Phenotypic, Genetic, and Environmental Properties of the Portrait Values Questionnaire

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The purpose of the present study was to examine the 10 value types from the Portrait Values Questionnaire (PVQ; Schwartz et al., 2001) both at the phenotypic (observed) level as well as the genetic and environmental level. Australian twins (N = 695) completed the PVQ as part of a larger questionnaire battery. Nine of the value types were found to have a genetic component with heritability estimates ranging from 10.8% for power to 38% for conformity. The achievement scale was best explained by environmental factors. The interscale correlations were found to range from –.02 to .70 at the phenotypic level. Of these 45 correlations, 16 were found to be explained by overlapping genetic factors and almost all (41) were found to have significant unique environment correlations.

Keywords: values, genetics, environment

Unlike attitudes (Bouchard et al., 2004; Olson et al., 2001), the genetic properties of values has not been studied extensively. The purpose of the present study was to add to the value literature by examining the phenotypic (observed), genetic, and environmental components for each scale from the Portrait Values Questionnaire (PVQ; Schwartz et al., 2001). The PVQ measures ten value types: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, and security. Each of these value types is assumed to be associated with a distinctive motivational goal. For example, the motivational goal for power values is social status and prestige, and control or dominance over people and resources; for benevolence values the motivational goal is the preservation and enhancement of the welfare of people with whom one is in frequent contact.

In the value model developed by Schwartz (1992), the values are aligned in a circular fashion with adjacent values (such as self-direction and stimulation) more likely to be compatible when they are simultaneously pursued and opposing values (such as universalism and power) more likely to come into conflict when simultaneously pursued. Recently, Hinz et al. (2005) failed to support the circumplex structure of the PVQ, but did support the composition of the 10 value scales. However, Schwartz (2006) provides evidence for the circular structure for the PVQ in many different countries sampled in cross-cultural research. A further support for the circular model would be if those values adjacent to each other have significant genetic and environmental correlations in addition to the phenotypic correlations.

Values, according to Schwartz (1996), emerge as conscious goals that represent adaptations to three universal requirements of human existence: the satisfaction of biological needs, requisites for coordinating social interaction, and the demands for group survival and functioning. Like Rokeach (1973) and Feather (1975, 1999, 2004), Schwartz conceives of values as general beliefs about desirable ways of behaving and desirable goals that are more abstract than attitudes, that transcend specific objects and situations, that vary in their importance for individuals, and that serve as guiding principles in people's lives.

Behavior genetic studies in the area of values are quite limited, and like the attitude literature, some researchers tend to assume that the development of values mainly occurs on the basis of social learning and socialization within a culture. For example, Rohan and Zanna (1996) found that the average correlation between parents and their male children was .44 across the 10 value types from Schwartz's SVS measure. The authors state that the behavior of the parents influences the development of the child's values, suggesting common environment effects. An alternative argument for this correlation between

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parent and child could be the influence of genetic factors. Harris et al. (2006) reported that, of the six factors extracted from two sets of 18 values from the Rokeach Value Survey (RVS; Rokeach, 1973), all six were found to have a genetic component with heritability values ranging from 17% for a religiosity factor (salvation, obedient, and forgiving) to 50% for a nationalism factor (world at peace, equality, freedom, and national security) based on the results from a sample of adult twins who had been reared together. In addition, the religiosity factor was the only factor to have significant common environmental effects. Keller et al. (1992) examined the genetic and environmental components of work values in twins reared apart. Of the six work value factors, heritabilities were found to range from 18% for altruism to 56% for achievement. Common environment effects were also found for the achievement, status, comfort, and autonomy work value factors.

Other studies of genetic influences on social attitudes have been reviewed by Bouchard et al. (2004). For example, Waller et al. (1990) examined the genetic and environmental influences on religious interests, attitudes, and values with twins reared together and reared apart. Of the five measures used, Waller et al. (1990) reported that heritabilities ranged from 41% for religious occupational interests to 52% for religious values, with an average heritability across the measures of around 50%.

Taken together, the results of the above studies suggest that values may have a genetic component. The present study was designed to further investigate this area of research.

