our results.

Another potential concern is a measurement error. Attenuation caused by a measurement error increases with twin-fixed effects due to the correlation within the pair, which leads to a lower effect, and biases our results downwards (Ashenfelter and Krueger 1994; Griliches 1979). The threat of a measurement error is perhaps highest in our traumatic experiences measures. The data are retrospective and people might unintentionally repress the memory of some traumatic event, or they might intentionally provide a misleading answer. If this is indeed the case, then our estimates would underestimate the true effect of adverse events on one's emotional well-being, and essentially, we would obtain a lower bound.

Second, a measurement error could stem from our emotional well-being measure. Though a measurement error in the outcome variable will not lead to biased estimates, it will still reduce the precision of our estimates since the measured variance would be higher than the true one. A number of problems could decrease the precision of the EWB, such as the respondents' mood during the interview, the experiences they have been through, their coping mechanisms, the framing of the questions, the order in which they appear, and some events (as external as the weather during the interview day) could possibly affect on the provided answers. Below, we address these potential problems one by one.

First of all, the well-being questions were asked at the beginning of the interview before the questions concerning traumatic events during one's childhood and adulthood. Experimental studies show that participants who were asked to describe a recent sad event and were afterwards asked to value their life satisfaction, gave an overall lower life-satisfaction score than subjects who were urged to remember recent happy events first (Schwarz and Clore 1983). Since our well-being questions precede the traumatic experiences sections, this was not likely to affect the mood of the respondents.

The next threat is the potential effect of one's mood on the EWB rating. This is not as problematic as one might initially imagine. First of all, good or bad mood is typically random (perpendicular to one's characteristics). Moreover, studies using repeated observations over time have established that there are no substantial and consistent

associations between mood states and SWB ratings. Test–retest correlations for mood are relatively small, whereas SWB correlations are substantially larger.<sup>8</sup>

Furthermore, it is very likely that personality affects the way people rate their well-being. Whether one is a pessimist or optimist, extroverted or introverted, are shown to correlate with life satisfaction reports, and such personality traits might predispose individuals to experience life events positively and negatively (Wilson 1967; Costa and McCrae 1980; Fujita 1991; Lucas et al. 1998). Some psychological studies show that even social desirability is a personality trait that enhances well-being rather than a source of error variance (Diener et al. 1991). We can explicitly control for extroversion and neuroticism using the revised small-scale Eysenck personality trait test, and implicitly for all other genetically determined personality traits. To address the issue of current mood affecting one's responses during the interview and for the respondent's general pessimism/optimism, we can compare the within-twin differences to questions that should have been answered in the same way.

Moreover, we can test for a comparison effect to one's co-twin. Numerous studies stress the importance of comparison to others in evaluating one's well-being. For instance, if overall unemployment is high, then losing a job would not have such a negative impact on one's happiness (Clark and Oswald 1994). We cannot account for effects stemming from all the peers of the respondents but we can use the information provided by the co-twin. For example, if one's twin is employed in a high-paying job, is happily married and enjoys great health, this could act as a negative externality on the co-twin who is not married, has health problems, or is in a low-paying job. In our robustness checks section we include some characteristics of the co-twin as right hand-side variables in the EWB equation.

A usual concern in twin studies is the presence of spillover effects. In our case, if one of the twins goes through a traumatic event and the other does not, the second might still be affected by his co-twin's experience. This is not very problematic for our estimations because we can explicitly control for a traumatic experience that happened to the respondent's co-twin, or anyone else close to him/her.

Finally, we need to be cautious about reverse causality. The presence of selection effects is especially troublesome for the marital status and health variables. Some studies find evidence that happy people enjoy a higher probability to get married and/or enjoy better health. To check whether a selection bias is a big problem for our estimates, we used health and marital status information from an earlier wave as instruments for the current ones, and as predictors of the current EWB.

