Emotion
2008, Vol. 8, No. 5, 635–642

1528-3542/08/$12.00 DOI: 10.1037/a0013439

A Behavioral Genetic Study of Trait Emotional Intelligence

Philip A. Vernon
University of Western Ontario, London, Ontario, Canada

K. V. Petrides
University College London, London, UK

Denis Bratko
University of Zagreb, Zagreb, Croatia

Julie Aitken Schermer
Management and Organizational Studies, University of Western Ontario, London, Ontario, Canada

Numerous models of emotional intelligence (EI) have proposed the existence of hitherto undiscovered mental abilities, competencies, and skills. The theory of trait emotional intelligence suggests that the content domains of these models invariably contain permutations of personality traits. The two studies in this article examine the heritability of trait EI scores with a view to demonstrating empirically that the construct has a similar level of genetic influence as other personality traits. Study 1 was a family design of 133 high-school students and their parents. Regressions of offspring on midparent scores suggested median upper-limit heritability estimates of .18 at facet level, .25 at factor level, and .32 at the global trait EI level. Study 2 was a twin design (213 pairs of monozygotic [MZ] twins and 103 pairs of dizygotic [DZ] twins). It yielded median heritabilities of .42 for the facets, .44 for the factors, and .42 for global trait EI. Overall, our findings are in accordance with studies of the major personality dimensions and provide further empirical support for the conceptualization of EI as a personality trait.

Keywords: trait emotional self-efficacy, family studies, heritability, personality, TEIQue

Trait emotional intelligence (trait EI or trait emotional self-efficacy) is a constellation of emotion-related self-perceptions and dispositions located at the lower levels of personality hierarchies (Petrides, Pita, & Kokkinaki, 2007). Its roots lie in the distinction between two EI constructs, namely, trait EI and ability EI (e.g., Petrides & Furnham, 2003; see also Amelang & Steinmayr, 2006; Austin, 2004; Austin, Parker, Petrides, & Saklofske, 2008; Austin, Saklofske, & Egan, 2005; Malterer, Glass, & Newman, 2008; Mikolajczak, Menil, & Luminet, 2007; Mikolajczak, Nelis, Hansenne, & Quoidbach, 2008; Tett & Fox, 2006; Warwick & Nettelbeck, 2004). The conceptualization of EI as a personality trait leads to a construct that lies wholly outside the taxonomy of human cognitive ability (Carroll, 1993).

A large number of alleged intelligences have been proposed over the years (creative, emotional, intrapersonal, interpersonal, practical, social, etc.), generally characterized by conceptual inconsistencies, questionable operationalizations (with most problems revolving around their subjective content and nature), and patchy nomological networks (Brody, 2004; Eysenck, 1998; Gottfredson, 2003; Jensen, 1998; Waterhouse, 2006). In its extended form, trait EI theory maintains that alleged intelligences essentially describe well-established personality traits (Petrides, Furnham, & Mavroveli, 2007).

Much trait EI research has sought to build a wide nomological network for the construct and to examine the conditions under which it can predict variance over and above the Big Five and other related variables (Kluemper, 2008; Mikolajczak, Luminet, & Menil, 2006; Petrides, Pérez-González, & Furnham, 2007; Saklofske, Austin, & Minski, 2003; Van der Zee & Wabeke, 2004). Other studies have focused on the psychometric integration of the construct into mainstream personality hierarchies (Petrides, Pita et al., 2007). The main conclusion of the latter studies is that trait EI is a distinct (because it can be isolated in personality space), compound (because it is partially determined by several personality dimensions) construct that lies at the lower levels of personality hierarchies (because the trait EI factor in joint factor analyses is oblique, rather than orthogonal to the Giant Three and the Big Five). A major advantage of this conclusion is that it connects the trait emotional self-efficacy conceptualization of EI to the differential psychology literature. Collectively, this research has provided strong support for trait EI theory and the proposition that alleged intelligences can (and should) be incorporated into existing taxonomies of personality.

In addition to empirical evidence of criterion and predictive validity, there are two types of methodological investigation that will be especially informative for trait EI theory. The first type concerns longitudinal designs that can shed light on the developmental trajectories of the construct; the second concerns behavioral genetic studies that can shed light on the degree to which variability in test scores is due to genetic and environmental

Philip A. Vernon, Department of Psychology, University of Western Ontario, London, Ontario, Canada; K. V. Petrides, Department of Psychology, University College London, London, UK; Denis Bratko, Department of Psychology, University of Zagreb, Zagreb, Croatia; and Julie Aitken Schermer, Management and Organizational Studies, University of Western Ontario, London, Ontario, Canada.

This research was partially supported by grant SG-42593 from the British Academy to K. V. Petrides.

Correspondence concerning this article should be addressed to Philip A. Vernon, Department of Psychology, University of Western Ontario, London, Ontario, Canada N6A 5C2. E-mail: vernon@uwo.ca

influences. In both cases, we would expect trait EI to yield findings analogous to those of broad-bandwidth personality traits because it is itself conceptualized as a broad-bandwidth personality trait. This article concentrates on the behavioral genetics of trait EI.

