Personal Goals of Older Female Twins

Genetic and Environmental Effects

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Abstract. This study examined genetic and environmental influences on older women's personal goals by using data from the Finnish Twin Study on Aging. The interview for the personal goals was completed by 67 monozygotic (MZ) pairs and 75 dizygotic (DZ) pairs. The tetrachoric correlations for personal goals related to health and functioning, close relationships, and independent living were higher in MZ than DZ twins, indicating possible genetic influence. The pattern of tetrachoric correlations for personal goals related to cultural activities, care of others, and physical exercise indicated environmental influence. For goals concerning health and functioning, independent living, and close relationships, additive genetic effect accounted for about half of the individual variation. The rest was the result of a unique environmental effect. Goals concerning physical exercise and care of others showed moderate common environmental effect, while the rest of the variance was the result of a unique environmental effect. Personal goals concerning cultural activities showed unique environmental effects only.

Keywords: personal goals, twins, older, female

Introduction

An increasing amount of research has been carried out in recent years on the role of genetic influences on personality. This research has focused mainly on personality traits and temperamental characteristics (Sherman et al., 1997). It has been suggested, however, that in addition to traits personality also consists of two other levels, that is, personal goals and identity narratives (Hooker & McAdams, 2003). Previous research on genetic influences on personality has, however, seldom investigated other levels besides personality traits. Hence, the aim of the present study was to examine genetic and environmental influences on older people's personal goals.

Genetic Effects and Personality

In one of the first meta-analyses in the field, Eaves, Eysenck, & Martin (1989) reported heritabilities of .58 for Extraversion, .44 for Neuroticism, and .46 for Psychoticism. Shared environmental impacts for all three traits were found to be close to zero. Recent twin studies on the heritability of personality traits have yielded similar results (for a review, see Bouchard & Loehlin, 2001). In one recent study, Vernon, Villani, Vickers, and Harris (2008) found the heritabilities of narcissism, Machiavellianism, and psychopathology to range between .31 and .72. A few studies have also examined changes in genetic effects on personality traits across age in adulthood. These studies have shown that the effects of shared environment on personality traits decrease with age (McCartney, Harris, & Bernieri, 1990), while those of heritability are quite stable (Johnson, McGue, & Krueger, 2005; Loehlin & Martin, 2001; Pedersen & Reynolds, 1998; Read, Vogler, Perdersen, & Johansson, 2006; Viken, Rose, Kaprio, & Koskenvuo, 1994).

Personality traits, apart from other levels of personality, have seldom been examined in genetic studies. The studies that come conceptually closest to the area of motivation and personal goals are those concerned with general attitudes and values (Robinson, Shaver, & Wrigthsman, 1991). Some genetic influence has been found for attitudes (McCourt, Bouchard, Lykken, Tellegren, & Keyes, 1999; Olson, Vernon, & Harris, 2001). For example, traditionalism showed only low heritability (.17) but a sizable common environmental component (.29) (Waller & Shaver, 1994). By contrast, conservatism showed a large genetic influence for both males (.64) and females (.45) (Eaves et al., 1999). Also, religiousness has been shown to be moderately heritable (Bouchard, McCue, Lykken, & Tellegren, 1999). In relation to interests, Betsworth et al. (1994) found that, on average, the variance of a wide range of vocational interests was attributed to 12% additive genetic and 24% nonadditive genetic effects, and to 9% shared environmental and 55% nonshared environmental effects.

Heritability estimates for self-esteem have been shown to range from 32–40%, with the remaining variance attributable to nonshared environmental influences (Kendler, Gardner, & Prescott, 1998). Similarly, there is a substantial

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evidence of genetic influence on depressive symptoms among older people (Agrawal, Jacobson, Gardner, Preswcott, & Kendler, 2004; Gatz, Pedersen, Plomin, Nesselroade, & McClearn, 1992; Jansson et al., 2004; Johnson, McGue, Gaist, Vaupel, & Christemsen, 2002). The familial influence, however, varies between the different clusters of depressive symptoms (Jang, Livesley, Taylor, Stein, & Moon, 2004; Takkinen et al., 2004).

