European Journal of Personality
Eur. J. Pers. **16**: 351–367 (2002)
Published online 17 May 2002 in Wiley InterScience (www.interscience.wiley.com). **DOI**: 10.1002/per.456

Self-Esteem: A Behavioural Genetic Perspective

MICHELLE B. NEISS*, CONSTANTINE SEDIKIDES
and JIM STEVENSON
University of Southampton, UK

Abstract

Self-esteem, the affective or evaluative appraisal of one's self, is linked with adaptive personality functioning: high self-esteem is associated with psychological health benefits (e.g. subjective well-being, absence of depression and anxiety), effective coping with illness, and satisfactory social relationships. Although several pathways have been hypothesized to effect within-family transmission of self-esteem (e.g. parenting style, family relationship patterns), we focus in this article on genetic influences. Genetic studies on both global and domain-specific self-esteem and on both level and stability of self-esteem converge in showing that (i) genetic influences on self-esteem are substantial, (ii) shared environmental influences are minimal, and (iii) non-shared environmental influences explain the largest amount of variance in self-esteem. We advocate that understanding of current issues in self-esteem research will be enriched by including behavioural genetic approaches. Copyright © 2002 John Wiley & Sons, Ltd.

INTRODUCTION

The capacity to ponder and represent symbolically one's attributes, past, relational bonds, roles, feelings, values, and goals is a uniquely human trait (Sedikides & Skowronski, 1997, 2000, in press). This capacity, termed the self-concept or self, has attracted the attention and fascination of writers and poets, political and religious figures, philosophers and social scientists. Interestingly, the construct of self has become indispensable to psychology, in particular personality psychology (McCann & Sato, 2000). Research on the self has increased threefold in the last 30 years, far exceeding the growth rate of published research in psychology as a whole (Tesser, 2000). It is astounding to realise that one out of seven recent publications in psychology journals examined aspects of the self.

A central aspect of the self-concept is self-esteem (Greenwald, Bellezza, & Banaji, 1988). Self-esteem refers to one's affective or evaluative appraisal of the self; that is, self-esteem reflects the extent to which a person likes or dislikes the self, or the extent to which a person thinks positively or negatively of the self (Baumeister, 1993, 1998). Self-esteem

*Correspondence to: Michelle Neiss, Centre for Research on Self and Identity, Department of Psychology, University of Southampton, Highfield Campus, Southampton SO17 1BJ, UK. E-mail: mbn@soton.ac.uk

Received 23 July 2001
Accepted 27 February 2002

can be global (reflecting an overall appraisal of the self) or specific (reflecting the appraisal of a given domain of the self, such as academic competence, physical appearance, or athletic ability) (Brown, 1993; Pelham, 1995). Furthermore, self-esteem has two fundamental components: level (whether it is high or low; Crocker, Thompson, McGraw, & Ingermane, 1987; Tice, 1991) and stability (whether it is stable or unstable; Kernis & Waschull, 1995; Kernis, Grannemann, & Barclay, 1989).

A reason why self-esteem has come under intense empirical scrutiny is its compelling association with adaptive development and personality functioning (Allport, 1937; Harter, 1993; Rogers, 1959). Self-esteem is associated with positive affectivity (Brown & Marshall, 2001; Heatherton & Polivy, 1991) and subjective well-being (Diener & Diener, 1995), and is inversely linked to depression (Tennen & Herzberger, 1987), loneliness (Jones, Freemon, & Goswick, 1981), generalized anxiety (Brockner, 1984), and death anxiety (Greenberg, Solomon, & Pyszczynski, 1997). Furthermore, self-esteem is positively related to self-determination (Deci & Ryan, 1995), effective coping (Bednar, Wells, & Peterson, 1989), and the formation of satisfactory social bonds (Leary & Baumeister, 2000). It is of no surprise, then, that psychologists regard the maintenance and enhancement of self-esteem as a primary motive of human behaviour (Baumeister, 1998; Brown & Dutton, 1995; Sedikides & Strube, 1997; Taylor & Brown, 1988).

Given its key relevance to personality functioning, researchers have focused on the determinants of self-esteem. A considerable amount of research has suggested that parents and families play a vital role in the development of self-esteem. Parenting style (Lamborn, Mounts, Steinberg, & Dornbusch, 1991), family relationship patterns (Jacobvitz & Bush, 1996), and family structure (Bynum & Durm, 1996; McCormick & Kennedy, 2000) have been proposed to influence children's self-esteem. These lines of enquiry assume that the transmission of self-esteem within families is carried out through social environmental pathways.

However, an alternative to this possibility is that the within-family transmission of self-esteem is effected, at least in part, through genetic pathways. Indeed, a small body of literature does point to the importance of genetic influences on self-esteem. Our objective in this article is to review this literature. After a brief description of behavioural genetic methodology, we shall discuss the evidence for genetic influence on self-esteem. Subsequently, we shall discuss how future research on self-esteem can be informed by the use of behavioural genetic approaches. Finally, we shall offer several potentially fruitful suggestions for empirical forays into the genetics of self-esteem.

BEHAVIOURAL GENETIC METHODOLOGY

Behavioural genetic methodology provides a useful tool for analysing human behaviour (Bouchard & Propping, 1993). In studies of parental influences on children, shared environmental influences are confounded with shared genetic influences. Quantitative behavioural genetic approaches are designed to separate out genetic influences and environmental influences by apportioning the observed differences between people (phenotypic variance) into three subcomponents: shared environment (c^2), non-shared environment (e^2), and heritability (a^2) (Plomin, DeFries, McClearn, & Rutter, 2001).

Sibling resemblance can arise through either genetic or shared environmental influences. Shared environment consists of factors that family members share and that serve to make them more alike. For example, family levels of closeness and warmth may

be a shared environmental factor to the extent that they generate similarity between siblings. In contrast, non-shared environmental influences are experiences unique to individuals within the family (e.g. peer relationships) and thus do not contribute to similarity between family members. In addition, non-shared environment estimates typically include measurement error. In order to estimate each of the three components, researchers attempt to hold one influence (genetic or environmental) constant, while varying the other. For example, researchers may examine individuals of differing genetic relatedness reared in the same family (e.g. biological and adoptive children of a particular set of parents). This strategy would hold shared environmental influences constant while varying the degree of genetic influence (relatedness).