Heritability studies of personality have consistently demonstrated that individual differences in a wide variety of normal and abnormal personality traits are substantially attributable to genetic factors (Plomin, DeFries, McClearn, & McGuffin, 2001). A recent review by Johnson, Vernon, and Feiler (in press) summarized the results of 145 behavioral genetic studies conducted between 1955 and 2007, reporting twin and other kinship correlations as well as heritability and environmental estimates for the Big Five and related traits, based on a total of 240,000 pairs of participants. The evidence summarized by Johnson et al. (in press) overwhelmingly supports the conclusion that genetic and nonshared environmental factors account for the great majority of the variance, with heritabilities averaging about .45.

Study 1

The first investigation in this article sought to obtain upper-limit heritability estimates for trait EI by means of a family study. Family studies are based on behavioral genetic designs that are less powerful than twin designs. This is because the phenotypic similarity of the members of a nuclear family living together can be viewed as being only compatible with, but not as proof of, the genetic hypothesis.[1] Owing to the fact that biological parents share the same environment as well as the same genes with their offspring, familial resemblance cannot be decomposed into separate genetic and shared environmental variance components in family designs.

Nevertheless, it has now been established that environmental influences operate primarily within the family, thus making individuals who are living together different (e.g., Loehlin, 1992; Plomin & Daniels, 1987). Therefore, exploring if a particular trait "runs in the family" is a useful source of genetic information that can complement data from other sources. Classical twin designs include monozygotic (MZ) twins reared together (who share 100% genetic and 100% shared or common environment influences) and dizygotic (DZ) twins reared together (who share 50% additive genetic, 25% [or less] nonadditive genetic, and 100% shared or common environment influences). In contrast, family designs include parents and offspring (who share only 50% of additive genetic influences). Therefore, family designs aggregate different quantitative genetic parameters from twin designs, since they do not include nonadditive genetic effects in their estimates.

Most family studies of personality have yielded relatively low parent–offspring correlations (Ahern, Johnson, Wilson, McClearn, & Vandeberg, 1982; Bratko & Butković, 2007; Bratko & Maruîsić, 1997; Carmichael & McGue, 1994; Loehlin, Willerman & Horn, 1985; Price, Vandeberg, Iyer, & Williams, 1982; Tambs, Sundet, Eaves, Solaas, & Berg, 1991). For example, biological parents and their adolescent offspring correlate only .16 and .13 for Extraversion and Neuroticism, respectively (Ahern et al., 1982). Carmichael and McGue (1994) summarized studies of Extraversion and Neuroticism and reported average parent–offspring correlations of .12 and .13, suggesting that the familial aggregation of these traits is in the neighborhood of 25%.[2] Familial aggregation represents the combination of additive genetic and shared or common environmental variance, and as such, it places an upper limit on narrow-sense heritability, which is heritability that includes only additive genetic effects (for a further explanation of terminology, see Plomin et al., 2001).

Loehlin (2005, p. 205) classified the personality scales used in 29 independent studies according to the Big Five scheme and reported the following familial aggregation estimates: .28 (Extraversion [E]), .22 (Agreeableness [A]), .18 Conscientiousness ([C]), .26 (Neuroticism [N]), and .34 Openness to Experience ([O]), giving an average of .26. In contrast, twin studies typically yield higher heritability estimates. For example, Riemann, Angleitner, and Strelau (1997) reported the following values for the Big Five factors assessed through self-report: .52 (N), .56 (E), .53 (O), .42 (A), and .53 (C), giving an average of .51.

Method

Participants

The sample consisted of 133 high-school students (99 girls and 34 boys), 122 mothers, and 70 fathers. Data were collected from only 1 child per family, and for 59 children data were available for both parents. Age of offspring varied between 15 to 19 years (M = 16.90, SD = .99). Age of fathers ranged from 38 to 62 years (M = 47.50, SD = 5.78), and age of mothers ranged from 35 to 56 years (M = 43.10, SD = 4.91). All participants in this study were Croatian.

Measure

The Trait Emotional Intelligence Questionnaire (TEIQue) consists of 153 items predicated on trait EI theory and covering the sampling domain of trait EI comprehensively (Petrides, in press). It yields scores on 15 distinct facets, four factors, and global trait EI. An independent psychometric analysis of the inventory is presented by Mikolajczak, Luminet, Leroy, and Roy (2007). Participants respond on a 7-point Likert scale, ranging from *completely disagree* to *completely agree*. The TEIQue is an open-access inventory available in over 20 languages. It was adapted into Croatian by a team of students led by Denis Bratko. The team included four students, two of whom studied psychology and two English language and literature. One pair, comprising a psychology student and an English language student, independently translated the instrument and discussed and settled differences. Subsequently, the second pair back-translated the instrument, compared it with the original, and resolved any remaining issues.

Procedure

The adolescents completed the TEIQue at school in small groups (ranging from 9 to 30). They were also asked to deliver the inventories to their parents and return them within a few days to their school psychologist. Parents were asked to fill in the

[1] The genetic hypothesis stipulates that genetic variability contributes to the phenotypic variability in a trait.

[2] Estimates of familial aggregation are obtained by doubling the parent–offspring correlations, since each parent shares, on average, 50% of their genes with their offspring.

inventory individually at home. Inventories were matched through a personal code.