Personal Goals

Individual motivation has been conceptualized in terms of self-articulated personal goals (Brunstein, 1993). Such goals provide a basis for the ongoing regulation of behavior, they form criteria for evaluating behavioral outcomes, and they motivate the construction of a variety of plans and strategies to cope with situational demands (Karoly, 1993). A typical way of analyzing personal goals is to focus on what a person aims to achieve by his or her goals, that is, the contents of his or her goals. In the analysis of such contents, most researchers have used categories that refer to different objectives and future events, such as family, work, hobbies, property, and self-related, existential concerns (Little, 1983).

Previous research on the associations between goal contents and well-being has shown that young adults who report goals focusing on education, intimate relationships, leisure time, family, and children seem to show a greater sense of well-being (Emmons, 1991; Salmela-Aro & Nurmi, 1997), whereas those who focus on self-oriented, existential kinds of goals tend to have a low level of well-being and elevated levels of depressive symptoms (Salmela-Aro, Nurmi, Saisto, & Halmesmäki, 2001).

However, little attention has been paid to the antecedents of personal goals. The overall assumption has been that motivation and personal goals develop in the socialization process (Nurmi, 2004). Several processes has been thought to play a role, such as learning to satisfy a particular need by certain objects (Nuttin, 1984), parental guidance, tutoring and feedback, negotiations, and social comparisons in peer groups (Nurmi, 2004).

Despite the considerable attention paid to personal goals during the last two decades, thus far, no studies have focused on the possibility that some of the individual differences in people's personal goals may be the result of genetic influences. There are, however, at least two reasons why this may be the case. One possible mechanism is that personality traits, which have been found to have a substantial genetic basis (Little, Lecci, & Watkinson, 1992), influence people's personal goals. Another possibility is that, besides individual differences in personality traits, evolution has also created differences in other types of strategies that individuals use to increase their fitness for the environment. For example, some people may be genetically more predisposed to use social means to increase their fitness, whereas others may adopt more autonomous strategies. Such differences might also be reflected in people's motivation and personal goals. One way to examine the relative impact of genetic and environmental factors in peoples' goal contents is to use twin data, which was the major rationale for the present study.

Aging and Personal Goals

The life-span theory of motivation assumes that the demands, challenges, and opportunities people experience in a particular stage of their lives channel the kinds of personal goals they construct (Salmela-Aro et al., 2001). These age-graded developmental environments have been described in terms of developmental tasks (Havighurst, 1948), role transitions (Elder, 1985), and institutional tracks (Mayer, 1986). The assumption that age-graded developmental environments channel people's personal goals has also gained empirical support. In his recent review, Nurmi (2004) showed that adolescents and young adults typically report topics such as future education, occupation, family, and leisure activities. In middle adulthood, individuals mention goals related to their children's lives, property, and leisure activities. Later on, these topics are complemented by goals related to health, broader societal issues, close relationships, and religion (Takkinen & Ruoppila, 2001).

Although it has been shown that age differences in individuals' personal goals reflect age-graded developmental tasks and role transitions, there remains much individual variation in the kinds of goals people report at a given age. No previous studies have been carried out that have examined to what extent these individual differences are the result of genetic and environmental effects. This was the primary aim of the present study.

Twin Analysis

By means of twin data, three general sources of variance and covariance can be estimated: additive genetic factors (A), common or shared environment (C), and nonshared or unique environment (E) (Plomin, DeFries, McClearn, & McGuffin, 2001). Additive genetic variance comprises the total summative effect of multiple genes. Common, or shared, environment comprises all the environmental factors that contribute to twin similarity, that is, all events that are effectively common. Nonshared, or unique, environment refers to the part of environmental factors that contribute to twin dissimilarity, including random error variance. It should be noted that a particular environmental event is not common or nonshared per se, but might be either, depending on its effect on twin similarity/dissimilarity.

Methods

Sample

This study is part of the Finnish Twin Study on Aging (FITSA), a research program on the effects of genes and the environment on the disablement process in older women. The sample was drawn from a larger twin study, the Finnish Twin Cohort Study with a population of 13,888 adult twin pairs at the baseline in 1975 (Kaprio & Koskenvuo, 2002; Kaprio, Sarna, Koskenvuo & Rantasalo, 1978). The zygosity of the twins was determined at the baseline by a validated questionnaire (Sarna, Kaprio, Sistonen, & Koskenvuo, 1978). The twins were classified as monozygotic (MZ), dizygotic (DZ), or as of uncertain zygosity (XZ). The method classified 92.7% of the pairs as MZ and DZ with a 1.7% probability of misclassification.

