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Short Communication

Miserliness is heritable

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ABSTRACT

Despite numerous folk sayings about miserly people, the genetic and environmental architecture of the character trait of miserliness has been very rarely studied to date. We administered six items of the miserliness scale to 1110 pairs of South Korean twins aged 12- to 25-years (M = 18.0, SD = 3.3). Model-fitting analyses indicated that 28% (95% CI: 21–34%) and 72% (95% CI: 66–79%) of individual difference in miserliness were attributable to genetic and unique environmental influences, respectively. Common family environmental effects were negligible, consistent with a large body of behavioral genetic literature on personality. Sex differences in the magnitude of genetic and environmental factors in miserliness were not significant.

1. Introduction

From a psychoanalytic perspective, Sigmund Freud (1856–1939) hypothesized that individual differences in the character trait of 'miserliness' originated from critical periods in early development such as the erogenicity of the anal zone in childhood (Alexander, 1963). According to Freud, if a child receives too much pressure or punishment from parents during toilet training, he will experience anxiety over bowel movements and subsequently react in an opposite way ('reaction formation') and take pleasure in being able to thwart the demands by withholding such functions. This may then lead to the later development of traits such as miserliness and/or excessive amounts of compulsiveness and obstinacy. Some research has supported these conjectures. For example, miserliness has been found salient in patients with obsessive–compulsive disorder (Samuels et al., 2007) and binge eating disorder (Grilo, 2004).

Behavior genetics provide alternative explanations for the origins of personality traits. Behavior geneticists have documented that about 30% to 60% of variation in most personality traits are heritable, with the remaining variance attributable to environmental experiences unique to individuals (Bouchard & Loehlin, 2001; Johnson, Vernon, & Feiler, 2008). Although miserliness has received considerable attention from lay people since Freud, little is known about the genetic and environmental architecture of the trait. However, several twin studies have found that traits related to the opposite of miserliness such as altruism and prosociality are significantly heritable (Hur & Rushton, 2007; Rushton, Fulker, Neale, Nias, & Eysenck, 1986).

Miserliness is a multidimensional construct, reflecting conscientiousness among others. From a finance perspective, being miserly is not necessarily *un*-altruistic in that the behavior may be for the betterment of the family unit. For example, Boyce and Wood (2011) found that individuals with high conscientiousness scores report greater satisfaction when there is an increase in household income. Pursuits of the cost-effectiveness and good money management strategies typically observed in misers can also be components of conscientiousness.

The goal of the present study is to explore genetic and environmental influences on individual difference in miserliness using 1110 pairs of South Korean twins. If Freud's hypothesis is correct, then rearing family environmental factors may be significant in miserliness. However, given the finding that most personality traits studied to date average a heritability of about 50% with negligible family environmental influences, we predict that miserliness will also show significant heritability with little influence of rearing environment.

2. Methods

2.1. Subjects

The sample was drawn from the South Korean Twin Registry (SKTR; Hur, Shin, Jeong, & Han, 2006), a nationwide volunteer registry of South Korean twins and their families. As part of the SKTR

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regular telephone interview, the Miserliness scale was given to twins aged 12- to 25-years (mean = 18.0 years, SD = 3.3 years). The zygosity of twins was determined from a questionnaire regarding physical similarities of twins and frequency of confusion. When compared to the analysis of DNA markers, this questionnaire method has yielded over 90% accuracy in Asian twin samples (Ooki, Yamada, & Asaka, 1993). To maximize the accuracy in zygosity classification, however, 35 twin pairs whose zygosity was ambiguous were excluded from data analyses.

The final sample included 1110 twin pairs consisting of 305 pairs of monozygotic male twins (MZM), 80 pairs of dizygotic male twins (DZM), 464 pairs of monozygotic female twins (MZF), 98 pairs of dizygotic female (DZF), and 163 pairs of opposite-sex dizygotic twins (OSDZ). The number of monozygotic (MZ) twins was much higher than that of dizygotic (DZ) twins in both sexes in the present sample, which reflected the twin birth rates in South Korea (Hur & Kwon, 2005). The present sample also had an overrepresentation of female twins, partly because some of the young adult male twins were in the military service at the time of the survey as males in South Korea have an obligation to army service.

2.2. Measure

The Miserliness scale consists of six items measuring stinginess and excessive interest in money and saving. The scale was developed through a rational approach and factor analyses of the items that assess various economic behaviors collected from a population-based sample of over 2500 individuals (Jeong, submitted for publication). Each of the six items was presented on a 4-point Likert scale (1 = not at all true, 4 = very true). Cronbach alpha reliability of the scale was .69 in the present sample. Responses to the six items were summed to yield a total score of Miserliness. The six items and the correlations between each item and the total score are listed in Table 1.