Results

Exploratory data analyses were performed, focusing on the distributions, sex differences, and internal consistencies of the Croatian TEIQue. Distributions were examined for deviations from normality, separately in the three samples (father, mother, and offspring). A series of Kolmogorov–Smirnov tests yielded nonsignificant z values ($p > .5$) for all scores, except Happiness in the offspring sample ($z = 1.39$, $p < .05$). However, the skewness and kurtosis values for this distribution (-1.13 and 1.15, respectively) indicated that the deviation from normality was marginal. There were sex as well as generational (parents vs. offspring) differences on various TEIQue variables (primarily at the facet level). The internal consistencies of TEIQue scores are presented separately for the mother, father, and offspring samples (see Table 1). As can be seen in Table 1, with few exceptions, the alphas were consistently high. Factor and global trait EI reliabilities were satisfactory throughout.

The main statistical analysis involved the calculation of three types of correlation coefficients: father–offspring correlations, mother–offspring correlations, and regressions of offspring on midparent scores. The latter of the three methods is thought to yield the best upper-limit estimate of narrow-sense heritability that can be derived in nontwin family studies.

The facet, factor, and global trait EI scores were correlated with sex in the offspring sample. At the facet level, sex (boys coded as 1 and girls as 2) was significantly associated with three scales: Empathy ($r = -.34$, $p < .01$), Emotion management ($r = .21$, $p < .05$), and Relationships ($r = .37$, $p < .01$). At the factor and global levels, sex was associated with Emotionality ($r = .32$, $p < .01$), Sociability ($r = .20$, $p < .05$), and global trait EI ($r = .20$, $p < .05$). Measures of parent–offspring resemblance (i.e., father–offspring and mother–offspring correlations and regressions of offspring on midparent scores) were calculated jointly for sons and daughters. Consequently, we removed, via standard regression, the linear component of sex from all TEIQue variables in the offspring sample in order to control for any potential bias in the parent–offspring resemblance estimates, which could have been introduced as a result of mean sex differences.

All scores in the three samples (father, mother, and sex-adjusted offspring) were standardized to have unit variances. Thus, the family resemblance analyses are based on standardized scores, corrected for sex differences in the offspring sample. The results of these analyses are presented in Table 2. At the facet level, the median father–offspring and mother–offspring correlations were .09 and .16, respectively, suggesting a familial aggregation between .18 and .32. The median regression of offspring on midparent scores was .18.

The correlations for factor and global trait EI scores were somewhat stronger, possibly due to higher internal consistencies. Thus, the median father–offspring and mother–offspring correlations for the four factors were .145 and .195, respectively, indicating an upper limit of heritability between .29 and .39. The median regression of offspring on midparent scores was .25. The corresponding correlations for global trait EI scores were .14 and .22 (suggesting an upper limit of heritability between .28 and .44), while the regression of offspring on midparent scores was .32.

As one reviewer noted, doubling the single parent–offspring correlation to estimate upper-limit heritability assumes that spouse correlations are negligible. High mother–father correlations on the trait EI facets would be problematic because they could lead to inflated estimates. In order to rule out this possibility, we calculated the father–mother correlations, which are given in Table 2. As can be seen, there were only three statistically significant values at the facet level (Emotion management = .33, Self-esteem = .35, and Happiness = .41) and one at the factor level (Well-being = .30; see Smith, Heaven, & Ciarrochi, 2008, for relevant results). While these correlations suggest the possibility of a small assortative mating effect, the familial aggregation estimates for these four variables did not depart from the general trend in Table 2. It should also be remembered that the regressions of offspring on midparent scores control for any assortative mating effects because the parental means do not carry information about the father–mother correlations.

Table 1
*TEIQue Internal Consistencies in Mothers (*N *= 123), Fathers (*N *= 70), and Offspring (*N *= 133) in Study 1*

TEIQue	Items	Mothers	Fathers	Offspring
Facet				
Adaptability	9	.72	.65	.78
Assertiveness	9	.57	.57	.63
Emotion expression	10	.78	.70	.79
Emotion management	9	.50	.54	.74
Emotion perception	10	.64	.65	.67
Emotion regulation	12	.70	.70	.70
Impulsiveness (low)	9	.73	.70	.69
Relationships	9	.55	.60	.56
Stress management	10	.64	.65	.59
Self-esteem	11	.72	.62	.80
Self-motivation	10	.65	.52	.70
Social awareness	11	.72	.65	.78
Trait empathy	9	.50	.62	.64
Trait happiness	8	.81	.78	.89
Trait optimism	8	.70	.62	.80
Factor				
Emotionality	4 facets	.85	.85	.83
Self-control	3 facets	.81	.81	.80
Sociability	4 facets	.81	.75	.87
Well-being	3 facets	.87	.85	.92
Global score				
Trait EI		.94	.93	.94

Note. TEIQue = Trait Emotional Intelligence Questionnaire; EI = emotional intelligence.

Discussion

It is clear from the findings of this study that a substantial proportion of individual differences in trait EI can be directly attributed to genetic variation in the population. Furthermore, the familial aggregation estimates for the trait EI variables are similar to those for the Big Five, which supports the conceptualization of emotional intelligence as a personality trait (Petrides, Furnham, et al., 2007). As is the case with the higher-order dimensions, this family study suggests that about a third of the trait EI variance can be directly attributed to additive genetic effects. Keeping in mind

Table 2
TEIQue Father–Mother Correlations, Father–Offspring Correlations, Mother–Offspring Correlations, and Regressions of Offspring on Midparent Scores in Study 1

