Curr Psychol
DOI 10.1007/s12144-015-9387-x

Genetic and Environmental Effects on Eudaimonic and Hedonic Well-Being: Evidence from a Post-Communist Culture

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Abstract Prior behavioral genetic studies in positive psychology were entirely based on data from Western democracies, leaving the question open whether the magnitude of genetic effects on well-being indicators is similar in substantially different societal contexts. The aim of this study, therefore, was to investigate the structure of the genetic and environmental influences on happiness, life satisfaction, meaning in life, optimism, sense of coherence, and general well-being in a non-Western sample. Altogether, 100 monozygotic and 36 same-sex dizygotic twin pairs from Hungary (73 % female; M_{age} = 43 years, SD = 16 years) participated in the survey. Univariate classical twin modeling (ACE analysis) was performed using structural equation models. Heritability estimates of the positive psychological variables were largely variable, ranging from 0 % (happiness and meaning in life) to 67 % (life satisfaction). Also, estimates for the influence of common environment fell between 0 % (life satisfaction, sense of coherence, and well-being) and 60 % (meaning in life). Unshared environmental influences however, explained a moderate variance of all investigated variables (33–62 %). Most results were in line with previous findings from Western countries; however, some notable differences—e.g., lower hereditary influence for happiness or more robust role of shared environmental effects for optimism—were also established. These findings suggest that the communist and post-communist legacy did not produce drastic differences in the structure of heritability and environmental influences as compared to countries with longer traditions of democracy and economic prosperity.

Keywords Heritability · Meaning in life · Optimism · Sense of coherence · Well-being · Cultural differences

Introduction

Positive psychology is the scientific investigation of factors that makes life most worth living. It is an orientation in psychological theory and practice that focuses on strength instead of weakness, on constructing the best things in life instead of repairing the worst, and on making the lives of healthy people more fulfilling instead of 'merely' healing disorders (Peterson 2008). Positive psychology deals with human virtues and strengths (Sheldon and King 2001) including positive experiences at the subjective level (e.g., optimism or happiness), personality traits on the personal level (e.g., wisdom or forgiveness), and civic virtues at the community level (e.g., tolerance or responsibility) (Seligman and Csikszentmihalyi 2000).

When conceptualizing positive psychological variables, relevant constructs are often categorized as hedonic or eudaimonic characteristics. While the first refers to well-being in terms of pain avoidance and pleasure attainment, the latter focuses on self-realization and meaning in life and approaches well-being in terms of the degree to which an individual fulfills her or his potential (Ryan and Deci 2001).

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Published online: 19 October 2015

However, there are also positive psychological constructs (e.g., optimism) that cannot be easily classified according to these two categories as they contain elements of both eudaimonic and hedonic well-being but are not pure manifestations of either (Boehm and Kubzansky 2012). Investigating all three categories of positive psychology constructs simultaneously is highly desirable as this approach provides more generalizable findings than investigations focusing only on one main group of these well-being indicators.

To further expand our understanding of the sources of variation in positive psychological characteristics, the present study investigates the relative contribution of genetic and environmental factors to a relatively large number of—hedonic, eudaimonic, and mixed—well-being indicators in a sample of twins from Hungary. Previous behavioral genetic studies in positive psychology were exclusively based on data from Western democracies, leaving the question open whether the magnitude of genetic effects on well-being indicators are similar in substantially different societal contexts. Namely, it is important to highlight that—in contrast to some common misinterpretation of the concept— heritability index is not an absolute value but a relative estimate referring to individual differences in a specific population arising from genetic differences (Nes 2010). Larger variability in socioeconomic and cultural factors influencing a psychological variable leads to lower heritability values for the given construct in the given population and vice versa: in highly developed, democratic and inclusive societies (Robinson and Acemoglu 2012), the genetic component in the variation of well-being indicators will increase reflecting a social good, the elimination of environmental inequality (Nes 2010). Therefore, heritability findings in behavior genetic studies cannot be automatically generalized across different populations and cultures, and thus results obtained in specific cultural contexts need to be cross-validated by studies conducted in societies with different traditions, institutions, and structures.

