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How Money Buys Happiness: Genetic and Environmental Processes Linking Finances and Life Satisfaction

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Measures of wealth such as income and assets are commonly considered to be objective measures of environmental circumstances, making direct contributions to life satisfaction. Here, the authors explored the accuracy of this assumption. Using a nationwide sample of 719 twin pairs from the National Survey of Midlife Development in the United States, the authors first noted the relative independence of most perceptions about financial status from measures of actual wealth. They then demonstrated that perceived financial situation and control over life completely mediated the association between measures of actual wealth and life satisfaction. Finally, they showed that financial resources appeared to protect life satisfaction from environmental shocks. In addition, control appeared to act as a mechanism translating life circumstances into life satisfaction.

Keywords: life satisfaction, perceived financial position, income, perceived control over life, twin study

Measures of wealth such as income and assets are commonly considered to be objective assessments of environmental circumstances, making direct contributions to happiness or life satisfaction. Indeed, the correlation between an individual's income and life satisfaction ranges as high as .50 in some countries (Diener & Oishi, 2000). The standard microeconomic explanation for this correlation is that income generates opportunities for individuals to select courses of action that improve well-being (Schwartz, 2004), leading to the presumption that there is a direct causal link between wealth and well-being (Diener & Seligman, 2004). The standard psychological explanation for this correlation posits essentially the same effect, but it focuses on the limitations on the development of human potential imposed by the stresses of meeting day-to-day needs in the difficult circumstances presented by relative lack of income (Adler & Snibbe, 2003). Either way, income and assets are assumed to provide direct measures of the environmental potential to generate resources to create a satisfying life.

At the same time, there is substantial evidence that the link between higher income and life satisfaction is not direct. Within nations, the correlations between income and life satisfaction are stronger in poorer nations than in wealthier nations (Diener & Oishi, 2000; Veenhoven, 1991), as are the correlations between financial satisfaction and life satisfaction (Diener & Diener, 1995). Life satisfaction increases only slightly relative to continuing increases in income in wealthy societies (Helliwell, 2003), and increases in individual income are reliably associated with later increases in individual well-being only when the income increases are slow and steady (Diener & Biswas-Diener, 2002), hinting that expectations about and perceived control of increases may be involved in the association with well-being. Longitudinal data also suggest that causation may flow in both directions: Higher life satisfaction contributes to higher income as well (Diener & Seligman, 2004), and a disposition toward optimism and positive affect may contribute to both a positive overall evaluation of life and a positive evaluation of particular life circumstances. In addition, the materialism associated with valuing higher income may reduce life satisfaction (Nickerson, Schwartz, Diener, & Kahneman, 2003), thus offsetting the positive effects of actually receiving higher income. Taken together, these data hint that the economic environment important to life satisfaction may consist of psychological perceptions about financial matters rather than the actual financial matters themselves. That is, psychological variables may mediate the association between income and other economic variables and life satisfaction.

Campbell, Converse, and Rodgers (1976) proposed the relative standards model to explain this psychological process. Income and assets are objective measures that confer a specific amount of purchasing power, but under the relative standards model, it is the value of these measures relative to one's expectations, desires, and standards of comparison that is of importance for satisfaction with one's circumstances in the financial domain. Michalos (1985) and Solberg, Diener, Wirtz, Lucas, and Oishi (2002) have provided empirical data in support of this overall model. In these studies, minimal discrepancy between material desires and the ability to afford them played the strongest role in predicting financial satisfaction as well as mediating the effects of comparison with socially important others and with earlier financial situations. It is reasonable to extend the relative standards model to propose that it is satisfaction with one's financial situation, rather than the financial situation itself, that is associated with life satisfaction. If this is true, one should expect perceived financial situation to be one

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environmental variable that mediates the association between income and life satisfaction. One might also expect perceptions about adequacy of financial resources to be only relatively loosely linked to actual financial resources. And, because the accumulation of financial assets requires income in excess of spending (or outlays to obtain desired material goods), one might expect assets to be relatively loosely associated with income.

Another psychological variable that may act as an environmental mediator between actual economic resources and life satisfaction is perceived control over one's life. Having a strong sense of control has been consistently linked to greater overall satisfaction (Cummins, 2000; Klonowicz, 2001; Lang & Heckhausen, 2001; Myers & Diener, 1995; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000), but the mechanisms underlying the association have not been articulated. One possibility is that people who perceive that they are capable of charting a course of action that will result in a desired outcome are more likely to pursue that course of action. Through that pursuit, they are more likely to achieve the desired outcome, leading to greater satisfaction because of both the attainment of a desired outcome and the enhanced perception of environmental mastery. This suggests a means by which perceived control might mediate the association between income and life satisfaction as well: Many of the courses of action people follow involve their jobs, careers, and other means by which they generate economic resources. Those who believe they have control over these aspects of their lives may be more successful in generating favorable economic outcomes for themselves. Lachman and Weaver (1998) have provided some evidence corroborating this interpretation with their finding that people in low-income groups who had high perceived control over their lives reported levels of well-being as high as those in high-income groups.

If this interpretation is correct, one should expect perceived financial situation and perceived control to be moderately correlated because the exertion of control over one's life is one of the major ways that one achieves a financial situation that is perceived to be satisfactory. One should also expect perceived financial situation and perceived control each to be moderately correlated with life satisfaction. At the same time, one should expect each to make a substantive environmental contribution to the prediction of life satisfaction, independent of the other. We thus proposed that both the standard microeconomic and psychological models of the environmental effects of economic circumstances need refinement: Actual dollar amounts of economic resources (in the form of income and assets) measure the environmental potential to generate resources to create a satisfying life only indirectly. Perceived financial situation and perceived control over one's life play the direct and mediating environmental roles.

Another condition is necessary if one is to consider perceived financial situation and perceived control over life to be environmentally mediating factors in the association between economic resources and life satisfaction. Though others have contributed corroborating data (e.g., Headey & Wearing, 1992; Plomin, Scheier, Bergeman, & Pedersen, 1992; Roysamb, Harris, Magnus, Vitterso, & Tambs, 2002), Lykken (2000; Lykken & Tellegen, 1996) has probably articulated most clearly the point that there appears to be a "happiness set point" under strong genetic influence, with as much as 80% of the stable variation in life satisfaction within individuals over time being associated with genetic variation. This means that, to be environmental mediators, perceived financial situation and perceived control over life must each be independently associated with life satisfaction after controlling for the genetic influences on individual differences in life satisfaction. Thus, the variance in life satisfaction they explain must be independent of the genetically influenced variation in life satisfaction.

