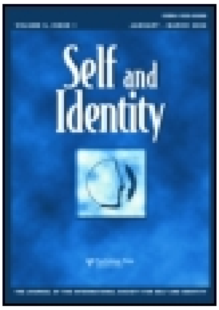

Self and Identity
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/psai20

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Published online: 02 Sep 2013.

Self and Identity, 2013
http://dx.doi.org/10.1080/15298868.2013.823007

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Contingent self-esteem has regularly been associated with socialization experiences. In the present study, genetic and environmental influences on a contingent self-esteem construct were investigated among women and men in different age groups. The study sample consisted of 21,703 same and opposite sex Swedish twins, aged 20 to 46 years. Contingent self-esteem was measured on a scale for performance-based self-esteem. Sex and age-group effects were assessed using biometrical model fitting procedures. Individual differences in performance-based self-esteem were best explained by additive genetic and non-shared environmental factors for both female and male twins, with similar heritability estimates. No age-group effects were found. However, partially different genes seem to influence performance-based self-esteem among women and men.

Keywords: Contingent self-esteem; Performance-based self-esteem; Twin; Genetic; Environment; Heritability.

Several studies have indicated that self-esteem is a heterogeneous characteristic (Baumeister, Campbell, Krueger, & Vohs, 2003; Kernis & Paradise, 2002), and that not only quantitative but also qualitative aspects of it should be examined. One important qualitative aspect of self-esteem concerns its contingency (Crocker & Luhtanen, 2003; Kernis & Goldman, 2006), which refers to its sources and how it is construed. Self-esteem is said to be contingent if it is based on meeting particular standards within or across domains, such as social approval, academic competence, and physical appearance. For some people, self-esteem may primarily depend on being popular and appreciated, for others on being competent at school or being good-looking. Within those domains, individuals with high contingent self-esteem are particularly sensitive to the actual or anticipated successes and failures, and they often experience fluctuations in state self-esteem, that compel them to demonstrate and validate their personal qualities and worth (Crocker & Wolfe, 2001). Because of these motivational pressures, contingent

Received 8 November 2012; accepted 2 July 2013; first published online 30 August 2013.

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This study was supported by the Swedish Council for Working Life and Social Research (2009-0548). The Swedish Twin Registry is supported by Sweden's Department of Higher Education, AstraZeneca, and the Swedish Research Council. The Study of Twin Adults: Genes and Environment (STAGE) was supported by the National Institute of Health, USA, grants [DK 066134] and [CA 085739].

self-esteem, more so than level of self-esteem, has been presumed to be closely linked to behavior (Crocker & Wolfe, 2001). Moreover, many studies have demonstrated the negative consequences of having high contingent self-esteem, in terms of learning, autonomy, and health (Crocker & Park, 2004; Dweck, 1999; Dykman & Johll, 1998). Also, within self-determination theory (Deci & Ryan, 2000), contingent self-esteem is regarded as a central manifestation of introjection, which frequently leads to experiences of ill-being. Accordingly, on this view, the importance of self-esteem does not primarily lie in its level, but in its contingency, and also in the subsequent pursuit of self-esteem (Crocker & Wolfe, 2001).

Contingent self-esteem has generally been assumed to arise as an unintended effect of socialization experiences (Crocker & Park, 2003; Deci & Ryan, 1985; Ryan & Deci, 2005), but the extent to which variations in indicators of contingent self-esteem are influenced by genetic factors have, to our knowledge, not been examined before. This was, however, accomplished in the present study by applying a scale of performance-based self-esteem to a nationally representative sample of Swedish twins.

Contingent and Performance-based Self-esteem

Studies of contingent self-esteem have often been carried out using the Contingencies of Self-Worth (CSW) model (Crocker, 2002a; Crocker & Wolfe, 2001). According to this model, people differ in the merit domains in which self-esteem is founded. However, although they may differ in the domain-related contingencies they have to meet to promote their self-esteem, self-esteem contingencies have a tendency to be positively correlated with one other (Crocker, Luhtanen, Cooper, & Bouvrette, 2003). Hence, in addition to this intraindividual view on contingent self-esteem, interindividual perspectives have been presented (Deci & Ryan, 1995; Kernis, 2003), which postulate rather stable individual differences in general contingent self-esteem. Further, from an interindividual perspective, contingent self-esteem may be captured by an overall score, or on a single scale that measures general contingent self-esteem (Burwell & Shirk, 2006; Neighbors, Larimer, Geisner, & Knee, 2004; Patrick, Neighbors, & Knee, 2004).

An instrument for assessing general self-esteem contingency is a scale for Performance-Based Self-Esteem (Hallsten, Josephson, & Torgén, 2005), which has been used in Scandinavian studies with large and nationally representative samples. Performance-based self-esteem refers to a compelling motive or orientation to gain or maintain self-esteem through good performance in the roles or arenas of importance for self-esteem. The concept of performance-based self-esteem was initially developed to understand processes of burnout (Hallsten, 2005; Hallsten et al., 2005), and also adaptations to tensions produced by competition and uncertainty in modern Western organizations and societies (Bauman, 2000).