Individuals, for instance, in Eastern European countries lived under totalitarian political regimes for decades in the second half of the twentieth century, after which a period of rapid political and social changes occurred in the last two and a half decades. This transformation resulted in a drastic growth in socioeconomic polarization and radically different levels of perceived stress, defenselessness, hopelessness, and learned helplessness across social strata (Erdos 2010; Pikó 2001, 2002a, 2002b; Skrabski et al. 2003). We argue that compared to the societal conditions of traditional Western democracies, the extremely large variability in these societal characteristics—also relevant in determining the psychological well-being of the individual—might also be reflected in heritability estimates. We assume that in an Eastern European country like Hungary, genetic effects would be less influential in determining positive mental health than in Western countries where the ratio of genetic and environmental factors in the background of positive psychology variables has been investigated traditionally.

Methods

Sample and Procedure

All participants gave informed consent prior to entering the study, which was approved by a local ethical committee. Altogether, 100 monozygotic and 36 same-sex dizygotic Hungarian adult twin pairs raised together were involved in this study (N = 272). Participants were recruited from the Hungarian Twin Registry (Littvay et al. 2013) in 2009 and 2010. Zygosity was assessed using a standard validated questionnaire on the degree of physical similarity of twins during infancy; this method of zygosity determination is 99 % accurate (Kyvik et al. 1995). Characteristics of the sample are summarized in Table 1.

Table 1 Characteristics of the study sample

	Total (N = 242)	Monozygotic (N = 200)	Dizygotic (N = 72)	Comparison of the MZ and DZ pairs
Age	43.27 ± 16.30 (18–82)	41.33 ± 16.33 (18–82)	48.67 ± 15.07 (18–74)	$t = -2.358$, $p = 0.020$
Sex [N (%)]				$\chi2 = 0.120$, $p = 0.729$
Male	66 (27.27)	56 (28.00)	18 (25.00)	
Female	176 (72.72)	144 (72.00)	54 (75.00)	
Happiness	7.75 ± 1.67 (1–10)	7.8 ± 1.66 (1–10)	7.61 ± 1.71 (3–10)	$t = 0.422$, $p = 0.674$
Life satisfaction	17.07 ± 4.07 (6–25)	17.40 ± 4.20 (6–25)	16.36 ± 3.43 (8–23)	$t = 1.361$, $p = 0.176$
Meaning in life	31.15 ± 4.71 (14–40)	31.4 ± 4.79 (14–40)	30.43 ± 4.44 (23–40)	$t = 0.372$, $p = 0.710$
Optimism	21.99 ± 4.18 (6–30)	22.23 ± 4.21 (8–30)	21.32 ± 4.04 (6–29)	$t = 0.508$, $p = 0.612$
Sense of coherence	66.62 ± 10.65 (37–91)	67.2 ± 10.85 (37–91)	65.03 ± 9.96 (39–87)	$t = 1.687$, $p = 0.094$
Well-being	18.15 ± 4.07 (5–25)	18.36 ± 4.09 (6–25)	17.58 ± 4.02 (5–25)	$t = 0.501$, $p = 0.617$

Displayed values for continuous variables are means ± standard deviations (minimum – maximum values)

Measures

To assess hedonic well-being, scales measuring life satisfaction, general well-being, and happiness were employed. General life satisfaction was measured by the Satisfaction with Life Scale (Diener et al. 1985; Martos et al. 2014) ($\alpha = 0.85$). General psychological well-being of the respondents was assessed using the WHO Well-being Index (Bech et al. 1996; Susánszky et al. 2006) ($\alpha = 0.84$). Happiness was assessed by the following question: "Taken as a whole, how much do you feel happy?" Respondents were asked to answer on a 10-point rating scale ranging from completely unhappy (1) to completely happy (10).