### 3 Results

#### 3.1 Testing Some Stylized Facts

Table 2 shows our first set of regression results. It explains the EWB in terms of common factors in the literature that influence one's well-being. Here, and in all the tables to follow, the scale variables (EWB, health status, extroversion and neuroticism) have been normalized to a mean of 0 and a variance of 1. Standard errors are clustered on the twin-pair level. In the first column we estimate a linear relationship. The results in column (1) accord with the majority of findings in other studies. The EWB decreases with age. A 1 year

<sup>8</sup> Pavot and Diener (1993) found a two-months test–retest correlation of 0.82 for rates of subjective well-being, and William (1991) reported a correlation of 0.86 on views of life scale.



**Table 2** Estimates for determinants of emotional well-being

	(1) OLS	(2) FE, all twins	(3) FE, MZ
Age	-0.013** (0.005)		
Male	0.0986*** (0.027)	0.0982* (0.051)	
Married	0.267*** (0.029)	0.304*** (0.043)	0.275*** (0.067)
Divorced	-0.293*** (0.057)	-0.336*** (0.081)	-0.205 (0.127)
Education (in years)	0.0255*** (0.005)	0.0316*** (0.010)	0.0592*** (0.015)
Kids	-0.0286** (0.014)	-0.0163 (0.020)	-0.0270 (0.034)
Religion	0.0444 (0.027)	0.0406 (0.048)	-0.0635 (0.072)
Health	0.353*** (0.014)	0.322*** (0.019)	0.244*** (0.031)
Extroverted	0.115*** (0.014)	0.0545** (0.026)	-0.00941 (0.041)
Neurotic	-0.144*** (0.015)	-0.0859*** (0.024)	-0.0351 (0.040)
Unemployed	-0.202** (0.082)	-0.0710 (0.113)	0.201 (0.173)
Low income	-0.216*** (0.057)	-0.189** (0.076)	-0.233* (0.138)
High income	0.00987 (0.040)	-0.0468 (0.058)	-0.0597 (0.086)
Constant	-0.0908 (0.168)	-0.588*** (0.135)	-0.774*** (0.201)
Observations	5524	5524	2326
R <sup>2</sup>	0.216	0.161	0.099

Standard errors in parentheses, clustered within twin pair; Subjective well-being, health, extroversion and neuroticism scales standardized  
 FE fixed effects, MZ monozygotic twins  
 \*  $p < 0.10$ ; \*\*  $p < 0.05$ ;  
 \*\*\*  $p < 0.01$

increase in age reduces the EWB with 0.013 of its standard deviation. Using the German Socio-economic Panel (GSOEP) data, Ferrer-i-Carbonell and Frijters (2002, henceforth FCF) find that the coefficient for age is -0.03 (well-being measured on the 0–10 scale). Using data from the Latinobarometer, Graham (2005) finds a decrease of 0.025 of happiness with increase of age (with an ordered logit), and an identical coefficient using data from the US; and Graham et al. (2004) use data from Russia to find a negative association between age and happiness of a magnitude of -0.067.

One extra child reduces the EWB with 0.03 of its standard deviation. FCF also find a coefficient of -0.03 when using an ordered probit, and -0.05 when using an OLS. Frey et al. (2004) find having children increases life satisfaction with 0.068 using data from the GSOEP. Kohler et al. (2005) find a small positive effect of having children equal to 0.028 for females, but it disappears and becomes negative when they account for current partnership. For males, the same authors find a small positive effect of having children even after accounting for current partnership.

Our marriage variable is highly significant and positive, equal to 0.27. In their OLS with controls, FCF obtain a coefficient of 0.23. Using information from the World Values Survey (WVS), Helliwell and Putnam (2004, henceforth HP) find that being married or living with someone increases the self-reported happiness between 0.31 and 0.48 (using a rescaled measure of happiness from 1–4 to a 1–10 scale). Using twin data from Denmark, Kohler et al. (2005) find a positive effect of 0.26 in the well-being of females and 0.32 on the well-being of males (and it does not decrease with age) for those currently in a relationship. Stutzer and Frey (2006) use the GSOEP data in a study trying to account for selection effects, and find a coefficient of around 0.3 in an OLS estimation of life satisfaction.