The Finnish Twin Cohort Study comprised 1260 respondent female twin pairs born in 1924–1937 and first studied in 1975. Of this group, an invitation to take part in the first laboratory study in 2000 was sent to 178 MZ, 212 DZ, and 24 XZ twin pairs selected on the basis of age and zygosity. The inclusion criteria were willingness of both sisters of a twin pair to participate, self-reported ability to walk two kilometers, and ability to travel independently to the laboratory. The reasons for nonparticipation were that one or both sisters were unwilling to participate (50 MZ, 51 DZ, and 5 XZ pairs), had poor health (28 MZ, 52 DZ, and 5 XZ pairs), or had died (2 MZ, 3 DZ, 1 XZ). A total of 98 pairs of MZ, 106 DZ, and 13 XZ twins participated in the laboratory examination. The zygosity of XZ twins was determined by a battery of 10 highly polymorphic gene markers using DNA extracted from a venous blood sample. According to the results, four XZ pairs were classified as MZ and nine as DZ.

The present participants also took part in the follow-up to the laboratory examination in 2003. The interview on personal goals was conducted for 76 MZ pairs and 90 DZ pairs. Reasons for dropout were that one or both sisters were unwilling to participate (28 MZ and 33 DZ), had poor health (5 MZ and 2 DZ), or had died (2 MZ and 5 DZ).

The participants filled in the revised Personal Project inventory (Little, 1983), and background information was elicited in an interview session.

Measurements

The Personal Project Analysis Inventory

The participants were asked first to fill in the revised version of Little's (1983) Personal Project Analysis inventory (PPA). They were asked to describe four of their current personal projects in response to the following instruction: "People have many kinds of things that they think about, hope for and hope to accomplish. Think about the kinds of personal goals/projects you have in your life at the moment. The goals/projects may be related to any life domain, such as hobbies, work, family, friends or yourself." They were asked to produce four goals or projects.

Content Analysis of the PPA

Each project mentioned by the participants was first classified independently by two trained assessors in one of 18 categories on the basis of content. The categories were similar to those used most frequently in earlier studies (Little, 1983). They were *health and functioning* ("take care of my health"), *physical exercise, sports or dancing* ("go regularly for a walk"), *household activities* ("take care of my garden"), *cultural activities* ("go to a concert"), *societal activities* ("go to a club"), *close relationships* ("spend time with friends"), *maintenance of way of living and living independently* ("be able to live on my own"), *travel* ("travel abroad"), *diet* ("healthy eating habits"), *live with illness* ("diabetes"), *memory* ("take care of my memory"), *property and financial issues* ("buy a summer cottage"), *work and occupation* ("do forestry work"), *others' health* ("I hope my child will stay healthy"), *taking care of others* ("look after grandchild regularly"), *religion* ("believe in God"), *politics and society* ("participate in political life"), and *self and personality* ("grow as a person"). The content analysis reliabilities measured by the percentage rate of agreement between the two independent assessors was 91%.

Next we combined some thematically related classes into larger ones: health and functioning was combined with memory, exercise with home chores, close relationships with social activities, and others' health was combined with taking care of others. Each project content was coded for further analyses on a dichotomous scale: 0 = *no projects mentioned in this category* and 1 = *at least one project mentioned in this category*.

Statistical Analysis

Tetrachoric correlations were calculated for the final six goal categories. A larger MZ than DZ correlation indicates genetic influence in the trait. If the MZ and DZ correlations are significant and about the same in magnitude, the source of individual variance is shared environmental effects.