Dispositional optimism, a positive psychological characteristic including elements of both hedonic and eudaimonic well-being, was assessed by the revised Life Orientation Test (Bérdi and Köteles 2010; Scheier et al. 1994) ($\alpha = 0.73$). To investigate eudaimonic well-being, measurement instruments of perceived life meaning and sense of coherence were employed. To assess the former, the Life Meaning Subscale from the Brief Stress and Coping Inventory was administered (Konkolÿ Thege et al. 2008; Rahe and Tolles 2002) ($\alpha = 0.76$). Sense of coherence was measured by the Sense of Coherence Scale (Antonovsky 1993; Jeges and Varga 2006) ($\alpha = 0.79$).

Statistical Analyses

SPSS 22.0 and Mplus 7.2 were used to conduct the statistical analyses. A descriptive estimate of the hereditary influence was performed using the within-pair correlation in monozygotic (*r*MZ) and dizygotic (*r*DZ) twin pairs with the corresponding 95 % confidence intervals. Further, univariate structural equation models were fitted to estimate the relative importance of hereditary and environmental effects on the investigated psychological variables.

Using ACE analysis (Medland and Hatemi 2009), it is possible to divide phenotypic variance into *hereditary influences* inferred from the difference between MZ and DZ co-twin dissimilarity (A: additive genetic effects); *common/shared environmental effects* from MZ and DZ co-twin similarity regardless of zygosity (C: any environmental factor that affects the twins in the same way); and *unshared environmental influences* from MZ and DZ co-twin dissimilarity regardless of zygosity (E: any environmental factor that affects one twin but not the other, or factors that affect either twin in a different way). Empirical confidence intervals were calculated with the Bollen–Stine Bootstrap procedure (Bollen and Stine 1992). All analyses were adjusted for sex and age. For each positive psychological attribute, the best fitting model was chosen using nested model comparison. If only one of the two reduced models (A-E or C-E) fit significantly worse than the full A-C-E model, then the other reduced model was chosen. If the A-C-E, A-E, or C-E models were indistinguishable in their fit indices, the A-C-E model was preferred.

Results

Correlations in the ACE model along the study variables between members of the twin pairs are shown in Table 2. Monozygotic co-twin correlation coefficients were higher than those of dizygotic twins in the cases of satisfaction with life, optimism, sense of coherence, and general well-being suggesting that heritability has considerable explanatory power for the variance of these variables. However, in the case of happiness, co-twin correlations were low and did not differ across zygosity providing evidence for the importance of unique environmental effects. Finally, concerning meaning in life, the co-twin correlations were similarly high independent of the proportion of genes shared pointing to the importance of shared environment.

Results of the structural equation modeling (Table 2) suggested that the relative importance of additive genetic factors was largely variable across the positive psychological variables under investigation. While for some positive characteristics, genetic factors did not explain any portion of the variance (happiness and meaning in life), for others, hereditary factors were the most influential agents (satisfaction with life and sense of coherence). Similarly, variance explained by common (shared) environmental factors was estimated to be within a wide range, with values falling between 0 % (life satisfaction, sense of coherence, and well-being) and 60 % (meaning in life). However, the unique (unshared) environmental influence explained a moderate variance in case of all investigated positive psychological attributes (33–62 %).

Discussion

The aim of the present study was to deepen our understanding of the extent to which positive psychological attributes—including eudaimonic, hedonic, and variables with mixed characteristics—are influenced by genetic factors, and to investigate whether these estimates are different in an Eastern European, rapidly changing and unsteady society when compared to previous reports from Western countries.