Younger people have shown higher performance-based self-esteem levels than older ones, and women have tended to have somewhat higher levels of performance-based self-esteem than men (Hallsten et al., 2005). High levels of performance-based self-esteem have been observed among medical students (Dahlin, Joneborg, & Runeson, 2007), for whom performance-based self-esteem is predictive of later psychiatric ill-health (Dahlin & Runeson, 2007). Similarly, performance-based self-esteem has been found to be an independent and prospective predictor of various forms and indicators of ill-health, such as cognitive stress symptoms (Albertsen, Rugulies, Garde, & Burr, 2010), work/home conflict (Innstrand, Langballe, Espnes, Aasland, & Falkum, 2010), hearing problems (Hasson, Theorell, Wallen, Leineweber, & Canlon, 2011), sickness presenteeism (Löve, Grimby-Ekman, Eklof, Hagberg, & Dellve, 2010), and long-term sickness absence

(Hallsten, Voss, Stark, & Josephson, 2011). A longitudinal study, over one year, of a national sample of Swedish employees (Blom, 2012) found that performance-based self-esteem acts as a mediator between work-related stressors and burnout.

The association between performance-based self-esteem and a modified CSW scale has been examined in a sample of Swedish teachers (Lindblad, 2003). Performance-based self-esteem correlated positively with the external and more detrimental dimensions (Crocker, 2002b) of this CSW scale, but it was uncorrelated with an internal and less detrimental dimension (virtue). Global self-esteem and performance-based self-esteem have been shown to have a moderately negative correlation ($r = -.38$) in a study by Hallsten and colleagues (2005), who also found that the rank-order stability of performance-based self-esteem over one year was at a level ($r = .68$) comparable with what has been found for the personality traits in the Big Five model (Caspi, Roberts, & Shiner, 2005; Roberts, Caspi, & Moffitt, 2001).

Genetic and Environmental Influences on Constructs of Self-esteem

Genetically informative sampling of siblings provides a way of assessing information about genetic and environmental influences on human behavior. Resemblance or familial clustering among siblings may arise from either genetic or shared environmental influences, which can be separated using behavior-genetic methods (Plomin, DeFries, McClearn, & McGuffin, 2008). Twin studies make use of the fact that monozygotic twin pairs share all their genes, whereas dizygotic twin pairs share half of their segregating genes on average. Hence, if monozygotic and dizygotic twin pairs show the same degree of similarity regarding a trait under study, environmental factors are most important for that trait, whereas higher concordances among monozygotic than among dizygotic twin pairs indicate that genetic factors are also of importance for the trait. Until now, no studies have been presented on the importance of genetic factors for individual differences in contingent self-esteem or performance-based self-esteem, but behavior-genetic studies of constructs related to contingent self-esteem, such as level of self-esteem and variability of self-esteem, have been carried out (Kendler, Gardner, & Prescott, 1998; Roy, Neale, & Kendler, 1995; Neiss, Sedikides, & Stevenson, 2002, 2006). These studies have typically pointed out that the phenotypic variance of self-esteem is accounted for by additive genetic and non-shared environmental factors. The studies have also indicated that the same genetic factors tend to influence the level of self-esteem in men and women (Kendler et al., 1998). With one possible exception (Raevuori et al., 2007), there is no evidence of non-additive genetic influences, i.e., dominance, on level of self-esteem, although widespread influences of this kind have been reported for personality traits (Bouchard & McGue, 2003).

Instability of self-esteem, i.e., individual variability in the level of self-esteem over time, is recognized as another qualitative aspect of self-esteem that is positively correlated with contingent self-esteem (Crocker, Karpinski, Quinn, & Chase, 2003; Kernis & Goldman, 2006). Behavior-genetic studies of the instability of self-esteem have reported comparable outcomes to those for level of self-esteem, in that additive genetic influences are substantial, and that non-shared environmental factors explain most of the remaining variance (Neiss et al., 2002, 2006). Nonetheless, instability has been shown to be influenced by unique genetic and unique environmental factors, which indicates that level and instability of self-esteem are partly independent constructs.

A behavior-genetic study of performance-based self-esteem should fill an essential gap in the literature on self-esteem and contingent self-esteem. It has been argued that self-esteem and self-esteem development lack an overarching theoretical framework, and that such a framework would necessarily incorporate not only social and psychological factors, but also biological ones (Robins & Trzesniewski, 2005). A comparison of performance-based self-esteem between monozygotic and dizygotic twin pairs of different ages would provide new insights into how genetic factors influence contingent self-esteem. Further, inclusion of both women and men, and of opposite-sexed dizygotic twins, enables investigation of sex differences in the relative importance of genetic factors, and also of whether the genes that operate in women differ from those that operate in men. Even though constructs related to performance-based self-esteem have been investigated using genetically informative designs, and dissimilar results might not be expected, further knowledge of individual differences, including differences in sex and age effects, would contribute to an increased understanding of the underlying factors that are important for performance-based self-esteem and for potential differences between performance-based self-esteem and other personality constructs (Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002; Robins, Tracy, Trzesniewski, Potter, & Gosling, 2001). The proposed maturity principle of personality development suggests that characteristics like level of self-esteem should show age-related increases, whereas maladaptive characteristics, such as self-esteem instability or contingency, should decrease as people grow older (Roberts, Walton, & Viechtbauer, 2006). Similarly, contingent self-esteem is assumed to be negatively associated with the processes of social investment (Lodi-Smith & Roberts, 2007). However, a previous study of university students, of whom a clear majority were female, showed an increase in performance-based self-esteem over time (Hallsten, Rudman, & Gustavsson, 2012). The reasons for this effect are still to a large extent uncertain, and it also remains unknown whether outcomes are similar among groups in the population other than students. However, one possible explanation is that higher education, at least for some students, entails a controlled and problematic transition that tends to reduce scores on ordinary maturity indicators, such as level of self-esteem, and to increase scores on contingent self-esteem. However, alternative hypotheses can be presented, which are capable of being examined in a twin setting. One such hypothesis is that genetic and environmental influences differ between level of self-esteem and contingent self-esteem, i.e., that contingent self-esteem is more influenced than level of self-esteem by non-shared environmental factors. A further hypothesis is that genetic and environmental factors influence contingent self-esteem differently among women and men.