To estimate the relative importance of genetic and environmental variance components for personal goals, Mplus mixture modeling was used (see Muthén & Muthén, 2007; Prescott, 2004). Total phenotype variance (V) was decomposed into three sources of variance: additive genetic (A), shared environmental (C), and nonshared environmental (E) effects. The assumptions for the decomposition of phenotype variance in MZ and DZ twins are the following:

$$V_{MZ} = A + C + E$$
$$V_{DZ} = \tfrac{1}{2}A + C + E.$$

The full ACE model and the reduced models AE, CE, and E were tested for each personal goal. Because personal

Table 1. Personal goals among older female twins (MZ pairs *n* = 76, DZ pairs *n* = 90)

Goals		Tetrachoric correlation[a]	
	(%)	MZ	DZ
Health and functioning, memory	67.8	0.58 (0.29–0.86)	0.28 (0.04–0.63)
Exercise, physical activity, household chores	42.7	0.55 (0.30–0.81)	0.57 (0.34–0.85)
Close relationships, social activities	35.2	0.43 (0.13–0.73)	0.24 (0–0.58)
Cultural activities	20.5	0.11 (0–0.45)	0.29 (0.05–70)
Independent living, self-development	21.8	0.48 (0.23–0.84)	0.08 (0–0.44)
Health and well-being/care of others	18.6	0.27 (0.02–0.75)	0.45 (0.16–0.86)
Diet, outlook	6.2	–	–
Travel	5.8	–	–
Living with symptoms/illness	5.8	–	–
Economic issues	3.2	–	–
Religion	1.0	–	–
Work	0.6	–	–
Politics	0.6	–	–
Other	1.0	–	–
No goals	0.6	–	–

[a]Between the members of a twin pair, not calculated if any cell of the 2 × 2 contingency table for MZ or DZ pairs was under 5.

goals were categorical variables, the threshold model for liabilities (Neale & Cardon, 1992) with logit link function and maximum likelihood estimator was used. The threshold model places the ACE variance and covariance restrictions on normally-distributed latent response variables, i.e., liabilities that are underlying the categorical outcomes. The means of the latent response variables were fixed at zero and their variances were held equal across the members of a twin pair. Age was included as a covariate in the models.

Raw data were used. When using raw data, it is not possible to test the absolute fit of the model. The difference between full models and nested models (the difference in –2 lnL (minus twice the log-likelihood ratio)) is distributed as χ^2 with the degrees of freedom being the difference in the number of parameters that are estimated. A significant χ^2 difference indicates that the reduction in the model significantly reduces the fit of the model to the data. The models were also compared according to Akaike's (1987) Information Criteria (AIC): A smaller value indicates a better model.

Because in the present study the frequency of social contacts between the co-twins may influence the twin correlations, we controlled for frequency of contact by calculating the tetrachoric correlations in three groups: 1 = *contacted less than once a month*, 2 = *contacted 1 –4 times a month*, 3 = *contacted more often than once a week*. The correlations did not differ between these three groups.

Results

Descriptive Results for Personal Goals

Six personal goal contents were large enough to enable us to analyze their genetic component (see Table 1). These were personal goals related to close relationships, health and functioning, physical exercise, care of others, independent living, and cultural activities.

The tetrachoric correlations (Table 1) for personal goals related to health and functioning, close relationships and independent living were higher in MZ than DZ twins, indicating possible genetic influence. Moreover, for personal goals related to cultural activities and care of others, the DZ intraclass tetrachoric correlations were higher than the MZ correlations. Finally, for physical exercise related goals, the MZ and DZ intraclass tetrachoric correlations were about the same size, suggesting a shared environmental effect.

Modeling Genetic and Environmental Effects in Personal Goals

Next, ACE models and reduced models (AE, CE, and E) were fitted to these six personal goal contents (see Table 2). The AE model included an additive genetic and a nonshared environmental component, the CE model included shared and nonshared environmental components, and the E model included a nonshared unique environmental component.

The results showed that the AE model for the goals concerning health and functioning showed satisfactory fit with the data, and was the most parsimonious (Table 2). The genetic factor accounted for 53%, and the nonshared environmental factor for 47%, of the variation of the health- and functioning-related goals.