A detailed exposition of behavioural genetic methodologies is beyond the scope of this article (for further discussion, see Neale & Cardon, 1992; Plomin et al., 2001). A brief description, however, is useful in illustrating the basic logic behind quantitative behavioural genetic studies. Many of the behavioural genetic studies on self-esteem have used a classic twin design. These studies rely on a comparison of similarity between identical twins (MZ twins) and fraternal twins (DZ twins). MZ twins are genetically identical, whereas DZ twins, like all full siblings, on average share half of those genes that differ across individuals. All sibling pairs share the same family and are assumed to be equally influenced by those environmental influences that tend to make siblings similar—the shared environment correlates perfectly within a family. Furthermore, behavioural genetic models assume that shared environmental influences affecting the behaviour or trait of interest are equally strong for MZ and DZ twins. This is known as the equal-environment assumption.

It is plausible that MZ twins experience more homogenous environments than do DZ twins. For example, perhaps MZ twins dress more alike, appear more alike, spend more time together, and their similarities (rather than their differences) are more emphasized by parents (Joseph, 2000; Rose, Kaprio, Williams, Viken, & Obremski, 1990). If so, this would constitute a violation of the equal-environment assumption. However, direct tests of the equal-environment assumption support its validity (Plomin et al., 2001). For example, neither physical similarity (Hettema, Neale, & Kendler, 1995) nor perceived zygosity (Kendler, Neale, Kessler, Heath, & Eaves, 1993) are related to twin concordance for several psychiatric disorders (e.g. phobia, depression, anxiety). Thus, although MZ twins may indeed experience greater environmental similarity, their shared experiences are often unrelated to sibling similarity for a variety of psychological outcomes. Importantly, other findings question the direction of causality underlying MZ twins' environmental similarity. Rather than similar environments causing MZ twins to be more alike, their innate similarity may evoke more similar environments. Research suggests that MZ twins spend more time together because of their greater likeness (Lykken, McGue, Bouchard, & Tellegen, 1990) and that their parents respond to greater similarity of MZ twins rather than create greater similarity (Lytton, 1977).

With these assumptions about shared environment and knowledge about degree of genetic relatedness, we can express mathematically the expected sibling correlations for MZ and DZ twins as follows:

$$r_{\mathrm{mz}} = a^2 + c^2 \quad \text{and} \quad r_{\mathrm{dz}} = 0.5a^2 + c^2.$$

If MZ twins are more alike on a given trait than DZ twins, their greater phenotypic similarity can be attributed to their greater genetic resemblance and, thus, provides evidence for heritable influences. If, however, MZ twins are no more similar than DZ

twins, there is no evidence for heritable influences on the trait, and thus sibling resemblance can be attributed to shared environmental influences. This basic logic can be expanded to studies that include full siblings, half-siblings (who share one parent and thus share 25% of their genes) or unrelated siblings reared in the same household (e.g. adoptive or step-siblings).

EVIDENCE FOR GENETIC INFLUENCE ON SELF-ESTEEM

Behavioural genetic studies on global self-esteem investigate the extent to which individuals' appraisals of themselves can be explained by genetic versus environmental influences. We present a comprehensive literature review, including in our discussion studies that used as participants children, adolescents, and adults. Also, we will break down our review in terms of level (global and domain-specific) and stability of self-esteem.

Self-esteem level

Several studies have used a behavioural genetic methodology to investigate whether sibling similarity in global and domain-specific self-esteem level is accounted for by genetic factors.

Global self-esteem

Four investigations have assessed the heritability of global self-esteem level. These studies are summarized in Table 1. In a longitudinal study of 738 adult female twin pairs from the Virginia Twin Registry, Roy, Neale, and Kendler (1995) obtained evidence for significant genetic influences on global self-esteem level. These researchers assessed self-esteem with a seven-item version of the Rosenberg Self-Esteem Scale (1965) at two time points, which were on average 16 months apart. At both time points, MZ twins showed greater similarity to one another ($r_{\text{time 1}} = 0.40; r_{\text{time 2}} = 0.36$) than did DZ twins ($r_{\text{time 1}} = 0.21; r_{\text{time 2}} = 0.12$). Neither similarity in environment nor frequency of contact predicted similarity in self-esteem, supporting the equal-environment assumption. The researchers estimated heritability of self-esteem to be 40% at time 1 and 36% at time 2. Shared environmental influences did not contribute significantly to self-esteem. The remaining variance in self-esteem was attributable to non-shared environmental influences.

Kendler, Gardner, and Prescott (1998) reported on an investigation of global self-esteem level among both female and male twins from the Virginia Twin Registry ($n = 3756$ twin pairs), a sample which included respondents who also participated in the study by Roy et al. (1995). Self-esteem was assessed with the Rosenberg Self-Esteem Scale (1965), and analyses were conducted with a shortened nine-item version. MZ twins showed a greater resemblance ($r_{\text{males}} = 0.30$, $r_{\text{females}} = 0.35$) than did DZ twins ($r_{\text{males}} = 0.11$, $r_{\text{females}} = 0.16$, $r_{\text{male–female}} = 0.13$). The equal-environment assumption seemed tenable, as evidenced by a lack of relation between similarity in childhood environments and frequency of current contact to sibling resemblance in self-esteem. Kendler et al. concluded that twin resemblance in self-esteem could be attributed to genetic factors ($a^2 = 32\%$). Furthermore, genetic influences on self-esteem were identical for males and females. Paralleling the findings by Roy et al., shared environmental influences were not significant and the largest portion of variance in self-esteem (66%) was due to non-shared environmental influences.

Further evidence of genetic influence on global self-esteem level comes from a study by Neiderhiser and McGuire (1994) of competence among children in the Colorado Adoption

Table 1. Heritability of global self-esteem

Citation	Sample	Age	Measure	a^2	c^2	e^2
Roy et al., 1995	Virginia Twin Register, female sub-sample	17–55	Rosenberg (7 items)			
	wave 1 (363 MZ pairs, 238 DZ pairs) and			0.40	—	0.60
	wave 2 (430 MZ pairs, 308 DZ pairs)			0.36	—	0.64
Kendler et al., 1998	Virginia Twin Register, wave 3 (2792 MZ pairs, 3523 DZ pairs)	18–60	Rosenberg (9 items)	Women 0.32 (0.25–0.39)	—	0.66
				Men 0.29 (0.23–0.34)	—	0.72
Neiderhiser & McGuire, 1994	CAP (58 pairs at age 10)	9	Harter's SPPC Self-Worth	0.49*	0.11	0.40
		10		0.00	0.09	0.91
McGuire et al., 1994	NEAD (720 sibling pairs)	9–18	Harter's SPPA Self-Worth	0.29	0.02	0.69

We provide confidence intervals in parentheses after estimates of genetic and environmental components when this information was available in the original article.
*Parameter estimates from Neiderhiser and McGuire (1994) are approximate estimates based on graphical presentations in the original article.