The aims of this study were to investigate the importance of genetic and/or environmental factors for individual differences in performance-based self-esteem in a population-based Swedish twin cohort, and to examine whether performance-based self-esteem is influenced similarly among women and men and in different age groups. In line with earlier behavior-genetic findings on constructs of self-esteem, we confine our hypothesizing to the single hypothesis that performance-based self-esteem is moderately and similarly influenced by genetic factors among women and men and in different age groups.

Methods

Participants

The source population consisted of twins from the Swedish Twin Registry (STR), born 1959–1986, who participated in the STAGE (Study of Twin Adults: Genes and Environment) web-based questionnaire in 2005, previously described elsewhere (Lichtenstein et al., 2006). In total, 25,378 individuals, of whom 8646 complete twin pairs of known zygosity, responded to the questionnaire. The twins were between 20 and

46 years of age at the time of data collection, and 56% of the responders were women. Excluded from the analyses were twins of unknown zygosity ($n = 830$), and a further 2845 twin individuals who did not respond to all the four items that make up the performance-based self-esteem scale. Hence, the study sample comprised 7083 twin pairs with complete information on performance-based self-esteem and zygosity, and a further 7537 single individuals who responded (with twin partner not responding) to all the performance-based self-esteem items. Of the complete twin pairs, 3022 were monozygotic and 2063 dizygotic same-sex, and 1998 were opposite-sex twin pairs.

Missing data analyses showed that the excluded individuals ($n = 3675$) were comparable to the studied individuals with regard to age, with a mean of 33.1 years ($SD = 7.78$) in those excluded compared with 33.5 years ($SD = 7.66$) in the study sample. Some differences were observed between the zygosity distributions, with the 830 twins of unknown zygosity not included: 33% monozygotic and 67% dizygotic among the excluded, compared with 38% monozygotic and 62% dizygotic in the study sample. Also, there was a difference between the sexes, with 48% women among the excluded, compared with 57% in the study sample.

Measures

Performance-based self-esteem. Contingent self-esteem was measured on the performance-based self-esteem scale, which consists of items on cognitions related to general contingent self-esteem, such as contingency and imperative beliefs and ego-oriented motives without reference to any specific domain (Hallsten et al., 2005). The performance-based self-esteem scale is composed of the following four items: "I think that I sometimes try to prove my worth by being competent"; "My self-esteem is far too dependent on my daily achievements"; "At times, I have to be better than others to be good enough myself"; and "Occasionally, I feel obsessed with accomplishing something of value", with a response scale ranging from 1 (*fully disagree*) to 5 (*fully agree*). The arithmetic mean of the responses to these items gave the performance-based self-esteem score for each individual. The performance-based self-esteem scale has good psychometric qualities and has shown convergent validity (Hallsten et al., 2005).

Zygosity for same-sex twin pairs was determined in the STAGE study on the basis of questions about childhood resemblance. When validated against serological and micro-satellite markers, this method is about 98% accurate (Lichtenstein et al., 2006). In addition, *sex* and *age* were used as independent variables. As level of performance-based self-esteem tends to change with increasing age, three *age groups* covering nine years each were constructed: 20–28, 29–37, and 38–46 years.

Statistical Analyses

Performance-based self-esteem was treated as a continuous variable, and mean values by zygosity, sex, and age group were calculated. A preliminary appraisal of whether genetic or environmental factors are important for performance-based self-esteem was made by comparing the monozygotic and dizygotic twin pairs with regard to performance-based self-esteem, as assessed by calculating intraclass correlations for each zygosity, sex, and age group. The presence of genetic effects is indicated if the dizygotic intraclass correlation is approximately half the value of the monozygotic intraclass correlation. If the dizygotic intraclass correlation is higher than half the monozygotic intraclass correlation, both genetics and shared environment are likely to be influential. Non-additive genetic effects are suggested if the dizygotic intraclass correlation is lower than half the monozygotic intraclass correlation. Finally, a lower intraclass correlation for opposite-sex twin pairs than for dizygotic same-sex twin pairs would indicate that different sets of genes operate in women than in men. Intraclass correlations were calculated for the complete twin pairs ($n = 7083$).

Biometrical Genetic Analyses

Genetic and environmental influences on performance-based self-esteem were estimated by applying structural equation modeling, which is commonly used to provide maximum-likelihood estimates and give the percentages of the total variance attributable to genetic sources (heritability) and environmental sources. We estimated the relative contributions of additive genetic influences (A), non-additive genetic influences, i.e., dominance or epistasis (D), shared environmental influences (C), and non-shared environmental (E) influences on performance-based self-esteem. Note that D and C cannot be modeled simultaneously.

Model fitting was performed in two steps. First, we tested whether there were any sex differences, quantitative or qualitative, in the whole sample, and included opposite-sex twins in a sex-limitation model. All twins of known zygosity with full responses to performance-based self-esteem were included (21,703 individuals), as were the twin individuals whose co-twin did not respond. Quantitative sex differences were tested by comparing a model in which the magnitudes of genetic and environmental effects were allowed to differ between men and women with a model in which the estimates were constrained to be equal between the sexes. Qualitative sex differences, i.e., different sets of genes are important for women compared to men, were tested by further constraining the additive genetic correlation between opposite-sex twins r_g to .5, and the non-additive genetic correlation r_d to .25.