Method

Participants

Participants were 690 Australian individual twins (391 females, 299 males) aged 18 to 33 years (M = 23.1, SD = 3.7) who completed the PVQ as part of a larger study (see Distel et al., in press). Twins were offered the opportunity to complete the survey online via the internet, or as a conventional mailed questionnaire; about 60% chose the online option. Zygosity of twin pairs was determined by DNA marker testing for 69 pairs and for the remaining same-sex pairs conventional items on twin similarity and mistaken recognition were used (see Distel et al., in press). The full sample comprised 280 complete pairs and 130 single twins (incomplete pairs). The latter are retained in the full information maximum likelihood (FIML) analysis of the raw data since they augment information about means, variances, and sampling biases. Zygosity information was entirely lacking for nine pairs so these 18 individuals were added to the samples of singles. Of those for whom zygosity could be assigned, there were 133 MZ pairs (83 female and 50 male) and 138 DZ pairs (47 female, 29 male and 62 pairs of opposite sex). Full details of the sample can be found in Distel et al. (in press).

Instrument

The Portrait Values Questionnaire (PVQ) has a total of 40 items and allows scoring of ten value scales, each consisting of three to six items. Participants are asked to read a description of an individual and then respond on a 1 to 6 scale the degree to which the description is similar to them (example item, 'Thinking up new ideas and being creative is important to this person. They like to do things in their own original way' with responses ranging from (1) *Not like me at all* to (6) *Very much like me*; Schwartz et al., 2001).

Statistical Methods

Analysis was performed in Mx (Neale et al., 2006). Tests of equality of means and variances were performed before variance components modeling of residual covariance, using standard structural equation modeling methods (Neale & Cardon, 1992). In conducting univariate genetic analyses, a phenotypic score is expressed as a linear function of three factors: genetic (A), common environment (C), and specific environment (E). Because of the small sample size and low power, a full ACE model was analyzed and heritability (a^2), common environment (c^2), and specific environment (e^2) values are computed from the standardized parameter estimates. Cholesky or triangular decomposition (see Neale & Cardon, 1992) was used calculate genetic and environmental correlations. For these analyses, a twin's score on one value scale is correlated with their co-twin's score on a different scale. If these cross-correlations are higher for MZ twins than for DZ twins, this suggests that the phenotypic correlation between the scales is due to some common genetic factor(s).

Results

Of the 690 individuals with returned questionnaires, 670 had answered all 40 items. The other 20 individuals were missing one or two items and rather than delete these cases, the mean of available items for each scale was used. Table 1 lists the scale properties of the 10 value scales of the PVQ. Internal consistency (coefficient alpha) values suggest that the scales are fairly reliable even though some of the scales have only a few items. Scale scores were computed and examined in subsequent analyses. Scores were found to be normally distributed and requiring no transformation. For the few outliers with values greater than 3SD, these points were winsorised to ±3SD.

Also shown in Table 1 are the means (and SD values) by sex, and tests for the difference between males and females for each of the value scales. The F-test results demonstrate that there are no significant differences in variance for any of the scales. With respect to mean differences, males were significantly higher than females on power (and almost so for stimulation) and females were higher on benevolence, universalism, security, and conformity. Spearman's correlation between age and scale scores was only significant for Security (r = 0.131, p <

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Table 1

Scale Properties of the Portrait Values Questionnaire

Scale	Total Sample *N* = 690				Female 1 *N* = 39		Male *N* = 299		EQ Variances		EQ Means	
	Items *N*	Means	*SD*	Cronbach α	Means	*SD*	Means	*SD*	*F*	*p*	*t*	p
Power	3	2.90	0.91	0.65	2.72	0.85	3.13	0.93	2.18	0.14	–6.06	.00
Achievement	4	3.93	1.00	0.83	3.89	1.02	3.99	0.98	0.19	0.66	–1.25	.21
Hedonism	3	4.35	0.92	0.76	4.34	0.92	4.36	0.92	0.13	0.72	–0.18	.86
Stimulation	3	3.86	0.98	0.70	3.80	1.00	3.94	0.95	1.10	0.29	–1.90	.06
Self-direction	4	4.25	0.79	0.67	4.29	0.78	4.20	0.81	0.02	0.88	1.38	1.69
Universalism	6	3.99	0.83	0.80	4.12	0.80	3.82	0.84	0.41	0.52	4.73	.001
Benevolence	4	4.32	0.82	0.74	4.54	0.75	4.03	0.82	0.88	0.35	8.48	.001
Tradition	4	3.17	0.79	0.51	3.18	0.79	3.15	0.78	0.23	0.63	0.57	0.57
Conformity	4	3.79	0.90	0.70	3.87	0.87	3.68	0.92	0.25	0.62	2.65	.008
Security	5	3.83	0.80	0.61	3.90	0.77	3.73	0.83	1.99	0.16	2.72	.006

Note: Tests for equal means and variance between sexes are shown.