Our results concerning optimism and subjective well-being were in line with previous Western research data showing hereditary estimates around 30 % and 40–50 %, respectively (Carver and Scheier 2014; Rietveld et al. 2013). Further, with regard to life satisfaction, the present analyses supported the higher hereditary estimates of the wide continuum (19–59 %) set by previous studies (Caprara et al. 2009; Franz et al. 2012). In contrast, our findings showed substantially lower estimates expressing the role of genetic factors than suggested by

Table 2 Parameter estimates for additive hereditary (A), common environment (C), and unique environmental influences (E) on positive psychological characteristics by structural equation modeling (100 monozygotic, 36 dizygotic twin pairs)

		AIC	BIC	−2LL	Difference in -2LL	*P* value of χ^2 difference (df = 1)	r_{MZ}	r_{DZ}	A	95 % CI for A	C	95 % CI for C	E	95 % CI for E
Happiness	Saturated	1030.3	1047.8	1018.3			0.38 (0.18–0.58)	0.39 (0.00–0.68)						
	A-C-E	**1030.4**	**1047.8**	**1018.4**					**0.00**	**0.00–0.30**	**0.38**	**0.10–0.61**	**0.62**	**0.45–0.82**
	A-E	1030.1	1044.7	1020.1	1.772	0.183			0.40	0.22–0.59	0.00	0.00–0.00	0.60	0.41–0.78
	C-E	1028.4	1042.9	1018.4	0	1.000			0.00	0.00–0.00	0.38	0.21–0.57	0.62	0.43–0.79
Life satisfaction	Saturated	1452.7	1470.2	1440.7			0.67 (0.56–0.77)	0.46 (0.08–0.72)						
	A-C-E	1452.7	1470.2	1440.7					0.41	0.00–0.72	0.26	0.00–0.675	0.33	0.24–0.44
	A-E	**1451.4**	**1466.0**	**1441.4**	**0.71**	**0.399**			**0.67**	**0.56–0.77**	**0.00**	**0.00–0.00**	**0.33**	**0.23–0.44**
	C-E	1453.9	1468.4	1443.9	3.182	0.075			0.00	0.00–0.00	0.62	0.50–0.73	0.38	0.27–0.50
Meaning in life	Saturated	1553.3	1570.7	1541.3			0.60 (0.46–0.72)	0.63 (0.31–0.81)						
	A-C-E	1553.3	1570.7	1541.3					0.00	0.00–0.611	0.60	0.36–0.73	0.40	0.29–0.54
	A-E	1557.0	1571.6	1547.0	5.696	0.017			0.61	0.48–0.72	0.00	0.00–0.00	0.39	0.28–0.52
	C-E	**1551.3**	**1565.9**	**1541.3**	**0**	**1**			**0.00**	**0.00–0.00**	**0.60**	**0.48–0.72**	**0.40**	**0.28–0.52**
Optimism	Saturated	1515.9	1533.4	1503.9			0.50 (0.35–0.62)	0.37 (0.11–0.68)						
	A-C-E	**1515.9**	**1533.4**	**1503.9**					**0.25**	**0.00–0.59**	**0.25**	**0.00–0.56**	**0.50**	**0.38–0.64**
	A-E	1514.6	1529.1	1504.6	0.642	0.423			0.50	0.37–0.62	0.00	0.00–0.00	0.50	0.38–0.63
	C-E	1514.6	1529.2	1504.6	0.712	0.398			0.00	0.00–0.00	0.46	0.00–0.60	0.54	0.40–0.65
Sense of coherence	Saturated	2027.2	2044.6	2015.2			0.52 (0.40–0.66)	0.12 (−0.30–0.48)						
	A-C-E	2027.8	2045.3	2015.8					0.52	0.31–0.67	0.00	0.00–0.00	0.48	0.34–0.63
	A-E	**2025.8**	**2040.4**	**2015.8**	**0**	**1.000**			**0.52**	**0.37–0.66**	**0.00**	**0.00–0.00**	**0.48**	**0.34–0.63**
	C-E	2031.1	2045.7	2021.1	5.276	0.021			0.00	0.00–0.00	0.43	0.30–0.59	0.57	0.41–0.70
Well-being	Saturated	1508.0	1525.4	1496.0			0.46 (0.30–0.62)	0.15 (−0.16–0.49)						
	A-C-E	1508.2	1525.7	1496.2					0.45	0.13–0.62	0.00	0.00–0.46	0.55	0.39–0.70
	A-E	**1506.2**	**1520.8**	**1496.2**	**0**	**1.000**			**0.45**	**0.30–0.61**	**0.00**	**0.00–0.00**	**0.55**	**0.39–0.70**
	C-E	1509.5	1524.1	1499.5	3.356	0.067			0.00	0.00–0.00	0.40	0.23–0.53	0.62	0.47–0.77

Best fitting models – based on nested model comparisons – are highlighted with bold

previous studies (35–50 %) concerning overall happiness (Nes 2010)—in accordance with our assumptions based on the extremely large socioeconomic polarization within the Hungarian society.