Model fit and the significance of parameters were evaluated in nested model comparisons. The likelihood-ratio test was used, which compares the fit of, for example, the full model (including all variance components A, C or D, and E, where the estimates are allowed to differ between men and women) with the fit of the nested constrained models, e.g., the AE model. Two-fold differences in log-likelihoods between the full and constrained models, with a minus sign (-2LL), follow the χ^2 distribution, with the difference in the number of estimated parameters as the degrees of freedom (Δdf). A non-significant difference indicates that a constrained model fits the data no worse than the full model, and thus that the parameters can be removed from the model. The parsimony of the model was assessed using Akaike's Information Criterion (AIC), where the lowest AIC value indicates the most parsimonious model. Depending on whether sex differences were present, age-group differences were tested separately in men and women, including only the same-sex twins ($n = 14{,}900$). All models were fitted in the structural equation program, Mx (Neale, Boker, Xie, & Maes, 2006), using a maximum likelihood estimation procedure for raw data.

The study was approved by the Regional Ethical Review Board in Stockholm, Sweden (2009/2053-31-5).

Results

Descriptive statistics are presented in Table 1. For all individuals with complete data on the performance-based self-esteem items, mean values and standard deviations were calculated, which showed that women ($M = 2.85$, $SD = 1.19$) had higher mean values than men ($M = 2.67$, $SD = 1.09$), and that the highest mean value was for the youngest

TABLE 1 Descriptive Statistics for Performance-based Self-esteem, Mean and Standard Deviation (*SD*) for 21,703 Swedish Twins and Intraclass Correlations with 95% Confidence Intervals (CI) for Complete Twin Pairs (7,083) by Zygosity, Sex and Age Group (20–28, 29–37 and 38–46 Years)

Age group	Zygosity group	No of individuals	Mean	*SD*	No of twin pairs	Intraclass correlation
20–28 yrs	Monozygotic Men	1217	2.72	1.08	403	.34 (.27–.40)
	Dizygotic Men	806	2.70	1.03	222	.02(−.07–.11)
	Monozygotic Women	1760	3.00	1.17	698	.40 (.36–.45)
	Dizygotic Women	1026	2.96	1.15	345	.19 (.12–.26)
	Opposite sex	1767	2.91	1.12	534	.07 (.01–.13)
29–37 yrs	Monozygotic Men	1259	2.71	1.09	414	.31 (.24–.38)
	Dizygotic Men	887	2.69	1.05	243	.12 (.03–.22)
	Monozygotic Women	1698	2.94	1.18	668	.32 (.27–.37)
	Dizygotic Women	1159	2.89	1.21	406	.14 (.07–.21)
	Opposite sex	2103	2.80	1.15	603	.12 (.06–.17)
38–46 yrs	Monozygotic Men	1017	2.56	1.11	329	.40 (.33–.46)
	Dizygotic Men	1213	2.51	1.11	318	.16 (.08–.23)
	Monozygotic Women	1340	2.76	1.24	510	.41 (.36–.47)
	Dizygotic Women	1518	2.64	1.17	529	.09 (.03–.15)
	Opposite sex	2933	2.69	1.15	861	.15 (.10–.20)

Notes: Mean levels and *SD* were calculated based on the total number of individuals with complete information on performance-based self-esteem and zygosity. Intraclass correlations were calculated using twin pairs where both twins in a pair had complete scores on performance-based self-esteem and known zygosity.

age group. Intraclass correlations were calculated using the twin pairs where both twins in a pair had fully responded to the items on the performance-based self-esteem scale. All the monozygotic intraclass correlations were higher than the dizygotic intraclass correlations, indicating that genetic influences are important for performance-based self-esteem. Monozygotic intraclass correlations were more than twice the magnitudes of the dizygotic intraclass correlations for both women and men in all age groups. This suggests the presence of genetic non-additivity.

Table 2 shows the fit statistics of the sex limitation model for testing sex differences in genetic and environmental influences on performance-based self-esteem independent of age. First, both the ACE and ADE models were fitted, where the parameter estimates were allowed to differ between women and men. Then, the magnitudes of the genetic and environmental influences were constrained to be equal between the sexes. This resulted in deterioration in the fit of both the ACE and ADE models, suggesting that quantitative sex differences were present. Further, qualitative sex differences were tested by constraining the additive genetic correlation r_g to .5 in the ACE model, and both the additive and non-additive genetic correlations ($r_g = .5$ and $r_d = .25$) in the ADE model. Again, constraining the models resulted in decreases in fit. Thus, different sets of genes seem to contribute to the genetic variation in performance-based self-esteem in men and women. Further, constraining the models to exclude the A, C, or D parameters indicated that the constrained AE model, with different quantitative and qualitative parameters for men and women, showed the best fit and parsimony in terms of the AIC heritability estimates (a^2): .34 (CI .33–.39) and .38 (CI .34–.41) for men and women, respectively, $r_g = -.35$.