Similarly, the AE model for goals related to independent living showed satisfactory fit with the data, and was

Table 2. Estimates of genetic and environmental effects of personal goals in older female twins (MZ pairs $n = 76$, DZ pairs $n = 90$)

	Parameter estimates						
Model	A (95%CI)	C (95%CI)	E (95%CI)	AIC	–2 lnL	*N* of parameters	$\Delta\chi^{2a}$
Health and functioning							
ACE	53 (0–78)	0 (0–48)	47 (22–83)	–232.6	375.40	6	
AE	53 (18–78)	0	47 (33–60)	–234.6	375.40	5	0 (1)
CE	0	34 (7–57)	66 (43–93)	–231.9	378.07	5	2.66 (1)
E	0	0	100	–228.0	384.04	4	8.64 (2)*
Physical activity							
ACE	0 (0–0)	42 (17–63)	58 (37–83)	–206.4	400.79	6	
AE	0 (0–0)	0	100 (99–100)	–202.7	411.25	5	10.47 (1)**
CE	0	45 (21–65)	55 (35–79)	–211.2	401.67	5	0.88 (1)
E	0	0	100	–195.9	420.08	4	19.29 (2)***
Cultural activity							
ACE	0 (0–52)	20 (0–49)	78 (47–98)	–298.5	309.55	6	
AE	21 (0–54)	0	79 (44–100)	–300.0	310.99	5	1.44 (1)
CE	0	21 (0–49)	79 (50–100)	–301.7	310.32	5	0.77 (1)
E	0	0	100	–302.0	312.03	4	2.48 (2)
Independent living							
ACE	44 (11–63)	0 (0–38)	56 (42–79)	–290.0	318.00	6	
AE	44 (24–64)	0	56 (43–78)	–299.0	318.01	5	0.01 (1)
CE	0	15 (0–46)	85 (54–100)	–290.7	319.87	5	1.86 (1)
E	0	0	100	–282.2	328.03	4	10.03 (2)**
Close relationships							
ACE	45 (7–83)	23 (4–50)	29 (13–44)	–265.0	278.53	6	
AE	68 (30–80)	0	32 (21–45)	–267.1	278.53	5	0 (1)
CE	0	49 (39–49)	51 (41–60)	–266.6	278.77	5	0.24 (1)
E	0	0	100	–281.0	284.83	4	6.3 (2)*
Health/care of others							
ACE	0 (0–6)	46 (38–54)	54 (45–63)	–279.4	533.69	6	
AE	59 (0–81)	0	40 (0–75)	–260.0	534.30	5	0.61 (1)
CE	0	46 (30–62)	54 (38–70)	–281.8	533.69	5	0.24 (1)
E	0	0	100	–277.0	554.86	4	21.17 (2)***

[a]Comparison to ACE model, difference in χ^2(df), *$p < .05$, **$p < .01$, ***$p < .001$.

Note. AE model included an additive genetic and a nonshared environmental component, CE model included shared and nonshared environmental components, E model included a nonshared environmental component. AIC = Akaike's information criterion; A = variance contribution of additive genetic effects; C = variance contribution of shared environmental effects; E = variance contribution of nonshared environmental effects.

the most parsimonious (Table 2). The genetic factor accounted for 44%, and the nonshared environmental factor for 56%, of the variation of the independent living-related goals. Moreover, personal goals concerning close relationships showed considerable genetic effect (45%), but also modest shared environmental effect (23%). Comparison of the models suggested that the AE model fitted the best (lowest AIC value), although the difference between the models was small.

The results indicated further that the CE model for goals concerning physical exercise showed satisfactory fit with the data, and was the most parsimonious (Table 2). The shared environmental factor accounted for 42%, and nonshared environmental factor for 58%, of the variation of the physical activity-related goals.

Similarly, the CE model for goals related to care of others showed satisfactory fit with the data, and was the most parsimonious (Table 2). The shared environmental factor accounted for 46%, and nonshared environmental factor for 54%, of the variation of the care of others-related goals.

For personal goals concerning cultural activities the E model showed a satisfactory fit, and was the most parsimonious (Table 2).

Discussion

Although much research has been carried out on the genetic background of personality traits, no previous studies have examined the role of genes in activating individuals' motivation, such as personal goals (Brunstein, 1993). The present study examined genetic and environmental influences on older women's personal goals.