TEIQue	F-M r	F-O r	M-O r	MIDPAR-O r
Facet				
Adaptability	.08	.12	.16*	.26*
Assertiveness	.10	.18	.34**	.31**
Emotion expression	.03	.02	.11	.22*
Emotion management	.33*	.00	.08	.08
Emotion perception	.01	.18	.10	.15
Emotion regulation	−.05	.05	−.04	.10
Impulsiveness (low)	.03	.09	.19*	.13
Relationships	.18	−.02	−.07	.00
Stress management	.02	−.03	.18*	.18
Self-esteem	.35**	.16	.21**	.28*
Self-motivation	.08	.18	.07	.19
Social awareness	−.01	.02	.23*	.28*
Trait empathy	−.12	.08	.09	.13
Trait happiness	.41**	.11	.20*	.18
Trait optimism	−.11	.20*	.19*	.20
Factor				
Emotionality	.04	−.03	.04	.14
Self-control	−.07	.17	.18*	.29**
Sociability	.09	.15	.29**	.28**
Well-being	.30*	.14	.21**	.22*
Global score				
Trait EI	.09	.14	.22**	.32**

Note. TEIQue = Trait Emotional Intelligence Questionnaire; F-M r = father–mother correlations; F-O r = father–offspring correlations; M-O r = mother–offspring correlations; MIDPAR-O r = regressions of offspring on midparent scores; EI = emotional intelligence.
* $p < .05$. ** $p < .01$.

the limitations of the present study, the results indicate that any serious consideration of the developmental trajectories of trait EI will be far removed from the homespun accounts currently prevailing in the literature and will have to pay full heed to genetic explanations.

Trait EI facets and factors seem to be differentially influenced by genes and environment, as can be seen in Table 2 (e.g., regressions of offspring on midparent scores ranged from .00 for Relationships to .31 for Assertiveness). If confirmed, this pattern of correlations would mirror that of higher-order personality traits, whose facets are also differentially susceptible to genetic influences (Jang, McCrae, Angleitner, Riemann, & Livesley, 1998; Loehlin, McCrae, Costa, & John, 1998). Thorough investigations of the behavioral genetics of trait EI will always require looking beyond the global score into the factors and, ultimately, the facets.

While heritability does not imply immutability, psychological dimensions with salient genetic components are not known for being malleable (see Jensen, 1998, for the case of cognitive ability). In fact, heritability contributes substantially to developmental stability across the life span (Bratko & Butković, 2007; McGue, Bacon, & Lykken, 1993). One implication of this is that if EI is conceptualized as a personality trait, which at present is the only scientifically viable conceptualization of the construct, then it will be necessary to adjust our expectations of what can be delivered by short-term training courses and interventions.

The findings of Study 1 should be interpreted with some caution, especially where they concern genetic effect estimates, due to the aforementioned limitations of family designs. Study 2 is based on a sample of MZ and DZ twins and was carried out to complement the conclusions of the first investigation.

Study 2

Twin studies provide the means to disentangle the relative influences of genetic and environmental factors on individual differences. The logic behind twin studies rests on the fact that MZ twins share 100% of their genes and 100% of their common environment, whereas DZ twins share only approximately 50% of their genes and 100% of their common environment. Thus, if the DZ correlation on some trait is subtracted from the MZ correlation, this leaves 50% of the genetic influence, so doubling the MZ − DZ correlation estimates all of the genetic influence and provides an index of heritability. By the same logic, subtracting the heritability coefficient (h^2) from the MZ correlation yields an estimate of the influence of the common environment (c^2), and subtracting ($h^2 + c^2$) from 1 estimates the influence of the nonshared or unique environment (e^2). These days, more sophisticated model-fitting procedures are typically used to estimate h^2, c^2, and e^2, but the underlying logic is the same.

A recent review of over 50 years of behavioral genetic research on the Big Five and related personality traits (Johnson et al., in press) identified 145 studies that reported twin and other kinship correlations as well as heritability and environmentality coefficients estimated by the above formulas or via model fitting. In total, these studies were based on data collected from 85,640 pairs of MZ twins, 106,644 pairs of DZ twins, and 46,215 pairs of other nontwin kinships, such as parents and their children and nontwin siblings. Across all studies, the results showed that individual differences in the Big Five were predominantly and approximately equally attributable to genetic and nonshared environmental factors; the influence of the shared environment was essentially nonexistent. The main goal of the second study was to complement the findings of Study 1 by confirming, through the twin method, the significant level of genetic influence in the variability of trait EI scores.

Method

Participants

The sample consisted of a total of 632 adult twins residing in Canada and the United States. These twins comprised 213 pairs of identical or monozygotic (MZ) twins [174 female pairs and 39 male pairs] and 103 pairs of same-sex fraternal or dizygotic (DZ) twins [95 female pairs and 8 male pairs]. Participants ranged between 18 and 82 years of age ($M = 38.4$, $SD = 15.23$). Despite the preponderance of women, especially among the DZ twins, the sample represented a wide cross-section, and we believe it unlikely that selection on personality traits will have biased our results.

Measures

Participants completed the English version of the TEIQue (see Study 1). They also completed a zygosity questionnaire (Nichols & Bilbro, 1966) asking questions about the twins' physical similarity (e.g., height, eye color, and general appearance) and the frequency with which they are mistaken for one another by other family members and friends. This questionnaire has been shown to be at least 93% as accurate as red blood cell polymorphism analyses for determining zygosity (Kasriel & Eaves, 1976).