Since sex differences were found, further investigation of age-group differences was carried out separately for women and for men. The results are presented in Table 3. First, for both women and men, the full ACE and ADE models were fitted, with parameter estimates being allowed to differ in each age group. Second, variance components were

TABLE 2 Model Fit Statistics for Univariate Model Testing for Sex Differences in Genetic and Environmental Influences on Performance-based Self-esteem in a Cohort of Swedish Twins ($n = 21{,}703$)

Model	−2*log-likelihood	*df*	Δ*df*	$\Delta\chi^2$	*p*-value	AIC
Full ACE men ≠ women, $r_g \neq .5$	67044.889	21695	–	–	–	23654.889
ACE men = women, $r_g \neq .5$	67117.542	21698	3	72.653	<.001	23721.542
ACE men = women, $r_g = .5$	67122.831	21699	1	5.289	.021	23724.831
AE men ≠ women, $r_g \neq .5$	**67044.889**	**21697**	**2**	**.000**	**–**	**23650.889**
CE men ≠ women, $r_g \neq .5$	67158.023	21697	2	113.134	<.001	23764.023
Full ADE men ≠ women, $r_g \neq .5$, $r_d \neq .25$	67041.199	21694	–	–	–	23653.199
ADE men = women, $r_g \neq .5$, $r_d \neq .25$	67121.452	21697	3	80.253	<.001	23727.452
ADE men = women, $r_g = .5$, $r_d = .25$	67114.128	21699	2	−7.324	–	23716.128
DE men ≠ women, $r_g \neq .5$, $r_d \neq .25$	67048.797	21696	2	7.598	.022	23656.797

Notes: r_g: additive genetic correlation, r_d: non-additive genetic correlation. Best-fitting and most parsimonious sub-models in bold, indicated by the lowest Akaike's Information Criteria (AIC) value. A = additive genetic factors; D = non-additive genetic factors (dominance); C = shared environmental factors; E = non-shared environmental factors.

TABLE 3 Model Fit Statistics for Performance-based Self-esteem by Sex, Testing for Age Group Differences, in a Cohort of Swedish Same-sex Twins (6399 men; 8501 women)

Model	−2*log-likelihood	*df*	Δ*df*	$\Delta\chi^2$	*p*-value	AIC
Men						
ACE age1 ≠ age2 ≠ age3	19036.798	6387	–	–	–	6262.798
ACE age1 = age2 = age3	19042.633	6393	6	5.835	.442	6256.633
AE age1 = age2 = age3	19042.633	6394	1	.000	–	6254.633
ADE age1 ≠ age2 ≠ age3	19032.542	6387	–	–	–	6258.542
ADE age1 = age2 = age3	19040.604	6393	6	8.062	.234	6254.604
DE age1 = age2 = age3	**19040.604**	**6394**	**1**	**.000**	**–**	**6252.604**
Women						
ACE age1 ≠ age2 ≠ age3	26700.078	8489	–	–	–	9722.078
ACE age1 = age2 = age3	26707.856	8495	6	7.777	.255	9717.856
AE age1 = age2 = age3	26784.661	8496	1	.000	–	9715.856
ADE age1 ≠ age2 ≠ age3	26776.512	8489	–	–	–	9717.578
ADE age1 = age2 = age3	**26782.779**	**8495**	**6**	**9.252**	**.160**	**9714.829**
DE age1 = age2 = age3	26782.244	8496	1	2.513	.113	9715.342

Notes: age 1: 20–28 years, age 2: 29–37 years, age 3: 38–46 years. Best-fitting and most parsimonious sub-models in bold, indicated by the lowest Akaike's Information Criteria (AIC) value. *df*: degrees of freedom. A = additive genetic factors; D = non-additive genetic factors (dominance); E = non-shared environmental factors.

TABLE 4 Parameter Estimates of Genetic and Environmental Factors with 95% Confidence Intervals (CI) for the Best-fitting Models for Performance-based Self-esteem for Men and Women in a Cohort of Swedish Same-sex Twins (6,399 Men; 8,501 Women)

Parameter	Men	Women
a^2	–	.18 (.00–.38)
d^2	.35 (.30–.40)	.20 (.00–.40)
e^2	.65 (.60–.70)	.62 (.58–.66)

Notes: a^2 = additive genetic influences; d^2 = non-additive genetic influences (dominance); e^2 = non-shared environmental influences.

equated across all three age groups. According to the AIC values for both men and women, this could be effected without any decrease in fit for either the ACE or ADE model. By further constraining the models to exclude the A, C, or D parameters, the model demonstrating the best balance of fit and parsimony for men was the model including dominant (D) and non-shared environmental (E) parameters, with no age-group differences (AIC 6252.604), even though it is a biologically questionable model. For women, the ADE model with the same parameters for each age group best explained the data according to the AIC (9714.829) (see Table 3). The parameter estimates for the best-fitting models by sex are presented in Table 4. We also tested possible age-group differences within the sexes by using two alternative cut-off criteria, at the median age of our sample, ≤ 34 years, and at < 30 years (results not shown). However, these additional analyses revealed no substantial differences in relation to the results and model fit statistics presented for the three age groups.

Discussion

This study examined the relative contributions of genetic and environmental influences on the individual variability of a contingent self-esteem construct, i.e., performance-based self-esteem, in a large cohort of Swedish twins, aged 20 to 46 years. Contingent self-esteem has been found to be an important factor in the development of various experiences of ill-health (Crocker, 2002b; Crocker, Brook, Niiya, & Villacorta, 2006; Ryan & Deci, 2000) but, to the best of our knowledge, this is the first time that a behavior-genetic design has been used to unravel genetic and environmental contributions to one of its indicators.