Project (CAP). These researchers investigated children's reports of global self-esteem at ages nine and ten, as assessed through a subscale of Harter's (1982) Self-Perception Profile for Children. Neither genetic nor shared environmental components were statistically significant, although the small sample size (25 pairs of adoptive siblings and 33 pairs of nonadoptive siblings at age ten) undoubtedly limited the power to detect either effect. At age nine, for example, heritability for self-esteem was estimated to be close to 50%, yet it was not statistically significant. Inspection of the intraclass sibling correlations for global self-esteem suggested that at age nine, but not age ten, genetically related siblings showed a greater resemblance ($r_{\text{age 9}} = 0.39$, $r_{\text{age 10}} = 0.08$) than did adoptive siblings ($r_{\text{age 9}} = -0.05$, $r_{\text{age 10}} = 0.09$).

In another study, McGuire, Neiderhiser, Reiss, Hetherington, and Plomin (1994) examined 720 same-sex siblings taking part in the Nonshared Environment and Adolescent Development (NEAD) Project. Participants' ages ranged from nine to 18 years and included both twin and full-sibling pairs from non-divorced families as well as full-siblings, half-siblings, and unrelated siblings from divorced families. McGuire and colleagues measured global self-worth using a sub-scale of Harter's (unpublished manuscript) Self-Perception Profile for Adolescents. Heritability for global self-worth was estimated to be 29%, although this was not statistically significant. The MZ correlation ($r = 0.32$) was greater than that of other sibling groups (e.g. $r_{\text{dz}} = 0.03$; $r_{\text{fullsib}} = -0.02$).

Domain-specific self-esteem

Five investigations have assessed the heritability of domain-specific self-esteem level. Table 2 summarizes results from these studies. McGue, Hirsch, and Lykken (1993) examined the level of self-esteem among adults twins ($n = 1225$ pairs) on six domains: interpersonal competence, workplace skills, trade skills, intellectual and cultural talents, domestic skills, and athletic competition. Pooled correlations (across age groups and gender) indicated that MZ twins manifested greater similarity (correlations between 0.46 and 0.67) than did DZ twins (correlations between 0.14 and 0.38). McGue et al. reported that approximately 50% of the variance in each of the six domains was attributable to genetic factors. Shared environmental effects were greater than zero only for one domain (intellectual and cultural talents), although the shared environmental estimate of 10% for this domain accounted for a relatively small portion of variance. Non-shared environmental influences accounted for the remaining variance in each domain. The magnitude of genetic and environmental effects did not differ across young adults, middle-aged adults, and older adults.

Given that shared environmental influences may decrease as a function of age (Plomin et al., 2001), it may not be surprising that a behavioural genetic study of adult self-esteem detected little to no shared environmental influences. However, several studies of domain-specific self-esteem among children and adolescents yielded similar findings. In a study of 407 pairs of preadolescent female twins, Hur, McGue, and Iacono (1998) used the Piers–Harris Children's Self-Concept Scale (Piers, 1984) to examine genetic and environmental effects on six self-esteem domains: popularity, physical appearance, anxiety, happiness, academic competence, and behaviour problems. MZ twins were more alike in each domain (correlations between 0.29 and 0.56) than were DZ twins (correlations between -0.01 and 0.32). Across the six domains, the mean heritability estimate was 32%, ranging from 19% for academic competence to 42% for popularity. Shared environment estimates were generally lower; the average value was approximately 7%, with values ranging from zero to 13%. Non-shared environmental influences comprised

Table 2. Domain specific self-esteem

Citation	Sample	Age	Measure	a^2	c^2	e^2
McGue et al., 1993	Minnesota Twin Register (678 MZ pairs, 547 DZ pairs)	27–86	Talent Inventory			
			Interpersonal	0.50 (0.47–0.52)	0	0.50 (0.48–0.53)
			Workplace Skills	0.44 (0.41–0.47)	0	0.56 (0.53–0.59)
			Trade Skills	0.51 (0.49–0.54)	0	0.49 (0.46–0.52)
			Intellectual/Cultural	0.56 (0.48–0.64)	0.10 (0.03–0.17)	0.34 (0.32–0.36)
			Domestic Skills	0.47 (0.44–0.50)	0	0.53 (0.50–0.56)
			Athletic	0.51 (0.48–0.53)	0	0.50 (0.47–0.52)
Hur et al., 1998	Minnesota Twin Family Study (females only: 243 MZ pairs, 164 DZ pairs)	11–12	Piers–Harris			
			Popularity	0.42 (0.13–0.62)*	0.13 (0.00–0.39)	0.45 (0.38–0.54)
			Physical Appearance	0.37 (0.23–0.47)	0.00 (0.00–0.09)	0.63 (0.53–0.75)
			Happiness	0.23 (0.00–0.40)	0.06 (0.00–0.32)	0.71 (0.60–0.83)
			Academic	0.19 (0.00–0.42)	0.13 (0.00–0.36)	0.68 (0.58–0.80)
			Behavior Problems	0.35 (0.06–0.45)	0.00 (0.00–0.23)	0.65 (0.55–0.76)
			Anxiety	0.36 (0.03–0.54)	0.55 (0.46–0.65)	0.55 (0.46–0.65)
Neiderhiser & McGuire, 1994	CAP	9–10	Harter's SPPC	Age 9/Age 10		
			Physical Appearance	0.87/0.84**	0.00/0.16	0.13/0.00
			Athletic	0.00/0.44	0.09/0.01	0.81/0.55
			Behavior Conduct	0.00/0.12	0.13/0.05	0.87/0.83
			Scholastic	0.55/0.36	0.13/0.15	0.32/0.49
			Social Acceptance	0.00/0.00	0.07/0.15	0.93/0.85
McGuire et al., 1994	NEAD	9–18	Harter's SPPA			
			Physical Appearance	0.47	0.00	0.53
			Athletic	0.54	0.04	0.42
			Morality	0.24	0.02	0.74
			Scholastic	0.61	0.01	0.38
			Friendship	0.10	0.06	0.84
			Social	0.49	0.04	0.47

We present confidence intervals in parentheses after estimates of genetic and environmental components when this information was available in the original article. Due to rounding, numbers may vary slightly from those in original.

*Estimates presented here are from univariate models presented by Hur et al. (1998).

**Parameter estimates from Neiderhiser and McGuire (1994) are approximate estimates based on graphical presentations in the original article.

the largest component of variance for each domain. Hur et al. did not report whether the genetic or shared environmental parameters were statistically significant for each domain, but a multivariate analysis revealed that common genetic and common shared environmental factors were both significant in explaining covariance between the six domains. The multivariate analysis also revealed that specific genetic influences on each domain were significant, although specific shared environmental influences were not significant.