2.3. Data analyses

To estimate genetic and environmental factors in Miserliness, we carried out univariate model-fitting analysis incorporating sex differences. The univariate model included additive genetic (A), non-additive genetic (D) effects, and shared environmental (C), and non-shared environmental (E) effects. A occurs when alleles at a locus and across loci add up to influence a trait, which is set at 1.0 and .5 for MZ and same-sex DZ twins, respectively. D represents effects of alleles that do not add up, that is, all interactive effects of alleles within a locus as well as across loci, which is set at 1.0 and .25 for MZ and DZ twins, respectively. C represents those environmental influences shared by two members of a twin pair, which is set at 1.0 for both MZ and DZ twins. Finally, E refers to those environmental influences unique to each member of a twin pair and measurement error.

Table 1
Items of the Miserliness scale and correlations between each item and the total score of the Miserliness scale.

	Item	*r*
1.	I am a penny pincher	.62
2.	I prefer to save rather than spend money	.67
3.	I do not buy things unless they are absolutely necessary	.68
4.	I value money very much	.54
5.	I am very tightfisted and hardly spend money even if I have enough money	.66
6.	I am very careful in managing money so that I always carefully check where and how much I spend, and what is left	.58

Because it was not possible to estimate D and C in the same model, two full models, i.e., the ADE and the ACE models were fit to the data separately. Variations of the full model were made to select the best-fitting model. For a baseline comparison, we used a saturated model that estimated means and variances of Miserliness for all zygosity groups.

For model-fitting analyses, we used a maximum likelihood estimation procedure for raw data in a software, Mx (Neale, 1999). This procedure in Mx yields a goodness of fit index calculated as two times the log-likelihood of the data (−2LL). The difference between the fit index of a full model and that of a sub-model, where parameters are fixed to be zero or constrained to be equal, follows a χ^2 distribution. Two criteria were used to choose the best-fitting model: the likelihood ratio test (LRT) and the Akaike information criterion (Akaike, 1987; AIC = $\chi^2 - 2df$). LRT was applied to evaluate the significance of the constraint when two models were nested. A non-significant difference in chi-square between the full and sub-models suggests that the reduction in parameter is acceptable, whereas a significant difference indicates that the parameter should be retained in the model. When two models were not nested, the model that yielded a lower AIC was chosen as a better model.

3. Results

3.1. Descriptive statistics and twin correlations

There was no significant sex difference in Miserliness ($t = 0.13$, $p = .90$). However, age was modestly, but significantly positively correlated with Miserliness ($r = .10$, $p < .01$), suggesting that as children grow older they tend to become more interested in money. Table 2 shows maximum likelihood twin correlations and means and SDs for Miserliness in five groups of twins. To compute twin correlations, we used age as a covariate. Means and SDs for Miserliness were not significantly different across zygosity groups or between the first- and the second-born twins, satisfying the assumptions for analyses of twin data.

Higher MZ than DZ correlations in both genders suggested genetic influences on Miserliness. Genetic factors appear to be primarily of non-additive variety as DZ correlations were much lower than half of the MZ correlations in both genders. Very low DZ correlations suggested that shared family environmental factors are unimportant for individual difference in miserliness.

3.2. Model-fitting analyses

Table 3 presents fit statistics of the models and parameter estimates for each sub-model as well as full models. In the ACE model, the estimate of C was zero, showing that shared family environ-

Table 2
Twin correlations (95% CI), means, and standard deviations for Miserliness.

	Miserliness		
		Twin 1	Twin 2
	r	Mean (SD)	Mean (SD)
MZM	.37 (.27 to .47)	14.8 (2.6)	14.9 (2.7)
DZM	−.10 (−.31 to .12)	14.9 (2.4)	14.6 (2.5)
MZF	.25 (.16 to .33)	14.8 (2.6)	14.8 (2.7)
DZF	.07 (−.13 to .26)	14.8 (2.7)	14.3 (2.8)
		Male	Female
OSDZ	.08 (−.08 to .23)	14.2 (2.3)	14.3 (2.5)

Note: MZM = monozygotic male twins; DZM = dizygotic male twins; MZF = monozygotic female twins; DZF = dizygotic female twins; OSDZ = opposite-sex dizygotic twins. Twin correlations were adjusted for age.

Table 3
Results of univariate model-fitting analyses.