The extent that perceived financial situation and perceived control do operate in this manner is important for two reasons. First, as Turkheimer and Waldron (2000) have pointed out, efforts to identify specific measured variables that account for substantial proportions of variance attributable to nonshared environmental influences have not been very successful. If we can demonstrate the relations proposed here, both the approach used and the results themselves will be noteworthy. Second, the existence of the proposed relations suggests a mechanism by which perceived financial situation and perceived control might exert their mean effects. As Diener and Diener (1996) have pointed out, most people are pretty well satisfied with their lives at any point in time. Cummins (2000) noted that across populations and measures, mean life satisfaction scores can be predicted to lie between 70% and 80% of the maximum for the scale used, with individual variation within populations negatively skewed and ranging normatively between 40% and 100% of the scale maximum. Positive and negative life events obviously affect life satisfaction, but their effects appear to be of very limited duration (Suh, Diener, & Fujita, 1996), with most individuals returning to some moderately positive set point relatively quickly after even extremely positive or negative life events. This suggests that positive and negative life events tend to contribute not to individual differences in life satisfaction that are stable over time but to individual differences that vary with time. Consistent with Lykken's (2000; Lykken & Tellegen, 1996) definition of the happiness set point, one might expect genetic influences to contribute primarily to stable variation among individuals in life satisfaction, leaving variation in life satisfaction within individuals to environmental influence. Such a positively biased and buffered system would have clear adaptive value, as threatening events would tend to be noticed quickly (yet overcome after the threat passed) and the overall positive bias would allow the goal-seeking behavior necessary for survival and reproduction to prevail. In the presence of greater economic resources and/or greater perceived control, however, one might expect both fewer threatening events and greater ability to cope with them, leading to reduced environmental variance associated with life satisfaction in such situations.

In summary then, we posited three novel hypotheses regarding the association between economic resources and life satisfaction. First, we proposed that actual financial resources are only loosely tied to perceptions about their adequacy, and assets are only loosely related to income. Second, we hypothesized that perceived control and perceived financial situation completely mediate any association between economic resources and life satisfaction and that both make substantial environmental contributions to life satisfaction. Finally, we proposed that the favorable situations created by both greater economic resources and greater perceived control are associated with reduced environmental variance in life satisfaction. This would mean that genetic influences account for a greater proportion of the total variance in life satisfaction in those situations, and that the heritability, which is the proportion of total variance attributable to genetic influence, of life satisfaction is

higher. We addressed the evidence for these hypotheses using the national twin sample from the Survey of Midlife Development in the United States (MIDUS).

Method

Participants

The MIDUS twin sample consists of 998 twin pairs distributed roughly according to population throughout the continental United States. They range in age from 25 to 74. For this study, we made use of the 719 same-sex pairs for whom we had zygosity data as well as most of the relevant measures described below, resulting in 172 monozygotic (MZ) male pairs, 195 MZ female pairs, 138 dizygotic (DZ) male pairs, and 214 DZ female pairs. We thus excluded 262 opposite sex pairs and 17 pairs with missing or indeterminate zygosity information from the full MIDUS twin sample of 998 pairs. The sample is 58% women, 42% men; about 92% listed their race as Caucasian, 4.1% as African American, 1.9% as other, and 2.2% did not report. Additional description of the sample and its recruitment is given in Johnson and Krueger (2005) and Kessler, Gilman, Thornton, and Kendler (2004).

Measures

MIDUS participants provided survey data about annual income in several categories including personal and spouse's earnings, Social Security, and other government assistance. They also provided data about marital status (including living as married), number of children living at home, and monthly amounts of money distributed to children and other relatives living away from home. We used this information to compute annual household income per person. The participants also estimated the amount of money they would have left over after cashing in all their savings and paying off all their debts. We used this information to compute household assets per adult. The participants were slightly more wealthy than the national median on the basis of income. Still, using cutpoints chosen because they represent limited economic means, we found about 30% had household income below the national median, 14% had household incomes below $20,000, and 8% had household incomes below $15,000. The full distribution of income and education is shown in Table 1. To normalize their distributions, we log-transformed the income and asset variables. Participants also reported their level of education in categories ranging from "some grade school" to PhD, MD, and other professional degrees. The median level of education was 1–2 years of college.

The MIDUS surveys included several other questions about participants' financial situations and their attitudes about those situations. Using a scale from 0 to 10, with 0 indicating the worst possible, they rated their current financial situation ($M = 6.4$, $SD = 2.1$) and the degree of effort they currently put into their financial situations ($M = 7.7$, $SD = 2.0$). Using more attenuated scales, they also indicated whether they felt they had less or more money than they needed (range = 1 [*less*] to 3, $M = 1.9$, $SD = .6$), the degree to which they found it difficult to pay their bills (range = 1 [*difficult*] to 4, $M = 3.0$, $SD = .9$), the degree to which they felt they and their spouses could keep their current jobs for the next 2 years if they wanted (range = 1 [*not likely*] to 5; $M = 4.4$, $SD = .9$ for self; $M = 4.5$, $SD = .9$ for spouse), the degree to which they felt that their families were better off than average when they were children (range = 1 [*much worse than average*] to 7, with 4 being average, $M = 3.9$, $SD = 1.3$), and the degree to which they felt that they were better off financially now than their parents were at the same age (range = 1 [*much worse than parents*] to 7, with 4 being same, $M = 3.5$, $SD = 1.8$).

The MIDUS questionnaires also included questions about the degree to which participants perceived they had control over various aspects of their lives. These questions made use of the same 0 to 10 scale as the perceived financial situation and financial effort questions. Participants were asked, ". . .how would you rate the amount of control you have over your _____ these days?" The life aspects queried were health, work situation, financial situation, contribution to the welfare and well-being of other people, overall relationship with children, marriage or close relationship, sexual aspect, and life overall. Coefficient alpha for the scale formed from the mean response from these ratings was .73 ($M = 7.5$, $SD = 1.4$). Participants who did not have spouses, close relationships, or children and thus did not respond to these items received scores that were based on the mean of the items to which they did respond. Finally, there were three questions that addressed life satisfaction. Participants were asked how satisfied they were with their lives, how satisfied they were with themselves, and the degree to which they felt their lives were the best possible overall. We combined these items to form a life satisfaction scale, with scores ranging from 3 to 18. Coefficient alpha for the three items was .62. The scores were generally consistent with Cummins's (2000) observations about such scales, as the mean was 15.2, or 84% of the maximum score, with standard deviation of 2.3 and skewness of −1.3.