As part of the CAP, Neiderhiser and McGuire (1994) analysed genetic and environmental influences on domain-specific self-esteem among children aged nine to ten. These investigators used Harter's Self-Perception Profile for Children to measure child ratings of behaviour conduct, athletic competence, scholastic competence, physical appearance, and social acceptance. Genetic influences were significant only for physical appearance at age nine, accounting for over 80% of the variance. Shared environmental influences were not significant for any of the six domains at ages nine or ten. As noted previously, however, the small sample size probably limited the power to detect significant genetic or shared environmental effects. Genetic effects were fairly large for a few of the domains (e.g. greater than 40% for scholastic competence at age nine), yet failed to reach statistical significance. Non-shared environmental effects were substantial for many of the domains. Overall, however, siblings showed little similarity. For example, correlations between genetically related siblings were not significant in any domain at age ten.

McGuire et al. (1994) examined also domain-specific self-esteem in the NEAD project. Participants' ages ranged from nine to 18 years and included both twin and full-sibling pairs from non-divorced families as well as full-siblings, half-siblings, and unrelated siblings from divorced families. McGuire and colleagues measured self-esteem (using Harter's Self-Perception Profile for Adolescents) in six domains: scholastic, social, athletic, physical appearance, morality, and friendship. None of the subscales manifested significant shared environmental influence. Scholastic, athletic, social, and physical appearance domains showed substantial genetic influence (a^2 close to 50%). All subscales manifested significant non-shared environmental influences.

Although most assessments of self-esteem rely on participants' subjective reports, it is possible to obtain observer ratings. Neiderhiser and McGuire's (1994) study included both mother and teacher reports of children's domain-specific self-esteem (i.e. leadership, confidence, and popularity), using the CAP Social Competence Scale. Mothers' reports of child confidence and teachers' reports of child confidence and leadership at age seven showed significant genetic influences, with heritability estimates greater than 60%. Shared environment was not significant for any of the mother or teacher ratings of social competence.

Summary

The existing literature provides compelling evidence for the heritability of level of global and domain-specific self-esteem. The overall pattern of results suggest that shared environmental effects on self-esteem are minimal. Shared environment is usually non-significant and at most may account for slightly over 10% of the variance in certain self-esteem domains. For both global and domain-specific self-esteem, genetic influences account for a more substantial amount, 30–50%, of the observed variance. Non-shared environmental influences (which include measurement error) account consistently for a large proportion of the variance. This is often over 50% of the observed variance in self-esteem.

Self-esteem stability

Only a handful of studies have used a behavioural genetic methodology to examine whether sibling similarity in global and domain-specific self-esteem stability is accounted for by genetic influences. These studies have focused on stability in level of self-esteem over time, measuring self-esteem at intervals of 1–3 years. As such, the studies investigate the extent to which relatively long-term stability of self-esteem is influenced by genetic or environmental factors.

Global self-esteem

Two studies have examined the contribution of genetic factors on global self-esteem stability. As stated earlier, Roy et al. (1995) assessed self-esteem at two time points. They tested a repeated measurements model examining the genetic contribution to the component of self-esteem which was stable across both time points. The model yielded a heritability estimate for self-esteem stability of 53%, which was higher than the heritability estimate for global self-esteem level at either time point alone (i.e. average heritability of 38%).

In a longitudinal follow-up of NEAD participants, McGuire et al. (1999) reported that genetic influences largely accounted for phenotypic stability in adolescents' global self-esteem across a period of approximately 2.6 years. Non-shared environment explained all of the change in global self-esteem.

Domain-specific self-esteem

Two studies have assessed the heritability of domain-specific self-esteem stability. McGuire et al. (1999) found that a substantial genetic influence for phenotypic stability in adolescents' perceptions of scholastic competence, athletic competence, and physical appearance across a 2.6 year period. Furthermore, genetic influences contributed to change in scholastic competence and social competence. The effect of shared environmental influences was minimal, with non-shared environmental influences accounting for the largest portion of change within all three domains.

Neiderhiser and McGuire (1994) also examined the extent to which genetic and environmental factors contributed to stability and change in both self-perception and teachers' reports of domain-specific self-esteem across time among CAP participants. Virtually all of the change in self-perceptions and teachers' reports were attributable to non-shared environment. Genetic influences accounted for the majority of stability in children's ratings of their own physical appearance, athletic competence, self-worth, and scholastic competence as well as the majority of stability in teachers' ratings of popularity, confidence, and leadership. Stability in behaviour conduct showed a slight genetic influence. Shared environmental influences contributed modestly to stability in children's ratings of physical appearance, behaviour conduct, and scholastic competence. Shared environment did contribute more substantially to stability of social competence, accounting for approximately one-third of the stability variance.

Summary

Although only a few studies have investigated the genetic and environmental architecture underlying stability and change in self-esteem, the pattern of results is relatively consistent. The major portion of self-esteem stability over time is accounted for by genetic factors. However, changes in self-esteem can largely be explained by the unique environmental events that individuals experience.

IMPLICATIONS

In this section, we shall attempt to highlight some implications of the behavioural genetic studies that we reviewed. A conclusion from our literature review is that shared environment has little effect on self-esteem. Non-shared environmental effects, however, are substantial. One implication of this conclusion is that individuals within a family can hold very different internal representations of the family. In fact, research has revealed only modest correlations between siblings' reports of family interactions (Pike, Manke, Reiss, & Plomin, 2000), even among families in which parents report treating their children similarly (Dunn & Plomin, 1990). Thus, children's perceptions of their families may be the link between their self-esteem and parental behaviour. In support of this notion, Gecas and Schwable (1986) found little correspondence between child and parent reports of parenting behaviours. In addition, children's perception of parental behaviour was more strongly related to their self-esteem than was parents' self-reported behaviour.

Parenthetically, we should note that behavioural genetic methods do *not* assume that parents treat each sibling within a family in exactly the same manner; nor do these methods assume that siblings interpret similar parental treatment in the same manner. If these propositions were true, such effects would fall under the shared environment component. On the other hand, if parents treated siblings differently or siblings interpreted similar parental actions differently, these individual differences within the family would fall under non-shared environment.