Procedure

Participants responded to advertisements placed in newspapers in a number of large cities in Canada and the United States. At the time of their first contact, participants were provided with information about the nature of the study and what their participation would entail. If they agreed to take part, they were mailed the TEIQue and the zygosity questionnaire and were asked to complete them on their own and then return them in a stamped, self-addressed envelope. Upon receipt of their completed questionnaires, each subject was sent $25.00 to compensate them for their time, and their names were entered into a drawing for one of ten $100.00 prizes.

Results

The internal consistencies of the 20 TEIQue variables were calculated separately for the MZ and DZ samples. This was necessary in order to ensure equivalence of the MZ and DZ datasets prior to the estimation of the genetic correlations. As can be seen in Table 3, the values were consistently similar.

Shown in Table 4 are the MZ and DZ twin correlations for the TEIQue facet scales, factors, and global score, along with the genetic and environmental parameter estimates derived from univariate behavioral genetic model-fitting analyses. In this table, d^2 and a^2 represent the proportion of the variance in each variable attributable to nonadditive and additive genetic effects, respectively, while c^2 and e^2 represent the proportion of the variance attributable to shared and nonshared environmental factors, respectively. Nonadditive genetic effects are suggested whenever MZ twin correlations are more than twice as large as DZ correlations, as is evident for several of the variables in Table 4. Dominant (i.e., nonadditive) genetic variance represents genetic influences that do not "breed true" and that contribute to differences between children and their parents. Additive genetic variance, in contrast, contributes to similarities between children and their parents.

The MZ correlations were found to be larger than the DZ correlations for all variables, and the model-fitting results indicate that the variance is entirely attributable to genetic and nonshared environmental factors, with heritabilities ranging from .24 to .53. Confidence intervals at 95% are given for all parameter estimates, and the fact that none of these includes zero indicates that all heritability and environmental coefficients are statistically significant beyond the .05 level. As was noted in several cases, MZ correlations were more than twice as large as DZ correlations, suggesting the presence of nonadditive genetic effects. In these cases, models estimating a^2 and e^2 were compared to models estimating d^2 and e^2, and the models with the best fit were retained and are reported in Table 4. As can be seen, nonadditive genetic effects were found for the majority of the TEIQue facets and factors.

In supplementary analyses available from Philip A. Vernon, we decomposed the phenotypic correlations among the TEIQue facets and found that they were entirely attributable to correlated genetic and correlated nonshared environmental factors. These results mirror findings with the Big Five and cognate variables and are consistent with the conceptualization of EI as a personality trait.

Table 3
*TEIQue Internal Consistencies in MZ (*N *= 426) and DZ (*N *= 206) Twins in Study 2*

TEIQue	MZ	DZ
Facet		
Adaptability	.73	.77
Assertiveness	.74	.75
Emotion expression	.90	.90
Emotion management	.67	.66
Emotion perception	.76	.79
Emotion regulation	.79	.80
Impulsiveness (low)	.76	.77
Relationships	.65	.73
Stress management	.79	.83
Self-esteem	.78	.82
Self-motivation	.69	.74
Social awareness	.80	.83
Trait empathy	.70	.74
Trait happiness	.90	.89
Trait optimism	.82	.81
Factor		
Emotionality	.81	.81
Self-control	.76	.79
Sociability	.78	.77
Well-being	.83	.85
Global score		
Trait EI	.89	.91

Note. TEIQue = Trait Emotional Intelligence Questionnaire; MZ = monozygotic; DZ = dizygotic; EI = emotional intelligence.

Discussion

In line with the results of Study 1, the twin data collected in Study 2 reveal that individual differences in all of the dimensions tapped by the TEIQue have moderate to large genetic influences. The results are also in line with many behavioral genetic studies of personality traits, which have shown that the variance in these traits is largely, if not entirely, attributable to genetic and nonshared environmental factors. In contrast, shared environmental factors, such as those experienced in common by siblings or parents and their offspring, contribute negligibly.

Despite some variability (heritability estimates for the TEIQue facets ranged from .24 for Emotion perception to .53 for Social awareness, and heritability estimates for the factors ranged between .35 for Emotionality to .50 for Sociability), the contribution of genetic and nonshared environmental factors to individual differences in most TEIQue variables are remarkably consistent. In Johnson et al.'s (in press) review of behavioral genetic studies of the Big Five, there was some indication that Extraversion was more highly heritable than was Agreeableness, but there too, the differences between the heritabilities of the traits were not large.

With reference to the Big Five, Vernon, Villani, Schermer, and Petrides (in press) found that Emotion perception and Emotionality both correlate more highly with the less heritable Agreeableness factor than do Social awareness and Sociability, which, in turn, correlate more highly with the more heritable Extraversion factor. This differential pattern of correlations between the TEIQue vari-