Table 1
Frequency Distributions of Income and Education

Characteristic	%
Family income level (in $)[a]	
0–10,000	5.1
10,001–20,000	8.6
20,001–35,000	17.2
35,001–50,000	24.5
50,001–75,000	24.3
75,001–100,000	9.1
100,001–150,000	5.9
150,000+	5.1
Education[b]	
Some grade school	0.3
Completed 8th grade	1.7
Some high school	7.9
GED	2.0
High school graduate	29.2
1–2 years of college	17.6
More college, no degree	4.2
Associate or vocational degree	8.3
Bachelor's degree	14.9
Some graduate school	2.2
Master's degree	5.5
Professional degree	2.5
Missing	3.8

Note. National data are from the 1995 Current Population Survey, which was current at the time of data collection. GED = general equivalency diploma.
[a] $M = 57{,}347$; $Mdn = 47{,}097$; $SD = 44{,}468$; national $M = 44{,}938$; national $Mdn = 34{,}076$. [b] Mdn = 1–2 years of college.

Because of the broad range of ages and the potential for sex differences in our variables, we adjusted the income, asset, education, perceived financial situation, control, and life satisfaction variables for the effects of age, age^2, the interaction of age and gender, and the interaction of age^2 and gender prior to analysis. This also had the effect of removing similarity between members of twin pairs that was because of their similarity in age and sex alone.

Results

Relative Independence of Actual and Perceived Financial Resources and Income and Assets

Table 2 shows the correlations among the measures of economic resources and perceptions about financial circumstances, control

Table 2
Correlations Among Variables Related to Perceptions About Financial Position

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Education	—												
2. Household income per person	.34	—											
3. Household assets per person	.25	.07	—										
4. Enough money	.20	.32	.24	—									
5. Can pay bills	.12	.32	.18	.52	—								
6. Effort invested in finances	−.09	−.03	−.04	−.05	.00	—							
7. Perceived job security	.06	.08	.00	.03	.10	.05	—						
8. Perceived spouse job security	.09	.10	.06	.05	.14	.07	.21	—					
9. Childhood financial situation	.03	−.01	−.09	−.12	−.14	−.09	.03	.06	—				
10. Current relative to childhood	.10	.17	.14	.22	.21	−.03	.06	−.03	−.03	—			
11. Perceived financial situation	.11	.29	.17	.48	.59	.12	.17	.16	−.20	.28	—		
12. Perceived control over life	.02	.10	.09	.22	.28	.29	.20	.17	−.17	.07	.39	—	
13. Life satisfaction	.06	.12	.11	.20	.31	.21	.27	.16	−.15	.14	.45	.55	—

Note. Correlations are pairwise because of differing amounts of missing data. They are significant at $p < .01$ if about .08 or more, adjusting for the correlations between members of twin pairs. This varies somewhat because of slightly differing *n*s per cell. "Current relative to childhood" (Item 10) refers to financial situation.

over life, and life satisfaction in the MIDUS data. The basic association between income and life satisfaction that we sought to explain was .12. This was highly consistent with the associations observed by others in the United States (Diener & Seligman, 2004), indicating that our sample was appropriate at this most basic level for the further investigations we planned. Income was correlated only about .3 with the measures of financial situation (with perceived financial situation [.29], perception of having enough money to meet needs [.32], and ability to pay bills [.32]), indicating that actual money available explained only about 10% of the variance in people's perceptions of financial well-being. The correlations between assets and these financial perception variables were significantly ($p < .001$) lower, ranging from .17 for perceived financial situation to .24 for perception of having enough money to meet needs. In addition, the correlation between income and assets was only .07 ($p = .01$). None of the other variables involving job security, effort invested in finances, or childhood financial situation had any substantive relation with either of the economic resource variables or the variables involving perceived sufficiency of resources (the largest was .14). Correlations located in the last two rows of the table (columns 4 and 5), between the perceived sufficiency of resource variables and both perceived control over life and life satisfaction, ranged from .20 to .31, substantially bearing out our proposition that these variables would be only modestly related. At the same time, as expected, the correlations (located in row 11, columns 4 and 5) involving perceived financial situation, perception of having enough money to meet needs, and ability to pay bills ranged from .48 to .59, and those (located in the lower right corner of the table) involving perceived control over life, perceived financial situation, and life satisfaction ranged from .39 to .55. These were all significantly ($p < .001$) higher than the correlations involving income and assets.

Mediation of Relation Between Economic Resources and Life Satisfaction by Perceived Financial Situation and Control

To test the proposition that both perceived financial situation and perceived control mediate the association between economic resources and life satisfaction, we fit several hierarchical linear models (HLM; Raudenbush & Bryk, 2002). Prior to doing so, however, we needed to transform the life satisfaction variable to establish the independence of its variance from its level to meet the assumptions underlying any regression model. This meant raising the life satisfaction variable to the fourth power. Similarly, we squared the control variable to reduce negative skew. To measure the significance of each variable in the model, we compared the −2 log likelihood (−2*LL*) statistic from the model including the variable with the analogous statistic from the model excluding the variable. The resulting change in −2*LL* statistics is distributed approximately chi-square with degrees of freedom equal to the difference in the numbers of parameters in the two models.

HLM makes specific provision for data that are clustered in systematic ways. It was originally developed to study the effects of educational programs on students clustered in classrooms, schools, and districts. In our sample, twins are clustered in families. Given this structure, there are two ways in which the independent variables we considered—education, income, assets, perceived financial situation, and perceived control—might affect life satisfaction. First, they may exert fixed effects across the family level of the data, and/or second, they may exert effects that vary within families at the individual level of the data.[1] When they exert such effects at the individual level of the data, the independent variables are associated with the variance in life satisfaction within families in a way that is independent of their fixed family level effects.

The information about biological relatedness provided by the presence of MZ and DZ twins, along with the data's hierarchical structure, makes it possible to do more than just estimate the effects of the independent variables on life satisfaction. It also makes it possible to assess the degree to which the independent variables exert their effects independently of genetic influences on life satisfaction and to distinguish environmental effects acting to make members of the same family similar from those that act to

[1] In commonly used HLM parlance, these are termed *random effects*. We use the term *individual-level effects* in this article to make clear the relevance of these effects to the particular family structure of our nested data.

make members of the same family different. Environmental effects that act to make members of the same family similar are generally termed *shared* environmental effects. Typical examples usually reflect childhood experiences such as parental income. Environmental effects that act to make members of the same family different are generally known as *nonshared* environmental effects. Examples might be having different social experiences or participating in different recreational activities. The distinction between shared and nonshared environmental effects can be subtle. For example, two children growing up in the same family may experience the same event (e.g., change in parental financial status during childhood), but that event is only a shared environmental influence to the extent that it makes the twins similar when we measured them in adulthood, and they may have reacted to it very differently.