A behavioural genetic design can help identify the particular differences in siblings' experiences that are related to level of self-esteem. Plomin, Manke, and Pike (1996) reported that, among NEAD participants, adolescents' global self-esteem was related to their perceptions of their parents' positive and negative parenting practices. Specifically, within a family, the sibling with higher self-esteem reported more positive and less negative parenting. This pattern held among both never-divorced families ($n = 93$ pairs) and stepfamilies ($n = 181$ pairs). The use of genetically informed methodologies would allow for further specification of non-shared environmental influences on self-esteem, while also identifying genetic effects. Of course, in cases where shared environmental factors are significant, similar approaches would allow for specification of shared environmental effects.

In addition to specifying environmental effects on self-esteem, it is possible to specify further the genetic influences that underlie self-esteem. The quantitative genetic approach used in the studies that we reviewed cannot assess directly specific genes that influence self-esteem. Such an analysis would require molecular genetic approaches (Plomin et al., 2001; Plomin & Rutter, 1998). It would be premature to propose a specific mechanism linking genes directly to self-esteem. Nevertheless, Cloninger, Svrakic, and Przybeck (1993) describe one possible pathway between innate temperament and self-concept. Their psychobiological model suggests that heritable biases in information processing reflect four basic dimensions of temperament: novelty seeking, harm avoidance, reward dependence, and persistence. Such information processing biases influence subsequently self-esteem and self-concept, which in turn shapes attention to and interpretation of environmental stimuli (Gramzow, Gaertner, & Sedikides, 2001; Green & Sedikides, 2001; Sedikides & Skowronski, 1993). Although initial temperament is largely innate, this model recognizes reciprocal influences between temperament and self-esteem or self-concept.

Quantitative behavioural genetic studies can identify genetic variance shared between self-esteem and other personality traits. Behavioural genetic designs can examine whether the genetic effects on personality characteristics explain the genetic variance in self-esteem. Plomin et al. (1996) obtained some support for this argument. Analyses of NEAD participants indicated that mothers and fathers rated the child with higher global self-esteem as less emotional, more active, and more sociable. However, the statistical associations between differences in self-esteem and differences in temperament were somewhat modest, with the absolute magnitude of correlations ranging from 0.22 to 0.34.

Other evidence suggests that genetic influence on self-esteem is not entirely mediated by genetic influence on other traits. In their analysis of NEAD participants, McGuire et al. (1994) examined whether the genetic influences on Harter's subscales could be explained by cognitive abilities or personality characteristics which are themselves genetically influenced. These researchers reported significant correlations between cognitive ability and scholastic competence, and between sociability and social competence. Although each of these two pairs shared some genetic influence, unique genetic influences on self-esteem were present. For example, 61% of the genetic variance in scholastic competence self-esteem was unique genetic influence separate from cognitive ability. Likewise, 63% of the genetic influence on social competence self-esteem was unique genetic influence. Although shared environmental effects were not statistically significant in these analyses, similar analyses could identify the extent to which multiple variables are influenced by common versus specific shared environmental factors.

Univariate behavioural genetic studies have established that self-esteem is primarily influenced by genetic and non-shared environmental influences; shared environmental effects are minimal. More complex behavioural genetic designs have begun to address the influence of genetic and environmental effects on developmental stability and change in self-esteem. Stability in self-esteem seems to reflect substantially genetic influences, whereas change reflects non-shared environmental effects. Shared environment effects on self-esteem are rather minimal, although certain domains may be influenced by shared environmental factors. Importantly, behavioural genetic methods can be used for more than just estimating the magnitude of genetic and environmental effects: genetically informed studies can also help to specify the environmental effects that are unique to self-esteem.

CAVEATS AND LIMITATIONS

Although the majority of the existing literature suggests that shared environmental influences on self-esteem are quite small, it is also important to note that few of the studies that we discussed considered gene $\times$ environment interactions. There is evidence that such interactions can be significant in other domains. For example, in an investigation of genetic and environmental influences on intelligence, Rowe, Jacobson, and Van den Oord (1999) found that among relatively uneducated parents—those with a high school degree or less—both the heritability and shared environmental estimates were about 25%. In contrast, the shared environmental effect diminished towards zero and heritability rose to more than 50% among parents with schooling beyond a high school education. Because the families with less than a high school education were a relatively restricted part of the population, comprising less than 20% of the sample, the overall contribution of shared environment was relatively small. Nevertheless, shared environmental effects were

important within a sub-group of the population. Future research should test whether shared environmental effects on self-esteem are statistically significant within certain segments of the population. Such research could help target interventions: when shared environmental effects are present, family interventions may be more effective. There may also be different contributions from genetic and environmental influences at the extremes of self-esteem than hold for individual differences across the normal range. This was found in a study of language development in young children (Dale et al., 1998).

Theoretical formulations of the link between innate temperament and self-concept support the idea that interactive effects may be particularly important in understanding the etiology of self-esteem. For example, Eder and Mangelsdorf (1997) note that parent personality may interact with children's temperament to affect self-concept. Halverson and Martin (1981; as cited by Halverson & Wampler, 1997) found that parents with a stable sense of competency were able to cope better with an irritable/difficult child than parents who felt less competent. Irritable children whose parents are less able to cope with parental demands may receive particularly negative feedback from parents and develop a more negative self-concept. A less irritable sibling, however, may receive more positive feedback and develop a positive self-concept. Stated somewhat differently, the fit between child temperament and parental personality may affect children's self-esteem (Eder & Mangelsdorf, 1997). In this case, the interaction effect may be included in the non-shared environment parameter—one explanation for why non-shared environment accounts for such a large portion of the variability in self-esteem.

Identifying the causal mechanisms that underlie non-shared environmental variability may prove to be challenging. Past research has met with limited success in pinpointing systematic non-shared environmental events (Rowe & Rodgers, 1993; Turkheimer & Waldron, 2000). The lack of success in this area has led some researchers to propose that the causal mechanisms underlying nonshared environmental variability may well be ones that pose considerable methodological obstacles (Turkheimer & Waldron, 2000). For example, the causal impact of particular environmental events may be small and unsystematic, detectable only through the cumulative effects of many small environmental differences, or, as noted above, gene $\times$ environment interactions may also contribute to sibling differences, yet be difficult to detect. Nonetheless, we believe genetically informed research designs are necessary to specify correctly the causal mechanisms underlying self-esteem.

Finally, we note some limitations in interpreting estimates of heritability. Estimates derived from quantitative genetic methods are descriptive of the specific assessed population at a specific moment in time. Changes in the broad environment or the genetic pool will influence heritability and environmental estimates. Therefore, high heritability does not necessarily imply immutability. For example, Tizard (1975) showed that although height is highly heritable, changes in nutrition can have a substantial impact on height within a population. Although we would like to highlight the importance of genetic factors in explaining differences in self-esteem between individuals, we do not presume that self-esteem is therefore genetically determined within individuals.