The two least studied variables investigated here were perceived level of meaning in life and sense of coherence, two key eudaimonic well-being indicators. Concerning life meaning, we are aware of one single behavioral genetic study from the US suggesting a hereditary estimate of 22 % for this construct (Steger et al. 2011). Even though—again in line with our expectations—our data revealed an even lower value, this finding is parallel with Steger and colleagues' results in the sense that it is among the positive psychological variables least determined by genetic factors—also in line with the low temporal stability of this construct (Konkolÿ Thege et al. 2013; Krause 2007).

To the best of our knowledge, a heritability estimate for sense of coherence has never been reported to date, the estimate of which was 52 % according to the present study. In general, it fits with the vast majority of empirical data showing a moderately strong influence of genetic effects on positive psychological variables. However, it is in contradiction with the theory of the developer of the construct, where the development of this characteristic is traced back mainly to influences of the narrower and broader social environment (Antonovsky 1991).

A further important aspect of our results is that shared environmental effects in previous investigations concerning positive psychological attributes usually proved to be negligible or non-existent (Sprangers et al. 2010), while according to the present data they were prevalent in the background of overall happiness and optimism, while robust in the case of life meaning. This pattern also supports the notion that Hungarian society has not been successful in lessening environmental inequalities shaping the well-being of its citizens (Nes 2010). This assumption is supported by other findings concerning political ideologies showing that shared environmental effects were most relevant in Hungary among the five countries investigated (Hatemi et al. 2014).

To sum up, the results of our study provided some but not homogeneous support for our hypothesis according to which genetic influences would be less significant in determining positive psychology variables in a cultural context with larger variability in socioeconomic and cultural factors relevant in determining wellbeing. It is possible that low sample size (see in detail among the study limitations) played an important role in such patterning of the results but it is also feasible that the obvious differences between Western democracies and Eastern Europe are still not large enough to change hereditary indexes systematically with regard to psychological flourishing. A further possible explanation is that Western societies themselves are less homogeneous than conceptualized here (cf. the apparent differences between the Western European societies and the US in terms of socioeconomic inequalities). Future studies from this and other non-Western regions are needed to help clarify the generalizability of the findings previously reported in Western behavioral genetic studies into positive psychology.

Some limitations of the present study also have to be noted. First, the overall sample size was relatively small for twin studies, not allowing, for instance, direct comparisons of males and females. Further, some argue that with small samples like the present one, model reduction should not be used at all as it artificially deflates confidence intervals (Hatemi et al. 2014); this is why the full A-C-E model was also presented in each case. Finally, the one-item overall happiness measure might also be criticized as single-item assessment tools are generally considered as less reliable when compared to multi-item questionnaires. However, at the time of conducting the study, no validated questionnaire was available in the Hungarian language to assess this construct.

Beyond shedding light on some potential cultural differences, we believe that the present study can also contribute to the recognition that psychological flourishing is not entirely—or in several cases not even mainly—determined by our genetic heritage, thus leaving considerably large room for its improvement by psychosocial intervention and prevention efforts. On the other hand, we also hope that the findings of the present paper can serve as further impetus for the efforts aiming to explore the specific genes or genomic regions relevant among the biological determinants of positive mental health (Sprangers et al. 2010).

Compliance with Ethical Standards

Disclosure of Potential Conflicts of Interest The study was supported by Medexpert Ltd. The first author also gratefully acknowledges the financial support of the Norlien Foundation and the IMPART program (Intersections of Mental Health Perspectives in Addictions Research Training) received while working on this paper.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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