Table 4
Twin Correlations and Model-Fitting Results for the TEIQue in Study 2

TEIQue	MZr	DZr	d^2 (95% CI)	a^2 (95% CI)	c^2 (95% CI)	e^2 (95% CI)
Facet						
Adaptability	.38	.14	.40 (.28 to .50)	—	—	.60 (.50 to .72)
Assertiveness	.41	.13	.41 (.29 to .51)	—	—	.59 (.49 to .71)
Emotion expression	.41	.17	—	.40 (.29 to .50)	—	.60 (.50 to .71)
Emotion management	.44	.17	—	.42 (.31 to .52)	—	.58 (.48 to .69)
Emotion perception	.23	.15	—	.24 (.11 to .36)	—	.76 (.64 to .88)
Emotion regulation	.46	.08	.45 (.34 to .55)	—	—	.55 (.45 to .66)
Impulsiveness (low)	.41	.14	.42 (.30 to .52)	—	—	.58 (.48 to .70)
Relationships	.31	.13	.34 (.21 to .46)	—	—	.66 (.54 to .79)
Stress management	.43	.06	.44 (.32 to .54)	—	—	.56 (.46 to .68)
Self-esteem	.42	.18	.44 (.33 to .54)	—	—	.56 (.46 to .67)
Self-motivation	.43	.33	—	.46 (.36 to .56)	—	.54 (.44 to .64)
Social awareness	.51	.07	.53 (.42 to .62)	—	—	.47 (.38 to .58)
Trait empathy	.23	.18	—	.25 (.13 to .37)	—	.75 (.63 to .87)
Trait happiness	.43	.02	.44 (.32 to .54)	—	—	.56 (.46 to .68)
Trait optimism	.40	−.01	.39 (.28 to .50)	—	—	.61 (.50 to .72)
Factor						
Emotionality	.35	.13	—	.35 (.23 to .46)	—	.65 (.54 to .77)
Self-control	.48	.02	.48 (.37 to .58)	—	—	.52 (.42 to .63)
Sociability	.50	.12	.50 (.40 to .59)	—	—	.50 (.41 to .60)
Well-being	.40	.03	.41 (.29 to .52)	—	—	.59 (.48 to .71)
Global score						
Trait EI	.41	.05	.42 (.30 to .53)	—	—	.58 (.47 to .70)

Note. TEIQue = Trait Emotional Intelligence Questionnaire; MZr = monozygotic correlation; DZr = dizygotic correlation; d^2 = dominant genetic effects; a^2 = additive genetic effects; c^2 = common environmental effects; e^2 = unique environmental effects; 95% CI = 95% confidence interval; EI = emotional intelligence.

ables and the Big Five factors may also contribute to the different magnitudes of their heritabilities.

General Discussion

The familial aggregation estimates from Study 1 (which aggregate additive genetic and shared environmental influences) were lower than the corresponding heritability estimates from Study 2. This result is in accordance with Plomin, Chipuer, and Loehlin's (1990) observation that upper-limit heritability estimates from family and adoption studies are typically lower than the corresponding estimates from twin studies, at least in the personality domain.

One common explanation for the low parent–offspring correlations focuses on the role of nonadditive genetic effects, that is, genetic effects that do not run in families. As was noted in Study 2, MZ twin correlations were more than twice as large as DZ twin correlations for many TEIQue variables, and models with nonaddiitive genetic effects typically provided the best fit for these variables. Thus, nonadditive genetic influences may be one factor contributing to low parent–offspring correlations. Another possibility is that the variable impact of genetic and environmental effects during development attenuated the resemblance estimates because parents and offspring were assessed at very different time points in their development (Plomin, 1986). However, the parent–offspring correlations in Study 1 were not substantially lower than the DZ twin correlations in Study 2, even though fraternal twins have the same degree of genetic overlap and were measured at the same time point in development.

The combined strength of the family and twin designs allows us to draw several conclusions. First, there are considerable genetic influences on trait EI, predisposing individuals to higher or lower scores. Nevertheless, as is the case for the Big Five, most of the phenotypic trait EI variance (which includes measurement error) is accounted for by nonshared environmental effects (e.g., experiences outside the family). The impact of nonshared environment on global trait EI ranges between 58% and 68%, according to the twin and family design, respectively. Second, the fact that the family aggregation estimates were lower than the heritability estimates supports the view that the similarity of family members is mediated genetically and not environmentally. On the whole, these results are consistent with the hypothesis of negligible shared environmental influence on the trait EI population variance.

With respect to trait EI theory, the finding that a substantial proportion of the construct's variance is heritable has two important implications. First, speculation about the determinants of emotional "intelligence" will now have to take into account the fact that one of the strongest predictors of adolescent trait EI is actually parental trait EI. In combination with the temporal stability that the construct shows even in children (Mavroveli, Petrides, Shove, & Whitehead, in press), this suggests that training and intervention programs, currently popular in educational and business settings, are unlikely to be more successful in changing trait EI than they have been in changing personality more generally (Costa & McCrae, 1986; Norlander, Bergman & Archer, 2002).

Second, the results are in line with the conceptualization of emotional intelligence as a personality trait. The heritable proportion of about 40% is higher than that of nonpersonality constructs (e.g., job satisfaction; Arvey, Bouchard, Segal, & Abraham, 1989) but lower than the heritability of most cognitive abilities (Jensen, 1998). In fact, this heritability estimate is very similar to the estimates obtained for broad-bandwidth personality traits, which is evidence that the characteristics routinely described as EI are personality traits. Of course, the main shortcoming of this argument is the absence of an established personality inventory from the research design, which prevents us from examining the phenotypic and genetic correlations that are key to deciding this issue (but see Vernon et al., in press).

The present studies contribute previously unavailable data that should be considered, not in isolation, but with reference to an expanding literature pointing out that alleged new intelligences require reconceptualization as personality traits. For example, Brody (2004) and O'Sullivan and Ekman (2004) highlighted some of the fundamental problems in the scoring procedures used in ability EI tests (see also Cronbach, 1955), Eysenck (1998) discussed inconsistencies in the conceptualization of EI as a novel mental ability, and Petrides, Pita, et al. (2007) demonstrated empirically how the construct can be integrated into the existing theories of personality.