FUTURE RESEARCH DIRECTIONS

We have presented evidence concerning the magnitude of genetic and environmental influences on self-esteem. We suggested that behavioural genetic methods can expand the

researchers' knowledge of specific factors contributing to self-esteem. In addition, behavioural genetic methodology can aid in specifying the relation between self-esteem and other variables. More complex behavioural genetic designs can also help specify the underlying nature (and perhaps causal direction) of relations between self-esteem and other variables. Below, we provide suggestions for further research on self-esteem using behavioural genetic methods.

Some of the more interesting applications of behavioural genetic methodology to the study of self-esteem may derive from multivariate analyses of the genetic and environmental architecture underlying sets of variables. For example, researchers could investigate whether self-esteem uniquely predicts psychopathological disorders once genetic effects are modelled. Roberts and Kendler (1999) used this type of approach to analyse the relation between self-esteem, neuroticism, and depression among female twin pairs from the Virginia Twin Registry. These researchers reported that specific genetic effects on self-esteem were present after modelling genetic effects common to self-esteem, neuroticism, and depression. Furthermore, Roberts and Kendler found that the covariance between self-esteem, neuroticism, and depression could be explained entirely by genetic influences common to all three. Although self-esteem was not uniquely related to depression after taking into account this common genetic component, neuroticism retained a separate genetic correlation with depression. Hence, Roberts and Kendler concluded that neuroticism was a better indicator of risk for depression than low self-esteem. This type of analysis can be useful in clarifying the sources of covariance (genetic or environmental) between self-esteem and other variables of interest, as well as in providing insight into the direction of influence among variables.

Some research suggests that stability in self-esteem rather than level of self-esteem may be implicated in negative outcomes such as hostility (Kernis et al., 1989), tenseness (Kernis, Paradise, Whitaker, Wheatman, & Boldman, 2000), or depression (Butler, Hokanson, & Flynn, 1994). A behavioural genetic analysis of the relation between stability and level of self-esteem could provide some insight into the extent to which the two are influenced by genetic and environmental factors in common, or factors specific to each. Multivariate studies examining the link between stability of self-esteem, neuroticism, and psychopathology could test whether variability in self-esteem is distinct from neuroticism, and whether variability makes a unique contribution to psychopathological outcomes.

Moreover, behavioural genetic methods have the potential to inform our understanding of implicit self-esteem. Implicit self-esteem refers to people's non-conscious affective or evaluative appraisals of the self (Greenwald & Banaji, 1995). Implicit self-esteem has been found in preferences for letters in one's name (Hoorens, Nuttin, Erdélyi Herman, & Pavakanun, 1990) and faster processing of positive rather than negative stimuli that are associated with the self (Greenwald, McGhee, & Schwartz, 1998). Implicit self-esteem, however, is often only weakly associated with explicit self-esteem (Bosson, Swann, & Pennebaker, 2000; Greenwald & Farnham, 2000). Although the study of implicit self-esteem is a burgeoning enterprise, the validity of implicit self-esteem measures is currently in question (Bosson et al., 2000).

Behavioural genetic approaches could shed light on this issue. For example, if implicit self-esteem measures provide a more accurate assessment of individuals' innate self-esteem (i.e. self-appraisals that are relatively immune to desirability or impression management factors), they may show greater genetic influence than explicit measures. Implicit gender self-esteem, for example, yields a greater sex difference than explicit

gender self-esteem (Greenwald & Farnham, 2000). The greater sex difference observed in the implicit measure may in part arise because the measure is less likely to be affected by self-presentational biases than explicit measures (Farnham, Greenwald, & Banaji, 1999). Therefore, to the extent that implicit self-esteem is a measure of latent trait self-esteem, it might actually manifest greater genetic influence than explicit self-esteem. Alternatively, if implicit self-esteem measures indeed assess more accurately self-esteem as shaped by chronic socialization experiences (and as relatively freed of self-presentation biases), the measures may actually show lower heritability and greater environmental influence than explicit self-esteem. Stated otherwise, if implicit self-esteem measures assess self-appraisals that have been formed through extensive past experiences, rather than personality characteristics (e.g. neuroticism) *per se*, researchers might predict stronger environmental effects.

CONCLUDING REMARKS

Behavioural genetic studies have clarified the relative contribution of the genetic and environmental underpinnings of self-esteem. Our literature review, for example, suggests that, whereas genetic influences on self-esteem are fairly substantial, shared environmental influences are minimal. Studies that simply assess the relation between parental characteristics and offspring self-esteem confound the effects of genes and environments.

Behavioural genetic methods can do more, however, than provide estimates of the magnitude of genetic and environmental influences. Genetically informed research designs can help researchers specify more precisely the environmental effects that exert an important influence on self-esteem. In addition, such designs can help locate the causal structure of relations between self-esteem and psychopathological outcomes. That is, behavioural genetic analyses can help specify the overlap between self-esteem and ability and self-esteem and other personality traits (e.g. neuroticism), as well as identifying the *unique* contribution of self-esteem to personality functioning. In addition, behavioural genetic analyses can clarify the nature of implicit self-esteem.

Certainly, other methodological approaches are also in a position to address these latter issues. Indeed, methodological convergence can increase the researcher's confidence in the validity of theoretical and directional or causal inferences. It is with this goal in mind that we advocate that the understanding of current issues in self-esteem research will be enriched by including behavioural genetic approaches.

REFERENCES

Allport, G. W. (1937). *Personality: A psychological interpretation*. New York: Holt.

Baumeister, R. F. (Ed.). (1993). *Self-esteem: The puzzle of low self-regard*. New York: Plenum.

Baumeister, R. F. (1998). The self. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (pp. 680–740). Boston, MA: McGraw-Hill.

Bednar, R. L., Wells, M. G., & Peterson, S. R. (1989). *Self-esteem: Paradoxes and innovations in clinical theory and practice*. Washington, DC: American Psychological Association.

Bosson, J., Swann, W. B., Jr., & Pennebaker, J. W. (2000). Stalking the perfect measure of implicit self-esteem: The blind men and the elephant revisited? *Journal of Personality and Social Psychology, 79*, 631–643.

Bouchard, T. J., Jr., & Propping, P. (1993). *Twins as a tool of behavioral genetics*. Chichester: Wiley.

Brockner, J. (1984). Low self-esteem and behavioral plasticity: Some implications of personality and social psychology. In L. Wheeler (Ed.), *Review of personality and social psychology* (pp. 237–271). Beverly Hills, CA: Sage.