The fixed effects can occur as a result of any combination of genetic, shared, and nonshared environmental influences. Genetic influences and shared environmental influences that act to distinguish among families contribute directly to the establishment of the family level average, but genetic influences and nonshared environmental influences that act to create differences between members of twin pairs also affect the family level average. We were able, however, to control for the presence of genetic and shared environmental effects by including with the fixed effects a set of terms defined by DeFries and Fulker (1985) and known as D–F (for DeFries and Fulker) regression terms. The terms are the Degree of Twin Genetic Relatedness (100% for MZ twins, 50% for DZ twins) and Twin Relatedness × Twin Life Satisfaction to Control for Genetic Relatedness and Twin Life Satisfaction to Control for Shared Environmental Influences. As long as an independent variable is measured separately for each twin in a pair, the effect of that independent variable remaining after inclusion of the D–F regression terms can be considered a nonshared environmental effect (Jaffee, Caspi, Moffitt, & Taylor, 2004; Turkheimer, D'Onofrio, Maes, & Eaves, 2005).[2] The effects that vary at the level of the individual within families occur as a result of some combination of genetic and nonshared environmental influences that distinguish only within families, and there will always be evidence of such effects when variables differ between family members. To control completely for the genetic influences on life satisfaction, we also needed to use the D–F regression terms to distinguish the within-family individual-level genetic effects from the within-family nonshared environmental effects.

Using Baron and Kenny's (1986) criteria for the establishment of a mediational relation, we first used HLM to predict both perceived financial situation and perceived control using education, income, and assets, with twins nested within families. Both HLMs established significant associations: $\Delta -2LL = 457.83$, $\Delta df = 2$, $p < .001$, for perceived financial situation; $\Delta -2LL = 382.32$, $\Delta df = 2$, $p < .001$, for perceived control. We then carried out a series of HLMs predicting life satisfaction. We began by entering education in Step 1 simply to control for whatever effects it might have. We followed this with income and assets in Steps 2 and 3. We then entered perceived financial situation in Step 4, followed by perceived control in Step 5. As Baron and Kenny described, mediation is complete when addition of the mediating variables, in this case perceived financial situation and control, renders the independent variables, in this case income and assets, no longer significant in predicting the outcome, in this case life satisfaction.

In carrying out these regressions, in Step 6 we included the D–F terms for cotwin life satisfaction at the family and individual levels of the HLM to control for genetic and shared environmental influences on life satisfaction (Turkheimer et al., 2005). For life satisfaction, there is little evidence for substantial shared environmental influence (Lykken, 2000; Lykken & Tellegen, 1996), but the important point in our treatment is that to the extent that perceived financial situation and control remain significant predictors of life satisfaction after application of the cotwin control D–F terms, perceived financial situation and control can be considered independent, nonshared environmental influences on life satisfaction.[3]

The results from the series of HLMs are shown in Table 3. As expected, financial resources alone were slightly but significantly associated with life satisfaction, and this association was completely mediated by perceived financial situation, and perceived control explained substantial additional variance. In their roles as mediators, the perceptions about financial situation and control had rather substantial effects of their own on life satisfaction: With all terms in the model, a standard deviation increase in perceived financial situation was associated with a .24 standard deviation in life satisfaction, and a standard deviation increase in perceived control was associated with a .41 standard deviation increase in life satisfaction. Thus, as proposed, mediation by perceived financial situation and perceived control over life completely explained the association between income and assets and life satisfaction, and these perceptions explained considerable variance in life satisfaction independent of each other and of important genetic and environmental influences on life satisfaction.

Genetic and Environmental Variance in Life Satisfaction Changes With Level of Financial Resources and Perceived Control

To test the propositions that favorable financial environment and higher perceived control are associated with reduced environ-

[2] Since this analysis was originally completed, Purcell and Koenen (2005) have published a commentary on the assessment of environmental mediation, suggesting analytical approaches that are alternatives to and elaborations of the approach we took. We implemented the two alternative approaches that they recommended most highly (inclusion of D–F terms for all variables in the model and regression of difference scores), and obtained essentially equivalent evidence for environmental mediation. These results are available from Wendy Johnson and Robert F. Krueger on request.

[3] Because the D–F terms were included in the HLM model, the data associated with these terms were of necessity double-entered. That is, each combination of twin and cotwin data appeared twice. This has no effect on the magnitude of the coefficients associated with these terms, but their standard errors are biased low (Kohler & Rodgers, 2001). In this case, this bias is unimportant, as these terms are not the focus of the analysis, and they do not have significant effects given the other terms in the model, anyway. In addition, the standard errors of the terms entered earlier in the model were not reduced by the addition of the D–F terms, so the significance of these terms has not been inflated by the addition of the D–F terms. We also did this analysis using ordinary least squares regression on both double- and single-entered data, with highly similar results.

mental variance in life satisfaction, we made use of variance component models for gene–environment interaction and correlation (Purcell, 2002), as implemented for maximum likelihood estimation of models fit to raw data in the computer program Mx (Neale, Boker, Xie, & Maes, 1999). The standard quantitative genetic model for a single variable is based on the understanding that the observed (phenotypic) variance in a trait is a linear function of the additive genetic (A^2) and shared (C^2) and nonshared (E^2) environmental variance components described above. The model can be depicted as shown in Figure 1.

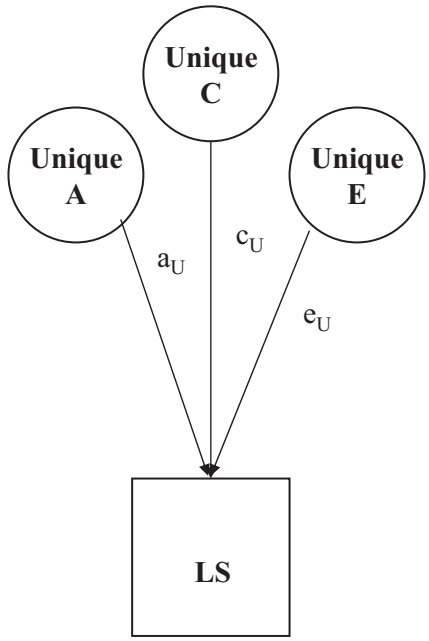

Figure 1. Standard model of independent genetic and environmental influences. The parameters of each path are constant. A = genetic influences; C = shared environmental influences; E = nonshared environmental influences; unique = unique to life satisfaction (LS); subscript U = unique.