To the foregoing body of evidence, the present article contributes original data showing that trait EI has heritability and environmental coefficients very similar to those of other broad-bandwidth personality dimensions. This leads us to conclude that, when the evidence is considered in its totality, it seems clear that alleged intelligences, such as emotional, social, personal and the like, should be reconceptualized as traits at the lower levels of mainstream personality hierarchies.

References

Ahern, F. M., Johnson, R. C., Wilson, J. R., McClearn, G. E., & Vandeberg, S. G. (1982). Family resemblance in personality. *Behavior Genetics, 12,* 261–280.

Amelang, M., & Steinmayr, R. (2006). Is there a validity increment for tests of emotional intelligence in examining the variance of performance criteria? *Intelligence, 34,* 459–468.

Arvey, R. D., Bouchard, T. J., Segal, N. L., & Abraham, L. M. (1989). Job satisfaction: Environmental and genetic components. *Journal of Applied Psychology, 74,* 187–192.

Austin, E. J. (2004). An investigation of the relationship between trait emotional intelligence and emotional task performance. *Personality and Individual Differences, 36,* 1855–1864.

Austin, E. J., Parker, J. D. A., Petrides, K. V., & Saklofske, D. H. (2008). Emotional intelligence. In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.), *The SAGE handbook of personality theory and testing: Vol. 1. Personality theories and models* (pp. xx–xx). Thousand Oaks, CA: Sage.

Austin, E. J., Saklofske, D. H., & Egan, V. (2005). Personality, well-being and health correlates of trait emotional intelligence. *Personality and Individual Differences, 38,* 547–558.

Bratko, D., & Butković, A. (2003). Family study of sensation seeking. *Personality and Individual Differences, 35,* 1559–1570.

Bratko, D., & Butković, A. (2007). Stability of genetic and environmental effect from adolescence to young adulthood: Results of Croatian longitudinal twin study of personality. *Twin Research and Human Genetics, 10,* 151–157.

Bratko, D., & Maruîsić, I. (1997). Family study of the Big Five personality dimensions. *Personality and Individual Differences, 23,* 365–369.

Brody, N. (2004). What cognitive intelligence is and what emotional intelligence is not. *Psychological Inquiry, 15,* 234–238.

Carmichael, C. A., & McGue, M. (1994). A longitudinal family study of personality change and stability. *Journal of Personality, 62,* 1–20.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York: Cambridge.

Costa, P. T., Jr., & McCrae, R. R. (1986). Personality stability and its implications for clinical psychology. *Clinical Psychology Review, 6,* 407–423.

Cronbach, L. J. (1955). Processes affecting scores on "understanding of others" and "assumed similarity." *Psychological Bulletin, 52,* 177–193.

Eysenck, H. J. (1998). *Intelligence: A new look.* New Brunswick, NJ: Transaction.

Gottfredson, L. S. (2003). Dissecting practical intelligence theory: Its claims and evidence. *Intelligence, 31,* 343–397.

Jang, K. L., McCrae, R. R., Angleitner, A., Riemann, R., & Livesley, W. J. (1998). Heritability of facet-level traits in a cross-cultural twin sample: Support for a hierarchical model of personality. *Journal of Personality and Social Psychology, 74,* 1556–1565.

Jensen, A. R. (1998). *The g factor.* Westport, CT: Praeger.

Johnson, A. M., Vernon, P. A., & Feiler, A. R. (in press). Behavioral genetic studies of personality: An introduction and review of the results of 50+ years of research. In G. Boyle, G. Matthews, & D. Saklofske (Eds.), *Handbook of personality and testing* (pp. xx–xx). Thousand Oaks, CA: Sage.

Kasriel, J., & Eaves, L. (1976). The zygosity of twins: Further evidence on the agreement between diagnosis by blood groups and written questionnaire. *Journal of Biosocial Science, 8,* 263–266.

Kluemper, D. (2008). Trait emotional intelligence: The impact of core-self evaluations and social desirability. *Personality and Individual Differences, 44,* 1402–1412.

Loehlin, J. C. (1992). *Genes and environment in personality development.* Thousand Oaks, CA: Sage.

Loehlin, J. C. (2005). Resemblance in personality and attitudes between parents and their children: Genetic and environmental contributions. In S. Bowles & M. Osbourne (Eds.), *Unequal chances: Family background and economic success.* New York: Russell Sage Foundation Press.

Loehlin, J. C., McCrae, R. R., Costa, P. T., Jr., & John, O. P. (1998). Heritabilities of common and measure-specific components of the Big Five personality factors. *Journal of Research in Personality, 32,* 431–453.

Loehlin, J. C., Willerman, L., & Horn, J. M. (1985). Personality resemblance in adoptive families when the children are the late-adolescent or adult. *Journal of Personality and Social Psychology, 48,* 376–392.

Malterer, M. B., Glass, S. J., & Newman, J. P. (2008). Psychopathy and trait emotional intelligence. *Personality and Individual Differences, 44,* 735–745.

Mavroveli, S., Petrides, K. V., Shove, C., & Whitehead, A. (in press). Investigation of the construct of trait emotional intelligence in children. *European Child and Adolescent Psychiatry.*

McGue, M., Bacon, S., & Lykken, D. T. (1993). Personality stability and change in early adulthood: A behavioral genetic analysis. *Developmental Psychology, 29,* 96–109.