Brown, J. D. (1993). Self-esteem and self-evaluations: Feeling is believing. In J. Suls (Ed.), *Psychological perspectives on the self* (pp. 27–58). Hillsdale, NJ: Erlbaum.

Brown, J. D., & Dutton, K. A. (1995). Truth and consequences: The costs and benefits of accurate self-knowledge. *Personality and Social Psychology Bulletin, 21*, 1288–1296.

Brown, J. D., & Marshall, M. A. (2001). Self-esteem and emotion: Some thoughts about feeling. *Personality and Social Psychology Bulletin, 27*, 575–584.

Butler, A. C., Hokanson, J. E., & Flynn, H. A. (1994). A comparison of self-esteem lability and low trait self-esteem as vulnerability factors for depression. *Journal of Personality and Social Psychology, 66*, 166–177.

Bynum, M. K., & Durm, M. W. (1996). Children of divorce and its effect on their self-esteem. *Psychological Reports, 79*, 447–450.

Cloninger, C. R., Svrakic, D. M., & Przybeck, R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*, 975–990.

Crocker, J., Thompson, L. L., McGraw, K. M., & Ingermane, C. (1987). Downward comparison, prejudice and evaluations of others: Effects of self-esteem and threat. *Journal of Personality and Social Psychology, 52*, 907–916.

Dale, P. S., Simonoff, E., Bishop, D. V. M., Eley, T. C., Oliver, B., Price, T. C., Purcell, S., Stevenson, J., & Plomin, R. (1998). Genetic influence on language delay in two-year-old children. *Nature Neuroscience, 1*, 324–328.

Deci, E. L., & Ryan, R. M. (1995). Human autonomy: The basis for true self-esteem. In M. H. Kernis (Ed.), *Efficacy, agency, and self-esteem* (pp. 31–49). New York: Plenum.

Diener, E., & Diener, M. (1995). Cross-cultural correlates of life-satisfaction and self-esteem. *Journal of Personality and Social Psychology, 68*, 653–663.

Dunn, J., & Plomin, R. (1990). *Separate lives: Why siblings are so different*. New York: Basic.

Eder, R. A., & Mangelsdorf, S. C. (1997). The emotional basis of early personality development: Implications for the emergent self-concept. In R. Hogan, J. Johnson, & S. Briggs (Eds.), *Handbook of personality psychology* (pp. 209–240). San Diego, CA: Academic.

Farnham, S. D., Greenwald, A. G., & Banaji, M. R. (1999). Implicit self-esteem. In D. Abrams, & M. A. Hogg (Eds.), *Social identity and social cognition* (pp. 230–248). Oxford: Blackwell.

Gecas, V., & Schwable, M. L. (1986). Parental behavior and adolescent self-esteem. *Journal of Marriage and the Family, 48*, 37–46.

Gramzow, R. H., Gaertner, L., & Sedikides, C. (2001). Memory for ingroup and outgroup information in a minimal group context: The self as an informational base. *Journal of Personality and Social Psychology, 80*, 188–205.

Q2 Green, J. D., & Sedikides, C. (2001). When do self-schemas shape social perception?: The role of descriptive ambiguity. *Motivation and Emotion, 25*, 67–83.

Greenberg, J., Solomon, S., & Pyszczynski, T. (1997). Terror management theory of self-esteem and cultural worldviews: Empirical assessments and cultural refinements. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 61–139). San Diego, CA: Academic.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102*, 4–27.

Greenwald, A. G., Bellezza, F. S., & Banaji, M. R. (1988). Is self-esteem a central ingredient of the self-concept? *Personality and Social Psychology Bulletin, 14*, 34–45.

Greenwald, A. G., & Farnham, S. D. (2000). Using the implicit association test to measure self-esteem and self-concept. *Journal of Personality and Social Psychology, 79*, 1022–1038.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology, 74*, 1464–1480.

Halverson, C. F., Jr., & Wampler, K. S. (1997). Family influences on personality development. In R. Hogan, J. Johnson, & S. Briggs (Eds.), *Handbook of personality psychology* (pp. 241–267). San Diego, CA: Academic.

Harter, S. (1982). The Perceived Competence Scale for Children. *Child Development, 53*, 87–97.

Harter, S. (1988). *The self-perception profile for adolescents.* Unpublished manuscript, University of Denver.

Harter, S. (1993). Causes and consequences of low self-esteem in children and adolescents. In R. F. Baumeister (Ed.), *Self-esteem: The puzzle of low self-regard* (pp. 87–116). New York: Plenum.
Heatherton, T. F., & Polivy, J. (1991). Development and validation of a scale for measuring state self-esteem. *Journal of Personality and Social Psychology, 60*, 891–895.
Hettema, J. M., Neale, M. C., & Kendler, K. S. (1995). Physical similarity and the equal-environment assumption in twin studies of psychiatric disorders. *Behavior Genetics, 25*, 327–335.
Hoorens, V., Nuttin, J. M., Erdélyi Herman, I., & Pavakanun, U. (1990). Mastery pleasure versus mere ownership: A quasi-experimental cross-cultural and cross-alphabetical test for the name letter effect. *European Journal of Social Psychology, 20*, 181–205.
Hur, Y., McGue, M., & Iacono, W. G. (1998). The structure of self-concept in female preadolescent twins: A behavioral genetic approach. *Journal of Personality and Social Psychology, 74*, 1069–1077.
Jacobvitz, D. B., & Bush, N. F. (1996). Reconstructions of family relationships: Parent–child alliances, personal distress, and self-esteem. *Developmental Psychology, 32*, 732–743.
Jones, W. H., Freemon, J. E., & Goswick, R. A. (1981). The persistence of loneliness: Self and other determinants. *Journal of Personality, 49*, 27–48.
Joseph, J. (2000). Not in their genes: A critical view of the genetics of attention-deficit hyperactivity disorder. *Developmental Review, 20*, 539–567.
Kendler, K. S., Gardner, C. O., & Prescott, C. A. (1998). A population-based twin study of self-esteem and gender. *Psychological Medicine, 28*, 1403–1409.
Kendler, K. S., Neale, M. C., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1993). A test of the equal-environment assumption in twin studies of psychiatric illness. *Behavior Genetics, 23*, 21–27.
Kernis, M. H., Grannemann, B. D., & Barclay, L. C. (1989). Stability and level of self-esteem as predictors of anger arousal and hostility. *Journal of Personality and Social Psychology, 56*, 1013–1022.
Kernis, M. H., Paradise, A. W., Whitaker, D. J., Wheatman, S. R., & Boldman, B. N. (2000). Master of one's psychological domain? Not likely if one's self-esteem is unstable. *Personality and Social Psychology Bulletin, 26*, 1297–1305.
Kernis, M. H., & Waschull, S. B. (1995). The interactive role of stability and level of self-esteem: Research and theory. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 93–141). San Diego, CA: Academic.
Lamborn, S. D., Mounts, N. S., Steinberg, L., & Dornbusch, S. M. (1991). Patterns of competence and adjustment among adolescents from authoritative, authoritarian, indulgent, and neglectful families. *Child Development, 62*, 1049–1065.
Leary, M. R., & Baumeister, R. F. (2000). The nature and function of self-esteem: Sociometer theory. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 2–62). San Diego, CA: Academic.
Lykken, D. T., McGue, M., Bouchard, T. J., Jr., & Tellegen, A. (1990). Does contact lead to similarity or similarity to contact? *Behavior Genetics, 20*, 547–561.
Lytton, H. (1977). Do parents create, or respond to, differences in twins? *Developmental Psychology, 13*, 456–459.
McCann, D., & Sato, T. (2000). Personality, cognition, and the self. *European Journal of Personality, 14*, 449–461.
McCormick, C. B., & Kennedy, J. H. (2000). Father–child separation, retrospective and current views of attachment relationship with father, and self-esteem in late adolescence. *Psychological Reports, 86*, 827–834.
McGue, M., Hirsch, B., & Lykken, D. T. (1993). Age and the self-perception of ability: A twin study analysis. *Psychology and Aging, 8*, 72–80.
McGuire, S., Manke, B., Saudino, K. J., Reiss, D., Hetherington, M. E., & Plomin, R. (1999). Perceived competence and self-worth during adolescence: A longitudinal behavioral genetic study. *Child Development, 70*, 1283–1296.
McGuire, S., Neiderhiser, J. M., Reiss, D., Hetherington, M. E., & Plomin, R. (1994). Genetic and environmental influences on perceptions of self-worth and competence in adolescence: A study of twins, full siblings, and step-siblings. *Child Development, 65*, 785–799.
Neale, M. C., & Cardon, L. R. (1992). *Methodology for genetic studies of twins and families*. Dordrecht: Kluwer.