Under this model, each of the variance components is estimated as a constant and independent of the others, and there is no provision for any association between the influences on life satisfaction and those on any other trait. Our hypotheses that favorable financial environment and perceived control are associated with reduced environmental variance in life satisfaction required that the assumptions of the independence and constant nature of the components of variance in life satisfaction be relaxed. In particular, they required that financial position and perceived control be allowed to exert moderating effects on the variance in life satisfaction.[4] They also required that some provision be made for the possibility of overlap in the influences on life satisfaction and financial position and perceived control. That is, rather than modeling variance in life satisfaction as consisting of constant variance components, we needed a model that both allowed the variance components of life satisfaction to vary with the levels of financial position and perceived control and measured the extent of overlap of influences between life satisfaction and each of these variance moderators. Variation in the variance components of life satisfac-

Table 3
Summary of Hierarchical Linear Models for Money-Related Variables Predicting Life Satisfaction

Variable	*B*	*SE B*	*t*[a]	*p*
Step 1				
Constant	.01	.03	0.46	.64
Education	.03	.03	1.20	.23
Step 2				
Constant	.01	.03	0.40	.69
Education	.01	.03	0.32	.75
Household income per person	.10	.04	2.67	.008
Step 3				
Constant	.00	.03	0.06	.96
Education	−.02	.03	−0.67	.50
Household income per person	.12	.04	3.06	.002
Household assets per person	.10	.03	3.55	<.001
Step 4				
Constant	.00	.03	0.05	.96
Education	−.01	.03	−0.34	.74
Household income per person	−.04	.04	0.83	.41
Household assets per person	.04	.03	1.31	.19
Perceived financial situation	.40	.03	14.73	<.001
Step 5				
Constant	.01	.02	−0.04	.97
Education	.01	.03	0.23	.82
Household income per person	−.03	.03	−0.79	.43
Household assets per person	.03	.02	1.03	.30
Perceived financial situation	.24	.03	9.45	<.001
Perceived control over life	.43	.03	17.34	<.001
Step 6				
Constant	.05	.07	0.73	.46
Education	.01	.02	0.30	.77
Household income per person	−.02	.03	−0.54	.59
Household assets per person	.02	.02	0.86	.39
Perceived financial situation	.24	.03	9.30	<.001
Perceived control over life	.41	.03	15.27	<.001
Twin relatedness[b]	−.07	.09	−0.77	.44
Twin life satisfaction[b]	.17	.11	1.55	.12
Twin Life Satisfaction × Relatedness[b]	.00	.08	−0.04	.97
Individual level Twin Life Satisfaction × Relatedness[b]	.17	.03	4.63	<.001

Note. Effects of age and sex were removed from all variables. All variables were standardized. Each step includes a constant at the individual level that serves as a placeholder to measure the variance at that level. The variables of interest were added at both the family and individual levels, but only those that generated significant improvement in model fit were retained. Variables shown are at the fixed family level unless otherwise indicated. When we added the Twin Life Satisfaction × Relatedness term at the individual level in Step 6, the constant term at that level was no longer significant so we dropped it. Because all variables were standardized, each regression coefficient at the fixed family level measures the effect on life satisfaction in a one-standard deviation increase in the associated variable.
Step 1: −2 log likelihood (−2 *LL*) = 3478.92. Step 2: −2 *LL* = 3471.83, Δ −2 *LL* = 7.09, *df* = 1, *p* = .008. Step 3: −2 *LL* = 3086.39, Δ − 2 *LL* = 385.44, *df* = 1, *p* <.001. Step 4: −2 *LL* = 2871.35, Δ −2 *LL* = 215.04, *df* = 1, *p* <.001. Step 5: −2*LL* = 2617.72, Δ−2 *LL* = 253.63, *df* = 1, *p* <.001. Step 6: −2 *LL* = 2334.36, Δ −2 *LL* = 283.36, *df* = 3.
[a] *df* = 696. [b]DeFries–Fulker regression terms to control for genetic and shared environmental influences on life satisfaction.

[4] Because these moderating effects act on the variance of life satisfaction rather than on the level of life satisfaction, their effects are not expressed with the product terms familiar from multiple regression analyses. Rather, they are expressed with linear terms acting directly on the variance as described in greater detail below.

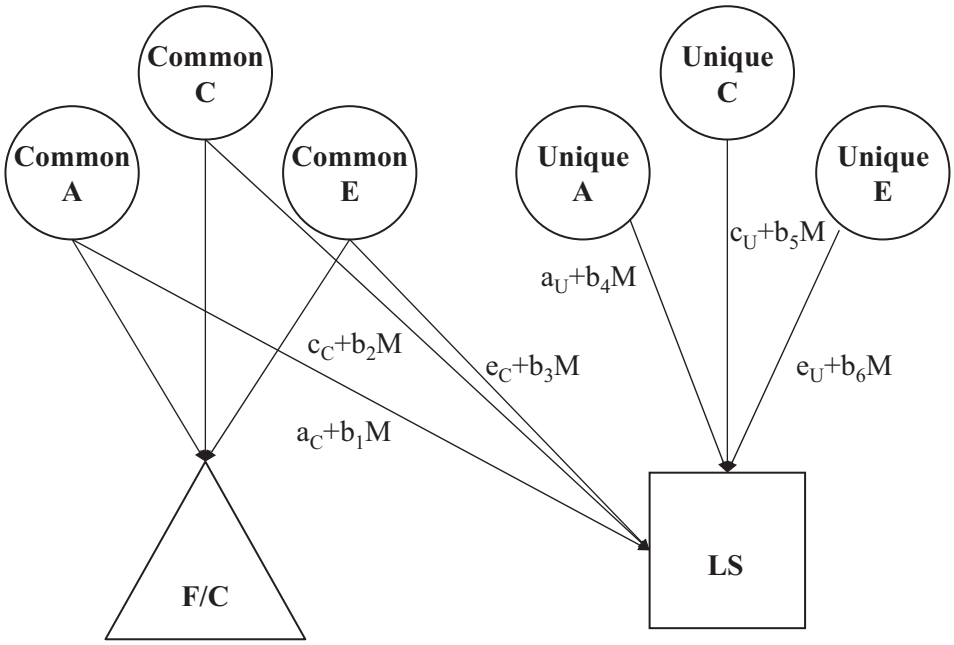

Figure 2. Model of moderation of genetic and environmental influences by a second variable in the presence of overlap in genetic and environmental influences on the two variables. A refers to genetic influences, C to shared environmental influences, and E to nonshared environmental influences. Under this model, finances/control (F/C) is represented as a triangle because we are conceptualizing A, C, and E as environmental variables exerting moderating influence on the outcome variable life satisfaction (LS). Variance in LS can result from any combination of the labeled paths: A, C, and/or E that also influence finances and/or control, and/or A, C, and/or E unique to it. Each of these paths can vary with level of F/C, noted above by M for moderator. The model includes estimates of the paths representing influences on F/C as well. These paths are constant and not labeled. Common = common to the environmental moderating variable; unique = unique to life satisfaction; subscript C = common; subscript U = unique; b = regression coefficient.

tion with variation in level of a third variable is an example of gene–environment interaction, which can also be thought of as differential genetic expression in different environments. Overlap in the genetic influences on two traits is an example of genetic correlation, and similar kinds of overlap can occur for shared and nonshared environmental influences. Genetic and environmental correlations range from −1 to 1 in the manner usual to correlations.