A 1*sd* increase in health status is associated with an increase of a 0.35*sd* of the EWB; for FCF the subjective health variable has a coefficient of 0.39, and HP find an effect of health of 0.54 to 0.65 on the happiness and the life satisfaction, respectively. Graham et al. (2004) finds an effect of health equal to almost 0.5 using the Latinobarometer, of 0.46 for Russia, and of 0.62 for the US. In our case, being religious does not increase one's happiness. This could be because of the way we measure religiousness. For example, we cannot account for the engagement of the respondent in religious activities, which some studies show is the main aspect associated with increased life satisfaction (Dolan et al. 2008).

Being unemployed and having income in the lowest quartile negatively affects the EWB. Our unemployment variable of  $-0.24$  is similar to the 0.33 decrease in the life satisfaction set forth by Di Tella et al. (2001), using a scale from 1 to 4. Graham et al. (2004) establishes a negative coefficient of 0.49 for the effect of unemployment on happiness with the Latinobarometer data, one of  $-0.66$  for Russia, and of  $-0.68$  for the US. HP find a negative effect of 0.36 of unemployment on happiness, and one equal to  $-0.65$  for life satisfaction. Reporting high income, similar to the findings of Kahneman and Deaton (2010), does not increase emotional well-being. The EWB also increases with the extroversion score, and decreases with the neuroticism score.

Overall, our OLS results are very similar to findings in the literature, despite the different scales, countries of the studies, years of interviews, and regressors included. However, we want to test the robustness of these findings using twin-fixed effects and purging of the common familial background and genetic similarities. These estimates are shown in the remaining sections of Table 2. In the second column, we include the entire sample of twins. We include as explanatory variables only those which differ within the pair. In general, the significance and magnitude of the majority of the variables is preserved as we move from OLS to the twin-fixed effects. This implies that there is little bias stemming from shared environment.

In the last column, we present the estimates for MZ only. The coefficient of being married is almost identical to the one from the OLS estimation in column (1). Reporting divorce/separation is no longer statistically significant, though the coefficient is comparable in magnitude to the first column. The years of education variable increases in magnitude compared to columns (1) and (2), and now 1 year increase in the years of schooling is associated with 0.06*sd* increase in the EWB. The self-reported health continues to be statistically significant at the 1 % level. Now, neither of the variables capturing one's extroversion or neuroticism are statistically significant, which could indicate that they are to a large extent genetically determined. Being unemployed is no longer statistically significant but reporting income in the lowest quartile increases in absolute value, though only significant at the 10 % level. The low income variable could be a proxy for the

**Table 3** Estimates for determinants of emotional well-being, including traumatic events

	(1) OLS	(2) FE	(3) FE, MZ
Controls	Yes	Yes	Yes
Physical abuse	-0.0894*** (0.025)	-0.0973** (0.038)	-0.0682 (0.057)
Sexual abuse	-0.138*** (0.046)	-0.195*** (0.067)	0.0260 (0.114)
Neglect	-0.362*** (0.141)	-0.235 (0.188)	0.259 (0.306)
Ever arrested	-0.0531 (0.082)	-0.0329 (0.110)	0.110 (0.163)
Ever in jail	-0.278** (0.122)	-0.267 (0.231)	-0.297 (0.391)
Could be arrested	-0.116*** (0.031)	-0.121*** (0.044)	-0.0729 (0.071)
Was in accident	-0.0684** (0.033)	-0.0800* (0.047)	-0.0887 (0.071)
Was in disaster	-0.00233 (0.034)	0.0534 (0.051)	-0.0254 (0.080)
Was held captive	0.0640 (0.048)	0.0983 (0.068)	0.0545 (0.099)
Was raped	-0.167*** (0.063)	-0.137 (0.092)	0.0305 (0.139)
Was assaulted	-0.0451 (0.046)	-0.0715 (0.064)	-0.212** (0.100)
Witnessed injury/murder	0.0944*** (0.030)	0.0836* (0.044)	-0.0117 (0.066)
Trauma somebody else	-0.0798* (0.046)	-0.0584 (0.065)	0.0839 (0.096)
Constant	-0.0394 (0.167)	-0.457*** (0.135)	-0.730*** (0.204)
Observations	5487	5487	2317
$R^2$	0.235	0.176	0.110