.001) suggesting that older individuals tend to value security more highly.

Twin Correlations

Correlations between co-twins (corrected for age and sex effects) were computed for each of the five sex-zygosity twin groups [MZ male, MZ female, DZ male, DZ female, and DZ opposite sex (DZOS)] and are shown in Table 2 for the 10 value scales. The analysis of All MZ plus All DZ twins includes 148 single twins. The analysis of All MZ plus DZ same sex pairs includes 272 single twins (for this analysis, DZOS twins were treated as singles). Single twins contribute to the estimation of fixed effects (age, sex regression) and total variance, but do not contribute to the estimation of correlations. The DZ correlation is significantly influenced by DZOS pairs only for Hedonism (indicated in italics in the table) so genetic analysis of this trait should be treated with caution. For nine of the scales, the MZ correlations are higher than the DZ correlations, suggesting a possible genetic influence but this difference is only significantly different (indicated

Table 2

Maximum Likelihood Estimates of Twin Correlations (Corrected for Age and Sex Differences) By Sex and Zygosity Group and for Total MZ and DZ (With and Without Opposite Sex Pairs) Groups

Zygosity	No. pairs	Power		Achievement		Hedonism		Stimulation		Self-direction	
		r (95% CI)		*r* (95%CI)		*r* (95%CI)		*r* (95%CI)		*r* (95%CI)	
MZF	83	.40	(.20 to.55)	.30	(.11 to .46)	.22	(.04 to .38)	.10	(–.10 to .29)	.30	(.11 to .46)
MZM	50	.04	(–.21 to .28)	.28	(.05 to .47)	.25	(–.00 to .46)	.45	(.17 to .63)	.28	(.05 to .47)
DZF	47	.11	(–.21 to .40)	.38	(.09 to .58)	.42	(.10 to .62)	–.02	(–.28 to .25)	.38	(.09 to .58)
DZM	29	.17	(–.10 to .41)	.11	(–.26 to .43)	.22	(–.14 to .50)	.40	(.03 to .63)	.11	(–.26 to .43)
DZ same sex	76	.15	(–.06 to .34)	.27	(.04 to .46)	.33	(.09 to .51)	.12	(–.10 to .33)	.27	(.04 to .46)
DZ opposite sex	62	.26	(.01 to .46)	.14	(–.15 to .38)	–.03	(–.26 to .21)	.03	(–.18 to .24)	.14	(–.15 to .38)
All MZ	133	.25	(.08 to .39)	.29	(.15 to .42)	.23	(.09 to .36)	.20	(.03 to .36)	.29	(.15 to .42)
All DZ	138	.19	(.03 to .34)	.22	(.04 to .37)	.14	(–.04 to .30)	.07	(–.08 to .22)	.22	(.04 to .37)
Zygosity	**No. pairs**	**Universalism**		**Benevolence**		**Tradition**		**Conformity**		**Security**	
		r (95%CI)		*r* (95%CI)		*r* (95%CI)		*r* (95%CI)		*r* (95%CI)	
MZF	83	.43	(.24 to .57)	.42	(.22 to .57)	.43	(.26 to .56)	.40	(.20 to .55)	.26	(–.00 to .46)
MZM	50	.26	(.02 to.45)	.21	(–.04 to .42)	.68	(.53 to .77)	.50	(.31 to .64)	.37	(.15 to .54)
DZF	47	.29	(–.02 to.52)	.12	(–.17 to .38)	.22	(–.10 to .47)	.03	(–.23 to .28)	.20	(–.07 to .43)
DZM	29	.15	(–.19 to.43)	.06	(–.28 to .37)	.45	(.07 to .66)	.01	(–.40 to .41)	.34	(–.11 to .61)
DZ same sex	76	.23	(.00 to .42)	.09	(–.13 to .30)	.30	(.06 to .49)	.02	(–.20 to .25)	.24	(.01 to .43)
DZ opposite sex	62	.13	(–.15 to.37)	–.16	(–.41 to .14)	.38	(.10 to .57)	–.03	(–.26 to .21)	.01	(–.22 to .24)
All MZ	133	.35	(.21 to.48)	.33	(.17 to .46)	.52	(.41 to .62)	.44	(.31 to .56)	.32	(.15 to .45)
All DZ	138	.19	(.01 to.35)	.01	(–.17 to .18)	.34	(.16 to .48)	.00	(–.17 to .16)	.13	(–.04 to .29)

as bold italic in the table) for Benevolence and Conformity ($p < .01$) and Tradition ($p <.05$).