Model description	−2LL	df	AIC	Δ−2LL	Δdf	*P*	Parameter Estimates (95% CI)							
							Male				Female			
							A	C	D	E	A	C	D	E
1. A_m, C_m, $E_m \neq A_f$, C_f, E_f	10440.9	2210	6020.9				.33 (.15,.42)	0 (0,.16)	–	.67 (.58,.76)	.24 (0,.32)	0 (0,.24)	–	.76 (.68,.84)
2. A_m, D_m, $E_m \neq A_f$, D_f, E_f	10437.2	2210	6017.2				0 (0,.38)	–	.35 (0,.44)	.65 (.56,.74)	0 (0,.31)	–	.25 (0,.33)	.75 (.67,.84)
3. A_m, $E_m \neq A_f$, E_f	10440.9	2212	6016.9	3.7	2	.16	.33 (.24,.42)	–	–	.67 (.58,.76)	.24 (.16,.32)	–	–	.76 (.68,.84)
4. A_m, $E_m = A_f$, E_f	**10444.4**	**2214**	**6016.4**	**7.2**	**4**	**.13**	**.28 (.21,.34)**	–	–	**.72 (.66,.79)**	**.28 (.21,.34)**	–	–	**.72 (.66,.79)**

The best-fitting model is indicated in bold.

mental influences are negligible. The ADE model yielded lower −2LL than did the ACE model, suggesting that the former is better than the latter. The chi-square difference between the saturated model and the ADE model was not significant ($\Delta\chi^2_{(13)} = 20.4$, $p > .10$), indicating that the ADE model was acceptable. D for both sexes could be eliminated from the full ADE model without a significant deterioration in fit (Model 3). We did not attempt to remove A from the ADE model because the DE model has been discussed to be biologically implausible (Keller, Coventry, Heath, & Martin, 2005). Equating A and E across two genders resulted in a non-significant change in chi-square (Model 4), indicating that the magnitudes of A and E are not significantly different between two genders. We therefore concluded that Model 4 was the best-fit, where A and E were 28% and 72%, respectively for both genders.

4. Discussion

There are large individual differences in the interest and tendency to spend money, with some people being overly stingy and others overly generous. Freud attributed the development of miserly behavior to parental discipline during toilet training in early childhood.

However, our results show that factors emanating from common family environments such as child rearing practices are negligible and that miserliness is about 30% caused by genes, with the remainder being due to environmental experiences unique to individuals. The estimate of unique environmental influences in miserliness was approximately 70%.

Although this estimate includes measurement error, it explains why children living in the same family are so different from each other in how they spend money.

The present sample includes adolescents and young adults. One can argue that heritability may differ across the two age groups, given the behavioral genetic findings that heritability in most psychological traits tends to increase with age, especially after adolescence when children leave home to seek their own environments (Plomin, DeFries, McClearn, & McGuffin, 2001). We estimated genetic and environmental influences in two age groups (Adolescents = 12–18 years; Young Adults = 19–25 years) separately and found no significant differences between the two groups. This finding may be in part due to cultural practice in Korea where many children live with their parents until they marry.

As our sample lacked statistical power to distinguish between A and D in model-fitting, all genetic variance was absorbed into A in the final model. Thus, one should interpret the estimate of A in our final model as a broad-sense heritability, i.e., a sum of A and D. Our twin correlations clearly suggested the importance of genetic non-additivity in miserliness, consistent with a large body of literature on personality (Keller et al., 2005). Penke, Denissen, and Miller (2007) argue that recurring selection tends to increase the proportion of non-additive genetic variance. Thus, the presence of genetic non-additivity in our study suggests that miserliness may have evolved by means of natural selection. Selection pressures may have operated against both extremes of the continuum of miserliness, leading an average trait value to the highest fitness.While most researchers agree that miserliness is a personality trait, it is not clear how miserliness is related to other personality factors. As a subsample ($N = 1935$) of the present study completed the NEO-FFI (Costa & McCrae, 1992), we computed correlations between Miserliness and the Big Five. The Big Five describes five broad personality domains: Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness (Costa & McCrae, 1992). Among these factors, only Conscientiousness showed significant correlations with Miserliness in males ($r = .29$) and females ($r = .30$). These correlations may not be surprising given the methodical and careful planning components of conscientiousness as well as the findings by Boyce and Wood (2011) who reported a positive relationship between conscientiousness and increasing household income. Future research may wish to examine how miserliness and conscientiousness are linked to behaviors such as personal financial planning and impulse spending.

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