Standard errors in parentheses, clustered within twin pair

\*  $p < 0.10$ ; \*\*  $p < 0.05$ ;

\*\*\*  $p < 0.01$

unemployment and this could explain why we no longer see any separate effect of the unemployment status.

Testing the stylized facts from the literature in Table 2, we can already draw some conclusions. Marital status, years of education, health status and low income continue to be significant determinants of the EWB when we apply twin-fixed effects, even when we focus on identical twins only. Moreover, the coefficients are close in magnitude to those from the OLS regression, which are overall, quite comparable to the findings of previous studies. This is reassuring as it indicates that despite using data from different countries, different scales and populations, and applying different estimation techniques, SWB (life satisfaction) studies still manage to persistently capture the most important factors that determine happiness.

### 3.2 Estimating the Effect of the Traumatic Factors

In Table 3 we repeat the estimations so far but instead include the variables for traumatic events in childhood and adulthood.<sup>9,10</sup> In the first column, we have again a linear relationship. Now, we are explaining around 24 % of the variance of the EWB compared to 22.7 % when we did not have the traumatic events included. All of the traumatic events in childhood—physical and sexual abuse and neglect—are statistically significant and negatively associated with the current EWB. If the respondent has been in jail, this is also likely to contribute negatively to his/her well-being. Among the traumatic events, a report of rape significantly reduces well-being and of witnessing an injury/murder significantly increases it. The latter could simply be a spurious relationship, or could indicate that if someone experienced something traumatic, in which he/she was not directly harmed, this would prompt them to appreciate and value life more.

In the entire sample of twins—given in column (2)—reporting physical or sexual abuse has a negative and statistically significant effect on the reported SWB, as well as doing something for which you could be arrested, even though you were not. Being involved in an accident reduces the EWB with 0.08*sd*. Among MZ twins, only being assaulted is statistically significant at the 5 % level. If someone reported assault at any point in their life, this reduces their EWB with 0.21 standard deviations. Overall, Table 3 does not provide convincing evidence that traumatic experiences affect one's long-run well-being once we remove the common family environment and genetics.

### 3.3 Testing the Adaptation Hypothesis with Traumatic Events in the Past 3 and 1 year

In this section we test the validity of the adaptation hypothesis by focusing on traumatic events that happened in the past 3 years and in the past year, respectively. If it is indeed the case that humans do adapt to their circumstances, then we expect to find a stronger effect of more recent events. The results for the sample of MZ are given in Table 4 below.

We see that marital, health status and years of education continue to be positive and statistically significant. We find interesting results for recent adverse experiences. If someone has been in an accident, or was assaulted in the past 3 years, all else being equal, this reduces his/her EWB with 0.4 and 0.51*sd*, respectively. When we focus on adverse events from the past year, all the above mentioned variables preserve their significance and magnitude. Moreover, now reporting rape significantly reduces the well-being with around 0.75*sd*. Therefore, we see in Table 4 that the more recent traumatic events seem to matter more for the EWB, which confirms the overall validity of the adaptation hypothesis.

<sup>9</sup> We estimated both models with and without extra controls. Those without controls in general explained less of the EWB variability and had higher in absolute value coefficients. We focus on models with full set of controls to increase the predictability of our model. In the FE, in general, the same variables had statistical significance (with minor exceptions).

<sup>10</sup> We also collapsed the different traumatic events only into a few categories, such as sexually-related traumas, violent traumas and accidental traumas in order to make sure it is not a few unlucky individuals who are driving the results. The estimates were comparable to Table 4 and are available from the author upon request.