The results of the present study suggest that individual differences in contingent self-esteem, as measured on the performance-based self-esteem scale, are best explained by a combination of genetic and non-shared environmental factors. We found a minor quantitative difference in heritability between the sexes, but no such differences between the age groups. However, the results indicate the presence of a qualitative sex difference, i.e., that performance-based self-esteem involves different sets of genes for women and for men.

Since there are no earlier studies that have examined genetic influences on contingent self-esteem, fully adequate reference data for our results are lacking. However, several behavior-genetic studies have investigated global or domain-specific self-esteem, which probably shares a common core with contingent self-esteem. Heritability estimates of around 35% for performance-based self-esteem are in line with previous findings on the genetic contributions of 30%–50% to global and domain-specific self-esteem; our findings on self-esteem variability are very much in line with previous findings (Kendler et al., 1998; Neiss et al., 2002, 2006). Also, our heritability estimates of performance-based self-esteem correspond to common findings on genetic influences on various personality dimensions, which usually account for one-third or more of the phenotypic variances on these dimensions (Bouchard & McGue, 2003). The trait-like character of performance-based self-esteem may have contributed to this similarity.

Even though the results of the present study show that genetic factors play a role in contingent self-esteem at population level, non-shared environmental factors explain a larger part of the variation, around 65%. Similar findings have been reported in previous studies of self-esteem, with no effects of the shared environment and sizeable effects of the non-shared environment. This indicates that environmental factors not shared by twins, e.g., education, occupation, or life events, affect individual variation in performance-based self-esteem rather than shared environmental factors. Hence, contextual factors in private and working life are likely to be important in the etiology of performance-based self-esteem.

Variation in performance-based self-esteem was explained by different genetic components among women and men. In men, variation in performance-based self-esteem seems to be primarily attributable to dominant genetic effects, whereas both additive and dominant genetic influences seem to be important for the phenotype in women. Since dominant genetic effects have often been found for personality traits (Bouchard & McGue, 2003), performance-based self-esteem may be more related to personality traits in men. Although such differences should not be exaggerated, and, for both males and females, it has been suggested that dominant genetic influences contribute, inter alia, to burnout (Blom, Bergström, Hallsten, Bodin, & Svedberg, 2012), which is clearly related to performance-based self-esteem (Hallsten, Voss, et al., 2011).

In contrast to some previous findings (Kendler et al., 1998), which indicate that the same genetic factors tend to influence global self-esteem in men and women, our results suggest qualitative sex differences in performance-based self-esteem. The conceptual discrepancy between performance-based self-esteem and global self-esteem may be responsible for these differences. However, sex differences in genetic and environmental sources of variance on a global self-esteem scale have previously been demonstrated in a study of adolescents (Raevuori et al., 2007), which suggests that the mechanisms involved in self-esteem might differ between males and females of young ages. Differences in biological processes have been proposed as plausible explanations for dissimilar pubertal development in boys and girls (Raevuori et al., 2007). Such differential processes may also be sources of qualitative genetic sex differences in performance-based self-esteem. Related but deviating processes from those during puberty, e.g., those related to bodily appearance, may have effects on contingent self-esteem, and more so among women than men (Biro, Khoury, & Morrison, 2006; Schousboe et al., 2003).

Regarding age differences, cross-sectional and longitudinal studies of the level and variability of self-esteem have presented stable (Neiss et al., 2006), or only slightly decreasing, genetic influences with age (Jonassaint, 2010; Raevuori et al., 2007). In the present study, when analyzing potential age-group differences in genetic and environmental influences on performance-based self-esteem, no such age effect was found. It is unlikely that this was due to our categorization of the age variable into three age groups, since the post-hoc analyses, using 30 or 34 years as cut-off points, generated very similar results.

It was initially thought that outcome data from a behavior-genetic study might substantiate an understanding of the increase in performance-based self-esteem during the higher-education period (Hallsten, Rudman, & Gustavsson, 2012), a trend that appears to challenge predictions based on the maturity principle. This, however, proved not to be the case. The similar relative contributions of genetic and environmental influences on performance-based self-esteem in the present study and the level of self-esteem reported in earlier studies (Kendler et al., 1998; Neiss et al., 2002, 2006) appear to refute these influences as determinants of the observed deviation from the maturity principle. Besides, since there were no, or only minor, quantitative differences between the sexes and/or the age groups regarding non-shared environmental influences in the current study, it seems implausible that the apparent deviation from the maturity principle can be explained by referring to the sex or age of the university students. A more reasonable explanation is that higher education may be experienced as a troublesome transitional period, which can increase performance-based self-esteem, but has decreasing effects on the level of self-esteem and on other maturity indicators.

Strengths and Limitations

This was a large population-based study that included both same and opposite sex twin pairs from the Swedish Twin Registry. In addition, although data were derived from a web-based questionnaire, and persons over 46 years were not included in the study, the results show the same sex and age tendencies as those in other extensive or nationally representative studies of performance-based self-esteem; that is, that women report higher levels of performance-based self-esteem than men, and that people of younger ages demonstrate higher performance-based self-esteem levels than older people.