Before taking a closer look at the results, some limitations of the study should be taken into account. First, the present study focuses only on older women, and consequently the results cannot be generalized to men and other age groups. More research is needed to study the genetic and environmental effects in personal goals among different age groups and inclusive of men. Second, the sample size in the present study was quite small. The minimum cell size of 5 or more allowed us to examine six categories of personal goals. However, comparison of the nested models indicated that on some occasions the sample sizes were not enough to differentiate A and C in the same model. The tetrachoric correlations indicated, however, that the selected models reflected the pattern of similarity/dissimilarity in the MZ and DZ twins, and supported the selection of those models. Finally, it should also be kept in mind that the qualitative nature of the personal goals data limited the use of more powerful methods suited to continuous data. In this study the personal goal variables were categorical and, therefore, analyzed as dichotomous items.

Overall, the results showed that three kinds of goal contents, that is health and functioning, independent living, and close relationship showed a substantial amount of familial influence. For personal goals concerning close relationships, the genetic impact explained 45%, shared environment 23%, and nonshared environment 32% of the variance. The power was limited to distinguish both additive genetic and shared environmental effect in the same model. The model, however, indicated substantial familial aggregation, and is in accordance with some earlier findings on personality factors (Olson et al., 2001). The present study contributed to previous findings by showing that similar results are also found when people's spontaneously produced personal goals are investigated. An important topic for future research would be to examine the extent to which the variance of personal goals concerning close relationships explained by genetic factors are shared by the sociability trait. This is particularly interesting in view of the suggestion that relatedness is one of the "basic motives" in the human motivational system (Deci & Ryan, 2000).

For health and functioning, around half of the individual variation was explained by familial factors, the model suggesting mainly additive genetic effect, and the other half was explained by nonshared environmental factors. This finding is in accordance with some earlier findings on social attitudes (Olson et al., 2001), suggesting that genetic factors also impact, to some extent, on goals relating to taking care of one's health and functioning. An important topic for future research would be to examine the extent to which the genetic variance of personal goals concerning health and functioning is associated with individuals' everyday activities concerning exercise and health, and how far any such association derives from joint genetic variance. It should be noted that because of the inclusion criteria, the older women who participated in the present study were relatively healthy and showed good physical functioning. One positive explanation for the role of genes in older people's personal goals concerning health and functioning is that such goals reflect people's anxiety and neuroticism regarding their health. Previous research has shown genetic influence on anxiety/neuroticism as a personality trait to be as high as .40 – .60. Another possibility is that the results also reflect genetic components of physical health, that is, actual health and concerns about it.

For personal goals concerning independent living, the familial factors (mostly the result of additive genetic factors) explained a little less than half of the variance, and nonshared environmental factors a little more than half of the variance. This is an interesting finding, since autonomy has been suggested to be among the "basic motives" in the human motivational system (Deci & Ryan, 2000). However, there is an evident need to examine further the reasons for such genetically determined interindividual variation in one of the motives thought to be basic in the motivational system directing individuals' behavior in different situations. It is possible, for example, that different basic motives are alternative ways of increasing individuals' environmental fitness rather than mechanisms that dominate the lives of all individuals.

It should be remembered, however, that in all the personal goals that showed a genetic impact, nonshared environment also played a role. Consequently, although goals related to health and functioning, life style/independent living, and close relationship have a genetic basis, they are also influenced by individual life histories and related experiences.

However, not all goal contents showed a genetic impact. In the personal goals related to physical activity and care of others almost half of the individual variation was due to shared environment. These results are also interesting, because they suggest that some personal goals, even among older people, originate from shared experiences, such as the childhood home, school environment or shares experiences in later life. Interestingly, current contact frequency between co-twins did not affect the correlations between co-twins. However, a bigger sample size would have enabled a more advanced analysis on the impact of contact frequency on twin similarity to be carried out.

The personal goals focusing on cultural activity were mainly influenced by nonshared environment, suggesting that such values and attitudes are acquired later during the individual's life-span.

The present study was a first attempt to study genetic and environmental effects on personal goals. The results showed a number of tested goal contents among elderly

women showed familial, genetic and/or shared environmental influence. However, because of the some limitations of the present study, there is an obvious need for future studies that utilize larger sample sizes, employ multivariate modeling, and investigate other age groups. Moreover, adding health status and personality traits would make it possible to study the shared genetic and environmental factors between personal goals and other personal characteristics.

References

Akaike, H. (1987). Factor analysis and AIC. *Psychometrika, 52,* 317–332.