The models we used to include provision for these phenomena adapted the standard quantitative genetic model shown in Figure 1 by explicitly measuring the possibility that the variance components of life satisfaction themselves varied as continuous functions of some variable that could be considered to provide an environment for life satisfaction (in this case, financial environment as measured by a composite of the income and asset variables described above, or perceived control over life) and by explicitly measuring the extent to which influences on the traits acting as environments also exerted moderating influences on life satisfaction. The adapted model, described by Purcell (2002),[5] is shown in Figure 2. In this model, the paths expressing the genetic and environmental influences on the environmental moderating variable (indicated as a triangle) are considered constant, as in Figure 1. We have not explicitly labeled these paths in Figure 2 (although, of course, we measured them) in order to keep the focus on the paths contributing to variance in life satisfaction. The paths that are labeled in the figure express the genetic and environmental influences on life satisfaction. These paths are all linear functions of the form a + bM, where a and b are regression coefficients and M is the level of the environmental moderating variable. It does not matter in this model whether the environmental moderating variables can be estimated separately for each member of a twin pair or not (Purcell, 2002); the environmental moderating variables we used of course can differ in this way. In addition, there are two sets of paths contributing genetic and environmental influences to life satisfaction: those common to the environmental moderating variable and those unique to life satisfaction. The extent to which the environmental variable moderates the variance in life satisfaction is measured on all six paths. The resulting model thus provides estimates of (a) the genetic and environmental variance common to both environmental variable and life satisfaction and the extent to which these vary with the environmental moderating variable and (b) the genetic and environmental variance unique to life satisfaction and the extent to which these vary with the environmental moderating variable. The model also provides estimates of genetic

[5] In addition to describing the model we used, Purcell (2002) referred the reader to Mx (Neale et al., 1999) scripts developed to implement all the models described in the article. We made use of the relevant script in our analyses.

and environmental correlations. In most multivariate models, these correlations are constant in the same manner as are the variance components. In the presence of significant moderation of genetic or environmental influences on life satisfaction, however, the corresponding genetic or environmental correlations vary as functions of the environmental moderating variables.

Because the models produced were potentially complex, we allowed parsimony to dictate the results presented. Thus, we dropped all terms indicating common and interactive genetic and/or environmental effects when we could do so without significant change in model $-2LL$, as described above for the HLM. We evaluated the appropriateness of doing this by means of an information theoretic fit statistic, Akaike's Information Criterion (AIC, Akaike, 1983). Information theoretic fit statistics provide objective criteria for the selection of models that minimize the amount of information required to express the data, making possible the most parsimonious or efficient representation of the data. The point of doing this was not to deny the potential existence of smaller interactive effects on the nonsignificant paths but to focus attention on the paths that were either most clearly related to our hypotheses or most important. Table 4 shows the models we considered and the resulting $-2LL$ statistics and AICs. Smaller AICs indicate preferred models. For each environmental moderating variable, the table shows model-fitting results for a model with all interaction parameters freely estimated, the best-fitting model, and all interaction parameters fixed to 0. For financial resources, the best-fitting model had no moderation on either the common or unique genetic and shared environmental influences on life satisfaction but included significant moderating terms for the nonshared environmental influences on life satisfaction. The best-fitting model for perceived control had no moderation of any source of influence on life satisfaction except the genetic influences unique to it.

The estimated components of variance, proportions of variance, and genetic and environmental correlations from the most parsimonious models described in Table 4 are given in Table 5, along with their 95% confidence intervals. The confidence intervals for the genetic and environmental correlations are very wide, but this is typical for these kinds of correlations because the models have little power to specify them exactly (Carey & DiLalla, 1994). About 30% of the variation in level of financial position was under genetic influence, and about 10% was under shared environmental influence. The remaining 60% was under nonshared environmental influence. About 10% of the variation in perceived control was under genetic influence. Another quarter was under shared environmental influence, with the remaining 65% under nonshared environmental influence. The allocation of variance in life satisfaction differed depending on whether life satisfaction was paired with financial position or perceived control as moderator.

The three components of variance as functions of financial resources are presented in Figure 3. Because there was no significant moderation of genetic and shared environmental variance by financial position, these variance components of life satisfaction were fixed to be constant across level of financial position. Because there was significant moderation of nonshared environmental variance, this variance component of life satisfaction did vary with level of financial position. As hypothesized, it was smaller in better financial positions. This meant that, as a proportion of total variance, the genetic component of variance was larger in better financial positions. Consistent with our hypothesis, a four-standard deviation change in financial resources was associated with about a twofold reduction in nonshared environmental variance in life satisfaction. As shown in Table 4, there was no overlap in genetic influences on financial position and life satisfaction, but shared environmental influences completely overlapped. The extent of overlap in nonshared environmental influences was negligible until financial position became quite favorable.

The three components of variance as functions of perceived control are shown in Figure 4. Because there was no significant moderation by perceived control of any source of variance in life satisfaction except unique genetic influences, the shared and nonshared components of variance were fixed to be constant across level of perceived control. Genetic variance, however, varied with level of perceived control. These results were somewhat different from those hypothesized, though the effect was similar to that hypothesized in the sense that genetic variance in life satisfaction was higher at high levels of perceived control than at lower levels.

Table 4
Fit Statistics From the Models of Variance Components Allowing for Gene–Environment Interaction and Correlation

Model	$-2LL$	*df*	χ^2	Δdf	*p*	AIC
Life satisfaction as a function of finances						
All parameters free	5,810.3	3894				5,844.3
Fix common and unique A and C moderation paths[a]	5,814.7	3898	4.4	4	*ns*	5,840.7
Fix common and unique E moderation paths	5,840.0	3900	25.3	2	<.001	5,862.0
Life satisfaction as a function of control over life						
All parameters free	6,056.1	3534				6,090.1
Fix common and unique C, E, and common A moderation paths[a]	6,061.0	3539	4.9	5	*ns*	6,085.0
Fix unique A moderation path	6,075.5	3540	14.5	1	<.001	6,097.5

Note. A refers to genetic influences, C to shared environmental influences, and E to nonshared environmental influences. There are possible common and unique moderation paths for each of A, C, and E. Fixed moderation paths are constrained to 0, which means that those sources of influence are present but do not vary across the levels of the moderators. In Figure 2, the b terms in the moderation equations for the relevant paths are constrained to 0. $-2LL$ = -2 log likelihood; AIC = Akaike's Information Criterion; common = common to the environmental moderating variable; unique = unique to life satisfaction.
[a] Best-fitting models.