A comparison between individuals in the cohort excluded from the analyses due to non-response to the performance-based self-esteem questions and the study sample showed some differences with regard to zygosity and sex distribution. There were more women than men in the study sample, but there was a sex balance among those who were excluded. Whether the individuals who were excluded had a higher or lower level of performance-based self-esteem, or had deviating intraclass correlations with contingent self-esteem compared with the study sample, is not known since such information was obviously lacking. Further, since adults over 46 years of age were not included in the present study, the results cannot be generalized to older adults, hence the relative importance of genetic and environmental factors for performance-based self-esteem in an older cohort may differ from what we found in the younger cohort. Presumably, the main weakness is that we used a single indicator of general contingent self-esteem; in the future, similar studies may well benefit from the use of other scales for contingent self-esteem, such as those based on the contingencies of the self-worth model (Crocker & Wolfe, 2001). Whether external and internal contingencies would show similar influences from genetic and environmental factors would be of special interest to study.

Conclusions

In sum, the present study has shown that genetic factors are of importance for individual differences in contingent self-esteem among both women and men, although partially different genes may possibly be involved according to sex. Even if genetic factors play an essential role, environmental factors explain a larger part of the variation in performance-based self-esteem, as has been found for other self-esteem constructs. Thus, it is important that future research on the etiology of contingent self-esteem explores and identifies specific environmental determinants. Also, if it is possible, such studies would benefit from considering familial factors as confounders.

References

Albertsen, K., Rugulies, R., Garde, A. H., & Burr, H. (2010). The effect of work environment and performance-based self-esteem on cognitive stress symptoms among Danish knowledge workers. *Scandinavian Journal of Public Health*, *38*(suppl 3), 81–89.

Bauman, Z. (2000). *The individualized society*. Cambridge: Polity Press.

Baumeister, R. F., Campbell, J. D., Krueger, J. I., & Vohs, K. D. (2003). Does high self-esteem cause better performance, interpersonal success, or healthier lifestyles? *Psychological Science in the Public Interest*, *4*(1), 1–44.

Biro, F. M., Khoury, P., & Morrison, J. A. (2006). Influence of obesity on timing of puberty. *International Journal of Andrology*, *29*, 272–277.

Blom, V. (2012). Contingent self-esteem, stressors and burnout in working men and women. *Work*, *43*, 123–131.

Blom, V., Bergström, G., Hallsten, L., Bodin, L., & Svedberg, P. (2012). Genetic susceptability to burnout in a Swedish twin cohort. *European Journal of Epidemiology*, *27*, 225–231.

Bouchard, T. J. Jr, & McGue, M. (2003). Genetic and environmental influences on human psychological differences. *Journal of Neurobiology*, *54*, 4–45.

Burwell, R., & Shirk, S. (2006). Self-processes in adolescent depression: The role of self-worth contingencies. *Journal of Research on Adolescence*, *16*, 479–490.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annual Review of Psychology*, *56*, 453–484.

Crocker, J. (2002a). Contingencies of self-worth: Implications for self-regulation and psychological vulnerability. *Self and Identity*, *1*, 143–149.

Crocker, J. (2002b). The costs of seeking self-esteem. *Journal of Social Issues*, *58*, 597–615.

Crocker, J., Brook, A. T., Niiya, Y., & Villacorta, M. (2006). The pursuit of self-esteem: Contingencies of self-worth and self-regulation. *Journal of Personality*, *74*, 1749–1771.

Crocker, J., Karpinski, A., Quinn, D. M., & Chase, S. K. (2003). When grades determine self-worth: Consequences of contingent self-worth for male and female engineering and psychology majors. *The Journal of Personality and Social Psychology*, *85*, 507–516.

Crocker, J., & Luhtanen, R. K. (2003). Level of self-esteem and contingencies of self-worth: Unique effects on academic, social and financial problems in college students. *Personality and Social Psychology Bulletin*, *29*, 701–712.

Crocker, J., Luhtanen, R. K., Cooper, M. L., & Bouvrette, A. (2003). Contingencies of self-worth in college students: Theory and measurement. *Journal of Personality and Social Psychology*, *85*, 894–908.

Crocker, J., & Park, L. E. (2003). Seeking self-esteem: Construction, maintenance, and protection of self-worth. In J. Tangney & M. Leary (Eds.), *Handbook of self and identity* (pp. 291–313). New York, NY: Guilford Press.

Crocker, J., & Park, L. E. (2004). The costly pursuit of self-esteem. *Psychological Bulletin*, *130*, 392–414.

Crocker, J., & Wolfe, C. T. (2001). Contingencies of self-worth. *Psychological Review*, *108*, 593–623.

Dahlin, M. E., Joneborg, J., & Runeson, B. (2007). Performance-based self-esteem and burnout in a cross-sectional study of medical students. *Medical Teacher*, *29*, 43–48.

Dahlin, M. E., & Runeson, B. (2007). Burnout and psychiatric morbidity among medical students entering clinical training. *BMC Medical Education*, *7*, 1–8.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.

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

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268.

Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality, and development*. New York, NY: Psychology Press.

Dykman, B. M., & Johll, M. (1998). Dysfunctional attitudes and vulnerability to depressive symptoms: A 14-week longitudinal study. *Cognitive Therapy and Research*, *22*, 337–352.

Hallsten, L. (2005). Burnout and wornout: Concepts and data from a national survey. In A.-S. G. Antoniou & C. L. Cooper (Eds.), *Research companion to organizational health psychology* (pp. 516–536). Cheltenham: Elgar Publications.

Hallsten, L., Josephson, M., & Torgén, M. (2005). Performance-based self-esteem: A driving force in burnout processes and its assessment. *Arbete & Hälsa [Work & Health]* (*Vol. 2005*, pp. 1–35). Stockholm: Arbetslivsinstitutet/National Institute for Working Life.