Agrawal, A., Jacobson, K.C., Gardner, C.O., Preswcott, C.A., & Kendler, K.S. (2004). A population-based twin study of sex differences in depressive symptoms. *Twin Research, 7,* 176–181.

Betsworth, D., Bouchard, T., Jr., Cooper, C., Grotevant, H., Hansen, J., Scarr, S. et al. (1994). Genetic and environmental influences on vocational interests assessed using adoptive and biological families and twins reared apart and together. *Journal of Vocational Behavior, 44,* 263–278.

Bouchard, T.J., & Loehlin, J.C. (2001). Genes, evolution, and personality. *Behavior Genetics, 31,* 243–273.

Bouchard, T.J. Jr, McGue, M., Lykken, D., & Tellegen, A. (1999). Intrinsic and extrinsic religiousness: Genetic and environmental influences and personality correlates. *Twin Research, 2,* 88–98.

Brunstein, J. (1993). Personal goals and subjective well-being: A longitudinal study. *Journal of Personality and Social Psychology, 65,* 1061–1070.

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.

Eaves, L., Eysenck, H., & Martin, N. (1989). *Genes, culture, and personality: An empirical approach.* New York: Academic Press.

Eaves, L., Heath, A., Martin, N., Maes, H., Neale, M., Kendler, K. et al. (1999). Comparing the biological and cultural inheritance of personality and social attitudes in the Virginia 30,000 study of twins and their relatives. *Twin Research, 2,* 62–80.

Elder, G.H. (1985). Perspectives on the life course. In G.H. Elder (Ed.), *Life course dynamics* (pp. 23–49). Ithaca, NY: Cornell University Press.

Emmons, R. (1991). Personal strivings, daily life events, and psychological and physical well-being. *Journal of Personality, 59,* 453–472.

Gatz, M., Pedersen, N., Plomin, R., Nesselroade, J., & McClearn, G. (1992). Importance of shared genes and shared environments for symptoms of depression in older adults. *Journal of Abnormal Psychology, 101,* 701–708.

Havighurst, R. (1948). *Developmental tasks and education* (3rd ed.). New York: McKay.

Hooker, K., & McAdams, D. (2003). Personality reconsidered: A new agenda for aging research. *Journals of Gerontology. Series B: Psychological Sciences and Social Sciences, 58B,* 296–304.

Jang, K.L., Livesley, W.J., Taylor, S., Stein. M.B., & Moon, E.C. (2004). Heritability of individual depressive symptoms. *Journal of Affective Disorders, 80,* 125–133.

Jansson, M., Gazt, M., Berg, S., Johansson, B., Malmberg, B., McClearn, G.E. et al. (2004). Gender differences in heritability of depressive symptoms in the elderly. *Psychological Medicine, 34,* 471–479.

Johnson, W., McGue, M., Gaist, D., Vaupel, J.W., & Christensen, K. (2002). Frequency and heritability of depression symptomatology in the second half of life: Evidence from Danish twins over 45. *Psychological Medicine, 32,* 1175–1185.

Johnson, W., McGue, M., & Krueger, R.F. (2005). Personality stability in late adulthood: A behavioral genetic analysis. *Journal of Personality, 73,* 523–551.

Kaprio, J., & Koskenvuo, M. (2002). Genetic and environmental factors in complex diseases: The older Finnish Twin Cohort. *Twin Research, 5,* 358–365.

Kaprio, J., Sarna, S., Koskenvuo, M., & Rantasalo, I. (1978). The Finnish twin registry: Formation and compilation, questionnaire study, zygosity determination procedures, and research program. *Prognostic Clinical and Biological Research, 24,* 179–184.

Karoly, P. (1993). Goal systems: An organizing framework for clinical assessment and treatment planning. *Psychological Assessment, 5,* 273–280.

Kendler, K., Gardner, C., & Prescott, C. (1998). A population-based twin study of self-esteem and gender. *Psychological Medicine, 28,* 1403–1409.

Little, B.R. (1983). Personal projects: A rationale and method for investigation. *Environment and Behavior, 15,* 273–309.

Little, B., Lecci, L., & Watkinson, B. (1992). Personality and personal projects: Linking Big Five and PAC units of analysis. *Journal of Personality, 60,* 501–525.