Univariate Genetic Analyses

The results of the univariate genetic analyses are presented in Table 3. Because of the small sample size and low power, the variance component estimates (and 95% confidence intervals) from the ACE model are reported and possible dominance effects are not examined (Gillespie et al., 2000). Point estimates of additive genetic variance (A — heritability) range from 0 to 38%, and for shared environmental influences (C) from zero to 14%. For each scale, the majority of variance is due to unique environmental (E) influences (47% to 81%), although this value includes measurement error, which for such short scales, may be large. Another consequence of small sample and low power is that confidence intervals for the parameter estimates are often very large.

Correlations Between Value Scales

The intercorrelations between the value scales are reported in Table 4. These results somewhat support the model of Schwartz et al. (2001) such that values which are suggested to be closer together in the circumplex model (such as universalism and benevolence) have moderately higher correlations than between values which are represented at opposite ends (such as self-direction and conformity), although some exceptions are evident (such as between self-direction and security and hedonism and benevolence).

Multivariate Genetic Analyses

Multivariate genetic analyses were performed to further examine the causes of covariance between the value scales. Because of the rather small sample size, the modest estimates of C from the univariate analyses for most of the scales, and the high degree of negative confounding of A and C factor loadings in multivariate analyses, the multivariate genetic models were restricted to fitting an AE Cholesky decomposition. Table 5 lists the additive genetic correlations and the unique environmental correlations are shown in Table 6. One cautionary note in reading the genetic and environmental correlations is that the confidence intervals should be considered. Given the relatively small sample size in the present study (especially with the same-sex DZ twins), the valence (but not the magnitude) of the genetic correlations is interpretable. Accordingly, all correlations with a 95% confidence interval that do not include zero are considered to be significant. Of the 45 correlations computed, 16 genetic correlations were found to not include zero in the confidence interval. Unique environmental correlations were found to be significant for 41 of the correlations, and four correlations were not found to have either significant genetic or environmental correlations.

Discussion

The present study was designed to examine the ten values from the PVQ (Schwartz et al., 2001) both at the phenotypic (observed) level as well as the genetic and environmental level. In terms of scale properties, the internal consistency estimates were found to be acceptable with the lowest alpha-value found for the Tradition value scale. In terms of sex differences, some of the results found in the present study reflect those previously reported. In a very detailed review, based on studies using the abbreviated and full versions of the PVQ, as well as the SVS, Schwartz and Ruebel (2005) reported that men have higher scores on power, stimulation, hedonism, achievement, and self-direction. Only the results for power and stimulation were replicated in the present study. Schwartz and Ruebel (2005) also reported that women scored higher on benevolence, universalism, and sometimes security. Both the benevolence and universalism sex differences were found with the present data set.

Table 3

Results of Structural Equation Modeling of Residual Variance Components

Scale			Model parameters (95%CI)					
	MZ_*r*	DZ_*r*	A		C		E	
Power	.25	.19	10.8	(0.0 to 39.0)	13.8	(0.0 to 32.2)	75.4	(61.0 to 89.1)
Achievement	.10	.19	0.0	(0.0 to 25.1)	14.3	(0.0 to 25.4)	85.7	(73.7 to 97.2)
Hedonism	.23	.14	17.9	(0.0 to 36.1)	5.2	(0.0 to 29.1)	76.9	(63.9 to 90.9)
Stimulation	.20	.07	19.2	(0.0 to 33.2)	0.0	(0.0 to 22.6)	80.8	(66.8 to 96.2)
Self-Direction	.29	.22	14.9	(0.0 to 41.8)	14.1	(0.0 to 35.6)	71.0	(58.2 to 84.6)
Universalism	.35	.19	33.1	(0.0 to 47.3)	2.1	(0.0 to 34.5)	64.8	(52.7 to 79.3)
Benevolence	.33	.01	27.9	(3.6 to 41.6)	0.0	(0.0 to 17.6)	72.1	(58.4 to 87.2)
Tradition	.52	.34	37.6	(1.4 to 61.7)	14.9	(0.0 to 45.5)	47.5	(38.1 to 59.1)
Conformity	.44	.00	38.0	(20.3 to 50.3)	0.0	(0.0 to 11.5)	62.0	(49.7 to 75.9)
Security	.32	.13	30.7	(0.0 to 43.8)	0.0	(0.0 to 28.3)	69.4	(56.2 to 84.8)

Note: Full information maximum likelihood estimates and 95% confidence intervals are shown. Models are fitted to total MZ and DZ (including opposite sex) correlations. A, C, and E values have been converted to percentages.