Mikolajczak, M., Luminet, O., Leroy, C., & Roy, E. (2007). Psychometric properties of the Trait Emotional Intelligence Questionnaire (TEIQue; Petrides & Furnham, 2003). *Journal of Personality Assessment, 88,* 338–353.

Mikolajczak, M., Luminet, O., & Menil, C. (2006). Predicting resistance to stress: Incremental validity of trait emotional intelligence over alexithymia and optimism. *Psicothema, 18,* 79–88.

Mikolajczak, M., Menil, C., & Luminet, O. (2007). Explaining the protective effect of trait emotional intelligence regarding occupational stress: Exploration of emotional labour processes. *Journal of Research in Personality, 41,* 1107–1117.

Mikolajczak, M., Nelis, D., Hansenne, M., & Quoidbach, J. (2008). If you can regulate sadness, you can probably regulate shame: Associations between trait emotional intelligence, emotion regulation and coping efficiency across discrete emotions. *Personality and Individual Differences, 44,* 1356–1368.

Nichols, R. C., & Bilbro, W. C., Jr. (1966). The diagnosis of twin zygosity. *Acta Geneticae Medicae et Gemellologiae (Roma), 16,* 265–266.

Norlander, T., Bergman, H., & Archer, T. (2002). Relative constancy of personality characteristics and efficacy of a 12-month training program in facilitating coping strategies. *Social Behavior and Personality, 30,* 773–784.

O'Sullivan, M., & Ekman, P. (2004). Facial expression recognition and emotional intelligence. In G. Geher (Ed.), *Measuring emotional intelligence: Common ground and controversy.* Hauppauge, NY: Nova Science.

Petrides, K. V. (in press). Psychometric properties of the Trait Emotional Intelligence Questionnaire (TEIQue). In C. Stough, O. H. Saklofske, and J. D. A. Parker (Eds.), Advances in the measurement of emotional intelligence. New York: Springer.

Petrides, K. V., & Furnham, A. (2003). Trait emotional intelligence: Behavioral validation in two studies of emotion recognition and reactivity to mood induction. *European Journal of Personality, 17,* 39–57.

Petrides, K. V., Furnham, A., & Mavroveli, S. (2007). Trait emotional intelligence: Moving forward in the field of EI. In G. Matthews, M. Zeidner, & R. Roberts (Eds.), *Emotional intelligence: Knowns and unknowns* (*Series in Affective Science*; pp. xx–xx). Oxford, UK: Oxford University Press.

Petrides, K. V., Pérez-González, J.-C., & Furnham, A. (2007). On the criterion and incremental validity of trait emotional intelligence. *Cognition and Emotion, 21,* 26–55.

Petrides, K. V., Pita, R., & Kokkinaki, F. (2007). The location of trait emotional intelligence in personality factor space. *British Journal of Psychology, 98,* 273–289.

Plomin, R. (1986). Multivariate analysis and developmental behavior genetics: Developmental change as well as continuity. *Behavior Genetics, 16,* 25–43.

Plomin, R., Chipuer, H. M., & Loehlin, J. C. (1990). Behavior genetics and personality. In C. A. Pervin (Ed.), *Handbook of personality: Theory and research.* New York: Guilford Press.

Plomin, R., & Daniels, J. (1987). Why are children in the same family so different from each other? *Behavioral and Brain Sciences, 10,* 1–16.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2001). *Behavioral genetics* (4th ed.). New York: Worth.

Price, R. A., Vandeberg, S. G., Iyer, H., & Williams, J. S. (1982). Components of variation in normal personality. *Journal of Personality and Social Psychology, 43,* 328–340.

Riemann, R., Angleitner, A., & Strelau, J. (1997). Genetic and environmental influences on personality: A study of twins reared together using self- and peer-report NEO-FFI scales. *Journal of Personality, 65,* 449–475.

Saklofske, D. H., Austin, E. J., & Minski, P. S. (2003). Factor structure and validity of a trait emotional intelligence measure. *Personality and Individual Differences, 34,* 707–721.

Smith, L., Heaven, P. C. L., & Ciarrochi, J. (2008). Trait emotional intelligence, conflict communication patterns, and relationship satisfaction. *Personality and Individual Differences, 44,* 1314–1325.

Tambs, K., Sundet, J. M., Eaves, L., Solaas, M. H., & Berg, K. (1991). Pedigree analysis of Eysenck Personality Questionnaire in monozygotic twin families. *Behavior Genetics, 21,* 369–382.

Tett, R. P., & Fox, K. E. (2006). Confirmatory factor structure of trait emotional intelligence in student and worker samples. *Personality and Individual Differences, 41,* 1155–1168.

Van der Zee, K., & Wabeke, R. (2004). Is trait emotional intelligence simply or more than just a trait? *European Journal of Personality, 18,* 243–263.

Vernon, P. A., Villani, V. C., Schermer, J. A., & Petrides, K. V. (in press). Phenotypic and genetic associations between the Big Five and trait emotional intelligence. *Twin Research and Human Genetics.*

Warwick, J., & Nettelbeck, T. (2004). Emotional intelligence is? *Personality and Individual Differences, 37,* 1091–1100.

Waterhouse, L. (2006). Multiple intelligences, the Mozart effect, and emotional intelligence: A critical review. *Educational Psychologist, 41,* 207–225.

Received October 4, 2007
Revision received June 2, 2008
Accepted June 24, 2008 ■