Hallsten, L., Rudman, A., & Gustavsson, P. (2012). Does contingent self-esteem increase during higher education? *Self and Identity*, *11*, 223–236.

Hallsten, L., Voss, M., Stark, S., & Josephson, M. (2011). Job burnout and job wornout as risk factors for long-term sickness absence. *Work*, *38*, 181–192.

Hasson, D., Theorell, T., Wallen, M. B., Leineweber, C., & Canlon, B. (2011). Stress and prevalence of hearing problems in the Swedish working population. *BMC Public Health*, *11*, 130.

Innstrand, S. T., Langballe, E. M., Espnes, G. A., Aasland, O. G., & Falkum, E. (2010). Personal vulnerability and work-home interaction: The effect of job performance-based self-esteem on work/home conflict and facilitation. *Scandinavian Journal of Psychology*, *51*, 480–487.

Jonassaint, C. R. (2010). Heritability of self-esteem from adolescence to young adulthood. *New School Psychology Bulletin*, *7*, 3–15.

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.

Kernis, M. H. (2003). Toward a conceptualization of optimal self-esteem. *Psychological Inquiry*, *14*(1), 1–26.

Kernis, M. H., & Goldman, B. M. (2006). Assessing stability of self-esteem and contingent self-esteem. In M. H. Kernis (Ed.), *Self-esteem: Issues and answers* (pp. 77–85). New York, NY: Psychology Press.

Kernis, M. H., & Paradise, A. W. (2002). Distinguishing between secure and fragile forms of high self-esteem. In E. L. Deci (Ed.), *Handbook of self-determination research* (pp. 339–360). Rochester, NY: University of Rochester Press.

Lichtenstein, P., Sullivan, P. F., Cnattingius, S., Gatz, M., Johansson, S., Carlstrom, E., ..., Pedersen, N. L. (2006). The Swedish Twin Registry in the third millennium: An update. *Twin Research and Human Genetics*, *9*, 875–882.

Lindblad, L. (2003). *Självkänsla och utbrändhet*. [Self-esteem and burnout] (Psykologexamen-suppsats [Psychology thesis]). University of Stockholm, Stockholm.

Lodi-Smith, J. L., & Roberts, B. W. (2007). Social investment and personality: A meta-analytic analysis of the relationship of personality traits to investment in work, family, religion, and volunteerism. *Personality and Social Psychology Review*, *11*, 68–86.

Löve, J., Grimby-Ekman, A., Eklof, M., Hagberg, M., & Dellve, L. (2010). "Pushing oneself too hard": Performance-based self-esteem as a predictor of sickness presenteeism among young adult women and men – A cohort study. *Journal of Occupational and Environmental Medicine*, *52*, 603–609.

Neale, M. C., Boker, S. M., Xie, G., & Maes, H. H. (2006). *Mx: statistical modelling* (7th ed.). Richmond, VA: Department of Psychiatry, Medical College of Virginia.

Neighbors, C., Larimer, M., Geisner, I., & Knee, C. (2004). Feeling controlled and drinking motives among college students: Contingent self-esteem as a mediator. *Self and Identity*, *3*, 207–224.

Neiss, M. B., Sedikides, C., & Stevenson, J. (2002). Self-esteem: A behavioural genetic perspective. *European Journal of Personality*, *16*, 351–368.

Neiss, M. B., Sedikides, C., & Stevenson, J. (2006). Genetic influences on level and stability of self-esteem. *Self and Identity*, *5*, 247–266.

Patrick, H., Neighbors, C., & Knee, C. R. (2004). Appearance-related social comparisons: The role of contingent self-esteem and self-perceptions of attractiveness. *Personality and Social Psychology Bulletin*, *30*, 501–514.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2008). *Behavioral genetics* (5th ed.). New York, NY: Worth Publishers.

Raevuori, A., Dick, D. M., Keski-Rahkonen, A., Pulkkinen, L., Rose, R. J., Rissanen, A., . . . , Silventoinen, K. (2007). Genetic and environmental factors affecting self-esteem from age 14 to 17: A longitudinal study of Finnish twins. *Psychological Medicine*, *37*, 1625–1633.

Roberts, B. W., Caspi, A., & Moffitt, T. E. (2001). The kids are alright: Growth and stability in personality development from adolescence to adulthood. *Journal of Personality and Social Psychology*, *81*, 670–683.

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*(1), 1–25.

Robins, R. W., Tracy, J. L., Trzesniewski, K., Potter, J., & Gosling, S. D. (2001). Personality correlates of self-esteem. *Journal of Research in Personality*, *35*, 463–482.

Robins, R. W., & Trzesniewski, K. H. (2005). Self-esteem development across the lifespan. *Current directions in Psychological Science*, *14*, 158–162.

Robins, R. W., Trzesniewski, K. H., Tracy, J. L., Gosling, S. D., & Potter, J. (2002). Global self-esteem across the life span. *Psychology and Aging*, *17*, 423–434.

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

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78.

Ryan, R. M., & Deci, E. L. (2005). On assimilating identities to the self: A self-determination perspective on internalization and intergrity within cultures. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 253–272). New York, NY: The Guilford Press.

Schousboe, K., Willemsen, G., Kyvik, K. O., Mortensen, J., Boomsma, D. I., Cornes, B. K., . . . , Harris, J. R. (2003). Sex differences in heritability of BMI: A comparative study of results from twin studies in eight countries. *Twin Research*, *6*, 409–421.