Loehlin, J., & Martin, N. (2001). Age changes in personality traits and their heritabilities during the adult years: Evidence from the Australian twin registry. *Personality and Individual Differences, 30,* 1147–1160.

Mayer, K.U. (1986). Structural constraints on the life course. *Human Development, 29,* 163–170.

McCartney, K., Harris, M., & Bernieri, F. (1990). Growing up and growing apart: A developmental meta-analysis of twin studies. *Psychological Bulletin, 107,* 226–237.

McCourt, K., Bouchard, T., Jr., Lykken, D., Tellegren, A. & Keyes, M. (1999). Authoritarianism revised: Genetic and environmental influence examined in twins reared apart and together. *Personality and Individual Differences, 27,* 985–1014.

Muthén, L.K., & Muthén, B.O. (2007). *Mplus user's guide* (4th ed.). Los Angeles, CA: Author.

Neale, M.C., & Cardon, L.R. (1992). *Methodology for genetic studies of twins and families*. The Netherlands: Kluwer.

Nurmi, J.-E. (2004). Socialization and self-development: Channelling, selection, adjustment, and reflection. In R. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 85–124). New York: Wiley.

Nuttin, J. (1984). *Motivation, planning and action. Relational theory of behavioral dynamics*. Hillsdale, NJ: Erlbaum.

Olson, J., Vernon, P., & Harris, J. (2001). The heritability of attitudes: A study of twins. *Journal of Personality and Social Psychology, 80,* 845–860.

Pedersen, N.L., & Reynolds, C.A. (1998). Stability and change in adult personality: Genetic and environmental components. *European Journal of Personality, 12,* 365–386.

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

Prescott, C.A. (2004). Using the Mplus computer program to estimate models for continuous and categorical data from twins. *Behavior Genetics, 34,* 17–40.

Read, S., Vogler, G., Pedersen, N., & Johansson, B. (2006). Stability and change in genetic and environmental components of personality in old age. *Personality and Individual Differences, 40,* 1637–164.

Robinson, J., Shaver, P., & Wrigthsman, L. (Eds.). (1991). *Measures of personality and social psychological attitudes.* San Diego: Academic Press.

Salmela-Aro, K., & Nurmi, J.-E. (1997). Goal contents, well-being and life context during transition to university – A longitudinal study. *International Journal of Behavioral Development, 20,* 471–491.

Salmela-Aro, K., Nurmi, J.-E., Saisto, T., & Halmesmäki, E. (2001). Goal construction and depressive symptoms during transition to motherhood: Evidence from two longitudinal studies. *Journal of Personality and Social Psychology, 81,* 1144–1159.

Sarna, S., Kaprio, J., Sistonen, P., & Koskenvuo, M. (1978). Diagnosis of twin zygosity by mailed questionnaire. *Human Heredity, 28,* 241–254.

Sherman, S., DeFries, J., Gottesman, I., Loechlin, J., Meyer, J., Pelias, M. et al. (1997). Recent developments in human behavioral genetics: Past accomplishments and future directions. *American Journal of Human Genetics, 60,* 1265–1275.

Takkinen, S., & Ruoppila, I. (2001). Meaning in life in three samples of elderly persons with high cognitive functioning. *International Journal of Aging and Human Development, 53,* 51–73.

Takkinen, S., Tolvanen, A., Kaprio, J., Berg, S., Koskenvuo, M., & Rantanen, T. (2004). The genetic and environmental effects on depressive symptoms among older female twins. *Twin Research, 7,* 626–636.

Vernon, P., Villani, V., Vickers, L., & Harris, J. (2008). A behavioral genetic investigation of the Dark Triad and the Big 5. *Personality and Individual Differences, 44,* 445–452.

Viken, R.J., Rose, R.J., Kaprio, J., & Koskenvuo, M. (1994). A developmental genetic analysis of adult personality: Extraversion and neuroticism from 18 to 59 years of age. *Journal of Personality and Social Psychology, 66,* 722–730.

Waller, N.G., & Shaver, P.R. (1994). The importance of nongenetic influences on romantic love styles: A twin-family study. *Psychological Science, 5,* 268–274.

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