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Table 4

Phenotypic Correlations Between Value Scales: Females (N = 391) Upper Triangle, Males (N = 299) Lower Triangle

										Females
	Power	Achievement	Hedonism	Stimulation	Self-Direction	Universalism	Benevolence	Tradition	Conformity	Security
Power	1	**.50**	**.23**	**.26**	**.24**	–.01	–.02	.03	**.14**	**.30**
Achievement	**.62**	1	**.39**	**.41**	**.38**	**.15**	**.16**	–.01	**.17**	**.42**
Hedonism	**.33**	**.46**	1	**.64**	**.44**	**.22**	**.40**	.08	**.15**	**.27**
Stimulation	**.31**	**.37**	**.70**	1	**.53**	**.33**	**.33**	.03	.03	**.19**
Self-direction	**.26**	**.46**	**.47**	**.52**	1	**.42**	**.33**	.03	.01	**.28**
Universalism	.11	**.26**	**.30**	**.31**	**.45**	1	.53	**.31**	**.27**	**.34**
Benevolence	**.20**	**.35**	**.44**	**.41**	**.40**	**.67**	1	**.34**	**.39**	**.36**
Tradition	.05	.09	.06	.04	.01	.40	.42	1	.53	.32
Conformity	**.20**	**.34**	**.21**	.09	.14	**.41**	**.49**	**.59**	1	**.49**
Security	**.37**	**.55**	**.36**	**.28**	**.36**	**.42**	**.47**	**.41**	**.60**	1
	Males									

Note: Values in bold significant at $p < .01$, two-tailed.

Univariate genetic analyses on the 10 value scales demonstrated that nine of the scales showed a genetic effect with heritability estimates ranging from 10.8% to 38% (the exception was the achievement values scale that was best explained by environmental effects). All scales were found to have unique environmental effects which were moderate to large. With respect to findings previously reported, Harris et al. (2006) demonstrated that all six of their value factors had a genetic influence, although their value factors are not those that comprise Schwartz's model. The finding in the present study that achievement, defined as successfully meeting social standards (Schwartz & Rubel, 2005), did not have a significant genetic effect needs to be further examined as Keller et al. (1992) demonstrated a heritable component for achievement in terms of work values with respect to preferences of job outcomes. Possibly the difference in results is due to the definition of achievement with specific work behaviors possibly reflecting more the personality dimension of achievement which has been shown to be highly heritable (e.g., Vernon et al. (1997) report a

Table 5

Genetic Correlations Between Values Scales

	1	2	3	4	5	6	7	8	9	10
1. Power	1									
2. Achievement	**.71**	1								
	(.33 to .91)									
3. Hedonism	.35	.43	1							
	(–.04 to .71)	(–.10 to .85)								
4. Stimulation	.01	.06	**.56**	1						
	(–.54 to .40)	(–.58 to .57)	**(.05 to .80)**							
5. Self-direction	–.02	**.56**	**.49**	**.59**	1					
	(–.41 to .28)	**(.14 to .84)**	**(.14 to .75)**	**(.23 to .85)**						
6. Universalism	**–.32**	–.05	.12	.25	.38	1				
	(–.02 to –.69)	(–.57 to .34)	(–.29 to .42)	(–.20 to .58)	**(.09 to .60)**					
7. Benevolence	–.18	.03	0.22	.20	.35	.77	1			
	(–.59 to .18)	(–.53 to .48)	(–.28 to .54)	(–.36 to .57)	(.00 to .63)	**(.56 to .95)**				
8. Tradition	–.08	–.23	.02	–.06	–.13	**.43**	**.61**	1		
	(–.33 to .16)	(–.63 to .10)	(–.26 to .29)	(–.40 to .24)	(–.38 to .09)	**(.24 to .60)**	**(.40 to .84)**			
9. Conformity	–.10	–.08	.00	–.26	–.16	**.35**	**.53**	**.75**	1	
	(–.45 to .19)	(–.59 to .29)	(–.39 to .31)	(–.72 to .10)	(–.49 to .11)	**(.08 to .57)**	**(.25 to .74)**	**(.62 to .88)**		
10. Security	.24	.34	.19	.08	.17	.26	**.52**	**.53**	**.70**	1
	(–.12 to .53)	(–.19 to .66)	(–24 to .51)	(–.42 to .47)	(–.19 to .44)	(–.07 to .50)	**(.19 to .78)**	**(.33 to .72)**	**(.49 to .88)**	

Note: Significant ($p < .05$) correlations shown in bold. Shared environmental contributions to covariance may be confounded with some of these correlations.