Table 5
Estimates of Variance Components and Proportions of Variance in Life Satisfaction and Its Moderating Variables and Their Genetic and Environmental Correlations

	Level of financial position						Level of perceived control					
	−2 *SD*		0 *SD*		2 *SD*		−2 *SD*		0 *SD*		2 *SD*	
Environmental variable	Variance component	95% CI	Variance component	95% CI	Variance component	95% CI	Variance component	95% CI	Variance component	95% CI	Variance component	95% CI
						Environmental moderating variable						
Variance components												
Genetic	.12	.02, .19	.12	.02, .19	.12	.02, .19	.10	.00, .32	.10	.00, .32	.10	.00, .32
Shared environmental	.04	.00, .12	.04	.00, .12	.04	.00, .12	.24	.04, .37	.24	.04, .37	.24	.04, .37
Nonshared environmental	.24	.21, .27	.24	.21, .27	.24	.21, .27	.63	.56, .72	.63	.56, .72	.63	.56, .72
Proportions of variance												
Genetic	.30	.04, .48	.30	.04, .48	.30	.04, .48	.10	.00, .35	.10	.00, .35	.10	.00, .35
Shared environmental	.10	.00, .34	.10	.00, .34	.10	.00, .34	.25	.04, .40	.25	.04, .40	.25	.04, .40
Nonshared environmental	.60	.40, .93	.60	.40, .93	.60	.40, .93	.65	.45, .95	.65	.45, .95	.65	.45, .95
						Life satisfaction						
Variance components												
Genetic	.23	.00, .48	.23	.00, .48	.23	.00, .48	.28	.07, .49	.22	.00, .45	.53	.07, 1.10
Shared environmental	.10	.00, .56	.10	.00, .56	.10	.00, .56	.13	.00, .41	.13	.00, .41	.13	.00, .41
Nonshared environmental	1.02	.90, 1.18	.62	.53, .73	.40	.14, .84	.53	.46, .70	.53	.46, .70	.53	.46, .70
Proportions of variance												
Genetic	.17	.00, .35	.24	.00, .48	.32	.00, .77	.30	.06, .52	.25	.00, .49	.45	.06, .71
Shared environmental	.07	.00, .38	.11	.00, .51	.14	.00, .80	.14	.00, .44	.15	.00, .47	.10	.00, .44
Nonshared environmental	.76	.46, 1.00	.65	.34, 1.00	.54	.12, 1.00	.56	.34, .91	.60	.35, 1.00	.45	.23, .91
Correlations with moderator												
Genetic	−.01	−.57, .65	−.01	−.57, .65	−.01	−.57, .65	.60	−.91, .91	.96	−1.00, 1.00	.62	−.92, .92
Shared environmental	1.00	−.75, 1.00	1.00	−.75, 1.00	1.00	−.75, 1.00	1.00	.23, 1.00	1.00	.23, 1.00	1.00	.23, 1.00
Nonshared environmental	−.12	−.21, −.06	.12	.01, .23	.49	.10, −.64	.38	.26, .48	.38	.26, .48	.38	.26, .48

Note. The variance components are raw. Thus, they do not sum to 1.00. The proportions of variance sum to 1.00. CI = confidence interval.

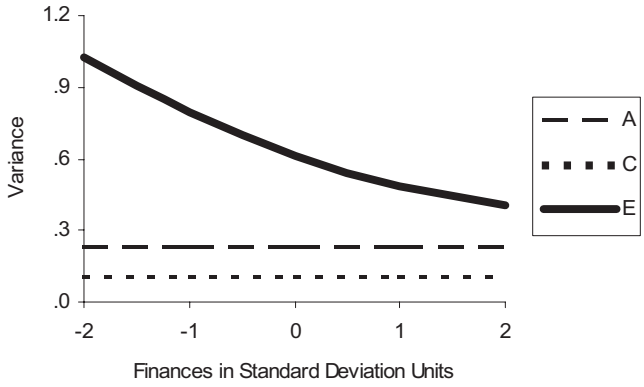

Figure 3. Variance in life satisfaction as a function of finances, by source of variance. Finances is a composite of age- and sex-adjusted standardized per capita income and assets. A = genetic variance; C = shared environmental variance; E = nonshared environmental variance.

Shared and nonshared environmental variances in life satisfaction were constant across the four-standard deviation range of perceived control, but genetic variance changed in a quadratic manner, decreasing by about 50% from the level at two standard deviations below the mean to reach a minimum slightly below the mean level of perceived control and increasing from there by a factor of about 2.5. As shown in Table 5, there was some overlap in nonshared environmental influences on perceived control and life satisfaction, and the shared environmental influences between the two were again complete. Because of the significant moderation of unique genetic influences on life satisfaction by perceived control, the genetic correlation between the two varied with level of perceived control. It was at a maximum of almost 1.0 at the mean level of perceived control, and remained .6 or more at both −2 and 2 standard deviations from the mean.

Discussion

In this study, we tested three novel hypotheses regarding the association between economic resources and life satisfaction, articulating the psychological manner in which money contributes to happiness, operationalized as life satisfaction. These analyses make clear that seemingly objective indicators of environmental circumstances such as income and assets have important psychological aspects. That is, one person's annual salary of, for example, $50,000 may have very different effects on his or her life satisfaction than might another's salary of the same amount. This provides further support for the relative standards model of Campbell et al. (1976). At the same time, our psychological perceptions about these economic resources are strongly environmentally associated with our satisfaction with our lives and with the clarity with which our genetically influenced happiness set points are expressed. This provides additional support for the genetic and environmental transactions involving life satisfaction that Lykken (2000; Lykken & Tellegen, 1996) articulated. Nevertheless, our study is subject to some limitations that must be considered in evaluating the findings. First, though national in scope, our sample is somewhat more wealthy, better educated, Caucasian, and female than the country as a whole, which hinders generalization to the full population of the United States somewhat and makes inferences about the applicability of the relations we observed to populations in other parts of the world very tenuous. Second, our measures are limited to self-report in a survey questionnaire format. Most of our variables involve personal perceptions; for these, self-report is probably the optimal format. For our measures of income and assets, however, the relatively informal and concise nature of the reporting format could lead to potential inaccuracy.