Neiderhiser, J. M., & McGuire, S. (1994). Competence during middle childhood. In J. C. DeFries, R. Plomin, & D. W. Fulker (Eds.), *Nature and nurture during middle childhood* (pp. 141–151). Malden, MA: Blackwell.

Pelham, B. W. (1995). Self-investment and self-esteem: Evidence for a Jamesian model of self-worth. *Journal of Personality and Social Psychology, 69*, 1141–1150.

Piers, E. V. (1984). *Piers–Harris Children's Self-Concept Scale: Revised manual*. Los Angeles, CA: Western Psychological Services.

Pike, A., Manke, B., Reiss, D., & Plomin, R. (2000). A genetic analysis of differential experiences of adolescent siblings across three years. *Social Development, 9*, 96–114.

Plomin, R., DeFries, J. C., McClearn, G. E., & Rutter, M. (2001). *Behavioral genetics*. New York: Worth.

Plomin, R., Manke, B., & Pike, A. (1996). Siblings, behavioral genetics, and competence. In G. H. Brody (Ed.), *Sibling relationships: Their causes and consequences* (pp. 75–104). Stamford, CT: Ablex.

Plomin, R., & Rutter, M. (1998). Child development, molecular genetics, and what to do with genes once they are found. *Child Development, 69*, 1223–1242.

Roberts, S. B., & Kendler, K. S. (1999). Neuroticism and self-esteem as indices of the vulnerability to major depression in women. *Psychological Medicine, 29*, 1101–1109.

Rogers, C. (1959). A theory of therapy, personality, and interpersonal relationships, as developed in the client-centered framework. In S. Koch (Ed.), *Psychology: A study of a science* (pp. 184–256). New York: McGraw-Hill.

Rose, R. J., Kaprio, J., Williams, C. J., Viken, R., & Obremski, K. (1990). Social contact and sibling similarity: Facts, issues, and red herrings. *Behavior Genetics, 20*, 763–778.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Rowe, D. C., Jacobson, K. C., & Van den Oord, E. J. C. G. (1999). Genetic and environmental influences on vocabulary IQ: Parental education level as moderator. *Child Development, 70*, 1151–1162.

Rowe, D. C., & Rodgers, J. L. (1993). Can we identify specific environmental influences on behavioral disorders in children? In T. J. Bouchard, Jr., & P. Propping (Eds.), *Twins as a tool of behavioral genetics* (pp. 205–215). Chichester: Wiley.

Roy, M., Neale, M. C., & Kendler, K. S. (1995). The genetic epidemiology of self-esteem. *British Journal of Psychiatry, 166*, 813–820.

Sedikides, C., & Skowronski, J. J. (1993). The self in impression formation: Trait centrality and social perception. *Journal of Experimental Social Psychology, 29*, 347–357.

Sedikides, C., & Skowronski, J. J. (1997). The symbolic self in evolutionary context. *Personality and Social Psychology Review, 1*, 80–102.

Sedikides, C., & Skowronski, J. J. (2000). On the evolutionary functions of the symbolic self: The emergence of self-evaluation motives. In A. Tesser, R. B. Felson, & J. M. Suls (Eds.), *Psychological perspectives on self and identity* (pp. 91–117). Washington, DC: American Psychological Association.

Sedikides, C., & Skowronski, J. J. (in press). Evolution of the self: Issues and prospects. In M. R. Leary, & J. P. Tangney (Eds.), *Handbook of self and identity* (pp.). New York: Guildford.

Sedikides, C., & Strube, M. J. (1997). Self-evaluation: To thine own self be good, to thine own self be sure, to thine own self be true, and to thine own self be better. *Advances in Experimental Social Psychology, 29*, 209–269.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 103*, 193–210.

Tennen, H., & Herzberger, S. (1987). Depression, self-esteem, and the absence of self-protective attributional biases. *Journal of Personality and Social Psychology, 52*, 72–80.

Tesser, A. (2000). On the confluence of self-esteem maintenance mechanisms. *Personality and Social Psychology Review, 4*, 290–299.

Tice, D. M. (1991). Esteem protection or enhancement? Self-handicapping motives and attributions differ by trait self-esteem. *Journal of Personality and Social Psychology, 60*, 711–725.

Tizard, J. (1975). Race and IQ: The limits of probability. *New Behaviour, 1*, 6–9.

Turkheimer, E., & Waldron, M. (2000). Nonshared environment: A theoretical, methodological, and quantitative review. *Psychological Bulletin, 126*, 78–108.