**Table 4** Effects of recent traumatic events on the emotional well-being

	(1) FE, MZ, traumas in the past 3 years	(2) FE, MZ, traumas in the past year
Married	0.253*** (0.064)	0.240*** (0.065)
Divorced	-0.214* (0.126)	-0.223* (0.126)
Education (in years)	0.0597*** (0.015)	0.0601*** (0.015)
Health	0.246*** (0.031)	0.244*** (0.031)
Religion	-0.0736 (0.071)	-0.0568 (0.072)
Unemployed	0.193 (0.172)	0.187 (0.173)
Low income	-0.195 (0.135)	-0.198 (0.136)
High income	-0.0571 (0.085)	-0.0518 (0.084)
Physical abuse	-0.0677 (0.055)	-0.0677 (0.056)
Sexual abuse	0.0336 (0.111)	0.0282 (0.111)
Neglect	0.253 (0.286)	0.231 (0.279)
Ever was arrested	0.130 (0.155)	0.0947 (0.155)
Ever in jail	-0.340 (0.378)	-0.335 (0.363)
Could be arrested	-0.0906 (0.070)	-0.0846 (0.070)
Recent accident	-0.413*** (0.124)	-0.413*** (0.157)
Recent disaster	-0.0496 (0.134)	-0.0904 (0.205)
Recent assault	-0.487** (0.191)	-0.672** (0.298)
Recent rape	-0.0243 (0.284)	-0.753** (0.360)
Recently witnessed injury/murder	0.00423 (0.113)	-0.00393 (0.154)
Recently held captive	0.452* (0.237)	0.667* (0.372)
Trauma somebody else	0.0695 (0.094)	0.0873 (0.093)
Constant	-0.741*** (0.195)	-0.758*** (0.197)
Observations	2326	2326
R <sup>2</sup>	0.118	0.114

Standard errors in parentheses

FE fixed effects, MZ monozygotic twins

\*  $p < 0.10$ ; \* $p < 0.05$ ; \*\*\*  $p < 0.01$

## 4 Robustness Checks

A few problems could threaten the internal validity of our estimation approach. First of all, the current mood could affect the provided answers. Second, we tried to account for a potential reverse causality by using information from an earlier wave. Third, we checked whether there was a direct effect of some of the co-twin's observable characteristics on the EWB of his/her sibling. Finally, we tried to say something about the nature and nurture debate by only looking at twins who lived together until they were 18.<sup>11</sup>

### 4.1 Measurement Error

The mood of the respondent during the interview could affect the provided answers. To check whether this was the case (and also to account for one of the twins being, in general, more negative than his co-twin), we regressed the difference in the ratings of the emotional well-being on the difference in the answers of the questions that should be answered in the same way.<sup>12</sup> We did not find any significant difference and overall, no compelling evidence of a systematic misreporting because of current mood or general pessimism/optimism.<sup>13</sup>

### 4.2 Reverse Causality

Since one might argue that it is happy people who enjoy a higher probability of marriage and better health, we used marital status and health information from a previous wave. The data were gathered 1989–1990. Unfortunately, the first questionnaire does not contain information on the emotional well-being, but only includes health behaviour (and problems) and marital status.

We instrumented the marital status at the time of the second wave with the marital status at the time of the first wave. The first stage of the 2SLS is strong, and the marital status in the past is a strong predictor of the current marital status (coefficient of 0.2, statistically significant at the 1 % level). However, in the second stage, the marital status is no longer significant (for the whole sample of twins, and the MZ samples). A similar pattern is found for health status. Overall, though we cannot perfectly control for reversed causality, we do not find an effect of marital status and health measured at the first wave on the emotional well-being measured in the second wave.