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Table 6

Unique Environmental Correlations Between Values Scales

	1	2	3	4	5	6	7	8	9	10
1. Power	1									
2. Achievement	**.52**	1								
	(.42 to .61)									
3. Hedonism	**.24**	**.42**	1							
	(.11 to .36)	**(.30 to .52)**								
4. Stimulation	**.37**	**.46**	**.70**	1						
	(.24 to .48)	**(.34 to .56)**	**(.62 to .76)**							
5. Self-direction	**.34**	**.38**	**.44**	**.51**	1					
	(.21 to .46)	**(.26 to .49)**	**(.33 to .54)**	**(.40 to .61)**						
6. Universalism	**.19**	**.27**	**.33**	**.36**	**.46**	1				
	(.04 to .32)	**(.14 to .40)**	**(.20 to .44)**	**(.23 to .48)**	**(.34 to .57)**					
7. Benevolence	.12	**.27**	**.47**	**.40**	**.36**	**.53**	1			
	(–.03 to .26)	**(.14 to .40)**	**(.35 to .57)**	**(.27 to .51)**	**(.23 to .48)**	**(.41 to .62)**				
8. Tradition	.10	**.16**	.11	.09	**.16**	**.32**	**.25**	1		
	(–.05 to .24)	**(.02 to .29)**	(–.03 to .25)	(–.06 to .23)	**(.02 to .30)**	**(.18 to .44)**	**(.10 to .38)**			
9. Conformity	**.28**	**.37**	**.26**	**.19**	**.20**	**.34**	**.42**	**.40**	1	
	(.14 to .41)	**(.24 to .49)**	**(.13 to .39)**	**(.05 to .32)**	**(.06 to .33)**	**(.21 to .47)**	**(.29 to .53)**	**(.27 to .51)**		
10. Security	**.34**	**53**	**.37**	**.29**	**.39**	**.47**	**.40**	**.26**	**.46**	1
	(.20 to .46)	**(.42 to .62)**	**(.24 to .49)**	**(.15 to .42)**	**(.26 to .51)**	**(.34 to .57)**	**(.27 to .52)**	**(.12 to .39)**	**(.34 to .57)**	

Note: Significant ($p < .05$) correlations shown in bold.

heritability for achievement to be 53%). One area of future research that needs to be examined is the genetic and environmental correlations between values and personality traits which have been shown to have a heritable component. Possibly the observed correlations between values and personality (e.g., see Roccas et al., 2002) are due to overlapping genetic and environmental factors.

Schwartz et al.'s (2001) circumplex model of values was found to be somewhat supported in the present study in terms of the interscale correlations at the phenotypic level in that correlations adjacent to the principal diagonal tended to be slightly higher than those further away, suggesting that values closer together in the model also had strong correlations. At the genetic level, 16 of the possible 45 correlations were found to have significant genetic correlations suggesting that the observed correlations between these values is due in some degree to common genetic factors. As with the phenotypic correlations, most of the genetic correlations directly beside the principal diagonal were significant (with the exception of achievement and hedonism), providing further support for the circumplex structure. A caveat is that, because of the negative confounding of A and C (as noted above), these genetic correlations may include some shared environmental influences on covariance between factors, although genetic influences are most likely making the greater contribution. Cholesky decomposition models examine the cross-correlations within twin pairs (such as one twin's power score correlated with their co-twin's tradition score). In the present sample, the average cross-correlation was .10 for MZ twins and .01 for DZ twins, suggesting that genetic factors are influencing some of the observed phenotypic correlations.

The results of the present study add considerably to the value literature by addressing the question of the degree to which values have a genetic versus environmental component, and as with attitudes (Bouchard et al., 2004; Olson et al., 2001), values should not be viewed as completely learned characteristics. The findings of the present study, in addition to the few findings reported in this research area, call for the need to further examine the genetic and environmental influences on values and to address questions such as why some values have a greater genetic influence compared to other values.

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