Third, our data are contemporaneous rather than predictive, making it impossible to draw inferences about the causal nature of the associations we have observed. It would be valuable in future work to assess the ways in which economic resources and perceptions about them transact with and influence life satisfaction across time and life span developmental periods. For example, it seems possible that young people at the beginnings of careers may be more tolerant of limited economic resources than older people, because young people may perceive that they will be earning more income as their careers develop. On the other hand, young people may be less tolerant of limited economic resources than older people if they are just emerging to live independently of families with much greater resources than young people have currently. It also seems likely that higher perceived control acts directly to increase income and assets, leading to better perceptions about one's financial situation and greater life satisfaction both because one's financial situation has actually improved and because one is aware of the role one's actions have played in the improved financial situation. On the other hand, a reduction in income as a result of lay off from a job may have very different effects on life satisfaction than a comparable voluntary reduction in income because of the very different implications for perceived control. These ideas, however, can only be tested by means of longitudinal data.

In spite of these limitations, our study reveals some important ways in which actual financial resources are relatively independent of perceptions about their adequacy. Corroborating our first hypothesis, the modest correlations (.07–.32, Table 2) between income and both perceived sufficiency of resources and ability to pay bills and between income and assets suggest that there are large differences among people in the relation between what they earn and what they spend. These associations hint at differences in people's ability and/or willingness to exert control over that rela-

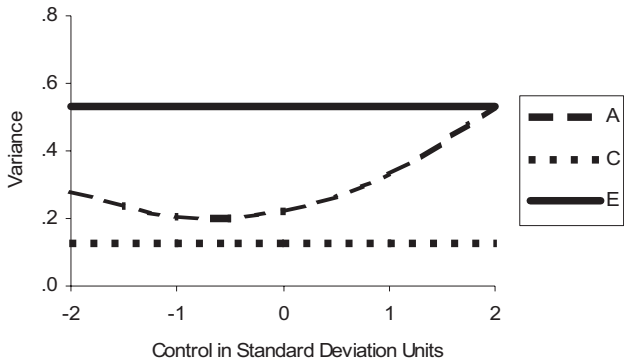

Figure 4. Variance in life satisfaction as a function of perceived control, by source of variance. A = genetic variance; C = shared environmental variance; E = nonshared environmental variance.

tionship. Filling out the picture, the modest correlations (.09–.29, Table 2) between the actual measures of financial resources and perceived financial situation, perceived control, and life satisfaction hint that this pattern is an important factor in the relative dissociation between actual financial resources and life satisfaction.

At the same time, the HLM's testing our second hypothesis demonstrated that perceived financial situation and perceived control over life completely mediate the associations between financial resources and life satisfaction (see Table 3). Though these associations are not particularly strong in developed economies, they are persistent, which maintains the interest of researchers investigating psychological well-being. The complete mediation of these associations, coupled with the relative importance of the mediators in explaining variance in life satisfaction, serve to illuminate possible reasons for individual differences in the relation between earning and spending. Diener (1984) has summarized several theories articulating the central role of personal desires in life satisfaction. Where material desires are greater, their attainment will require greater financial resources, the pressure to spend all available earnings will be greater, and perceived financial situation will be poorer at any given level of resources, making discrepancy between desires and the ability to attain them of primary importance in perception of financial situation. But material and other financial desires are long-term in nature as well as short-term, and it is through exertion of control over life that one can alter one's financial circumstances to bring about the ability to satisfy one's material desires and thus bring about greater life satisfaction. Our findings here are completely consistent with this view. In addition, our findings that perceived financial situation and perceived control have environmental associations with life satisfaction provide clear examples of specific, nonshared environmental influences on a measured psychological variable. They also provide an example of a method for identifying other such influences, and they corroborate Lykken's (2000) assertion that one can choose one's life circumstances to maintain life satisfaction at a level consistent with or even higher than most people's genetically influenced tendency to be relatively happy.

Evidence for our third hypothesis—that the favorable environments created by both greater economic resources and greater perceived control are associated with reduced environmental variance in life satisfaction—was mixed. With respect to financial resources, variance in nonshared environmental influences on life satisfaction decreased with increasing financial resources, whereas genetic and shared environmental influences remained constant (see Figure 3). This did mean, however, that the proportion of variance that could be attributed to genetic influences on life satisfaction increased with increasing financial resources. More important, though, it suggests an alternative mechanism through which life choices may maintain life satisfaction. That is, greater financial resources appeared to serve as a buffer to minimize nonshared environmental influences, presumably especially those from negative events, on life satisfaction. An example of this phenomenon might be the occurrence of an automobile accident (not involving serious injury) to people with greater and lesser financial resources. Those with greater financial resources simply replace or repair the damaged vehicle and likely suffer little threat to the apparently natural, genetically influenced tendency of most people to be relatively happy (Diener & Diener, 1996). Those with lesser financial resources may face significant hardships that sap life satisfaction while accumulating the resources to do the same.

With respect to perceived control, on the other hand, genetic variance in life satisfaction first decreased and then increased over the range of perceived control, whereas both shared and nonshared environmental variance remained constant (see Figure 4). Thus, perceived control appeared to operate through its links to the genetic influences on life satisfaction, substantiating the idea that it is through the exertion of control over life that one attempts to bring about greater life satisfaction. For example, one might initiate a diet and exercise program to look and feel better or to participate in sports. But exertion of control is a double-edged sword: Successful exertion of control may bring increased satisfaction, but unsuccessful exertion of control may not (Wortman, Sheedy, Gluhoski, & Kessler, 1992). Thus, high perceived control may increase genetic variance in life satisfaction because it increases the possibility that exerted control will be unsuccessful (leading to reduced satisfaction) as well as successful (leading to increased satisfaction). At the same time, low perceived control may increase genetic variance in life satisfaction because those with low perceived control are less likely to attempt to exert control by making clear life choices, leaving them more completely at the mercy of whatever circumstances come their way.

At the broadest level, this study emphasizes the psychological nature of even the most apparently objective environmental variables, pointing out that one cannot assume that any environmental circumstance will have any specific direct effect on any outcome. In addition, this study highlights the relevance and value of genetically informative samples and biometric methods in identifying and describing both the genetic and the environmental mechanisms underlying the associations among psychological variables. At the same time, the most insightful findings from the genetic information provided by the sample involved environmental effects and were based on the relaxation of the common assumptions that genetic and environmental influences do not correlate or interact, highlighting the evolving nature of the technical methods this approach makes available. Finally, this study helps to link microeconomic and psychological explanations for the link between income and life satisfaction by illuminating the manner in which income can be both associated with individual actions to improve life satisfaction and act as a buffer to protect life satisfaction against the stresses of meeting day-to-day needs.

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