### 4.3 Comparison to Co-twin

One might argue that twins, especially identical twins, have a special relationship and a twin's experiences could significantly affect his co-twin. Studies show that comparisons people make with others are very important in the way they rate their well-being so we checked to what extent the well-being and some personal characteristics of the co-twin directly affected his/her sibling's well-being. If one of the twins is doing quite well, enjoys a prosperous job, good health and a happy marriage, his co-twin could either share his happiness, or this could exert a negative effect on his well-being if his own situation is any

<sup>11</sup> We thank an anonymous referee who suggested that.

<sup>12</sup> Such as whether the respondents were raised by both natural parents, whether the parents used to fight in front of the children, whether either of the parents had problems with alcohol, how often the twins see and contact each other.

<sup>13</sup> Results available upon request.

less favorable. Therefore, we included the co-twin's well-being, marital status, self-reported health, unemployment status and indicators for having either low or high income as right-hand side variables. Only the marital status and the emotional well-being of the co-twin were significant. If the twin is married, this decreases the EWB of his co-twin with  $0.06sd$ , and one deviation increase in the EWB of a twin increases the EWB of his co-twin with around  $0.07sd$ . So, there is some indication for the effect of the co-twin's situation but since we cannot perform our twin-fixed effects estimation, we refrain from making strong conclusions.

#### 4.4 The Effect of Nature

To distinguish between nature versus nurture, we repeated our main estimates for twins who lived together until they were 18. For pairs who started to live apart from early on, one could argue there is a lower effect of the shared environment (lower nurture effect). The majority of our respondents (96 %) lived together until they were at least 16, and more than 75 % of them lived together until they were at least 18. Repeating our main estimations and the estimations for the effect of traumatic events for twins who lived together until they were 18, we found quite similar results to those in Sect. 3.<sup>14</sup> Therefore, a lower effect of shared environment would not be a problem for our results.

### 5 Discussion and Conclusions

Despite the increased economic interest in well-being in the past few decades, there are still quite a few pressing issues in the literature. Establishing causality is difficult and so far, the best attempts in the literature use longitudinal data. Whereas using panel data reduces bias stemming from individual heterogeneity, with such approach we cannot account for time-invariant characteristics of the respondents—a limitation we can overcome with twin data. The biggest advantage of the twin-fixed effects is that we purge our estimates of unobserved familial and genetic similarities, reducing the omitted variables bias. Furthermore, some studies argue that happiness is a genetically determined personality trait. With data on identical twins, such a hypothesis—even if true—would not pose a problem for our results. Of course, this approach comes with its limitations, acknowledged and extensively discussed in the paper.

Our findings are consistent with the stylized facts in the literature. We find that marital status, self-reported health, years of education and low income have a significant effect on self-reported emotional well-being. Moreover, the magnitude of our coefficients is rather similar to the most prominent studies in the literature. This is a good signal of the usefulness of well-being as a valuable concept with potential important implications. We also confirm the validity of the adaptation hypothesis, which postulates that humans can adjust to negative shocks. We find the strongest effect from traumatic events that happened in the past year, still a strong effect from some adverse experiences from the past 3 years, and overall, a dissipating effect over time.

As we noted, we were limited in using only a single question to measure the well-being in our sample. We believe that a more extensive analysis using twins could be helpful in answering some pressing questions in the well-being literature. In the future, more complex measures of well-being (focusing on a number of aspects of one's life), questions

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<sup>14</sup> Full regression results could be obtained upon request.

about one's satisfaction with life, as well as inquiries about co-twin's well-being would be welcome. In this way, we could better distinguish the difference in well-being measures as well as gain more understanding about the nature-nurture relationship.

Our results raise a number of policy-relevant implications. First of all, we cannot ignore the important impact of health and education on one's well-being. Therefore, promoting education and healthy behaviour is likely to generate returns in terms of well-being, among other things. Eradicating poverty and promoting relationship skills is likely to contribute to society's well-being as well. Finally, victims of different traumatic experiences should be assisted in order to recover more quickly from their ordeals. All of these policies could lead to large potential returns and contribute to a happier society.

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