The Journal of Positive Psychology
Vol. 6, No. 3, May 2011, 181–191

Routledge
Taylor & Francis Group

Genetic and environmental influences and covariance among meaning in life, religiousness, and spirituality

Michael F. Steger[a]*, Brian M. Hicks[b], Robert F. Krueger[b] and Thomas J. Bouchard[b]

[a]*Department of Psychology, Colorado State University, Fort Collins, CO, USA;* [b]*Department of Psychology, University of Minnesota, Twin Cities, MN, USA*

(*Final version received 3 March 2001*)

Meaning in life, spirituality, and religiousness have been empirically linked in previous research. This study aimed to advance knowledge of the interrelations among these variables by examining their heritable and non-heritable sources of influence, as well as the genetic and environmental contributions to their inter-relations. A sample of 343 middle-aged twins drawn from the Minnesota Twin Registry completed measures of meaning in life and spirituality. There was evidence that religiousness, spirituality, and meaning in life shared common genetic and environmental influences, suggesting that these people's attitudes concerning these variables may arise from shared factors. These results provide novel evidence of a shared genetic substrate for meaning in life, religiousness, and spirituality, and support the possibility that people's basic attitudes about the meaning of existence are commonly rooted in evolved biological factors and conjointly influenced through people's experiences with life.

Keywords: heritability; meaning in life; spirituality; religiousness; twin studies

Introduction

Psychologists increasingly have been interested in understanding the etiology and correlates of individuals' beliefs about the fundamental nature of their existence. These beliefs can have varied expressions, ranging from people's judgments about whether their own, personal lives matter, and whether the universe as a whole has a particular significance underlying everything, to behavioral and attitudinal adoption of specific religious practices and tenets. Although there are broad bodies of research exploring each of these expressions on its own, it appears increasingly common to try to understand people's attitudes about their personal lives, the entirety of life, and religion in relation to each other. In this article, we use a biometric approach to understanding the interrelations among meaning in life, spirituality, and religiousness. Meaning in life, which refers to people's comprehension of their experience and possession of a strong purpose, has been researched since the 1960s (see Steger, 2009, for review). Meaning in life can be seen as describing people's concerns with the significance and core nature of their personal existence. Religion has been a topic of active psychological inquiry since before James' (1902) *Varieties of Religious Experience*. Although commonly equated, recent efforts differentiate religiousness from spirituality. Religiousness refers to people's pursuit of the sacred in the context of an existing faith community, incorporating communal, and ritual aspects, whereas spirituality refers to people's pursuit in non-formal, often idiosyncratic ways (Hill et al., 2000). Religiousness can be seen as describing people's adoption of a core set of previously established beliefs and practices concerning the ultimate nature of life and existence, and spirituality can be seen as describing the ways in which people approach this topic in their own particular manner. All three variables – meaning in life, spirituality, and religiousness – share a conceptual core of meaningfulness; all three are concerned with people's ideas about the meaning life holds, whether it is their own individual lives or the entirety of life in the universe.

However, beyond their shared concerns with deeper matters of meaning, there are conceptual complexities that confront research directed at meaning, spirituality, and religiousness. First, all three of these existential attitudes have roots in an epistemology that prizes the individual's unique perspective. Existential theory asserts that each person creates his or her own meaning (e.g., Frankl, 1963), and even though religions promote specific doctrines and practices, individual adherence and interpretation is variable. Of course, spirituality is often defined in terms of idiosyncratic efforts (e.g., Hill et al., 2000). Thus, the approach pursued in this study, which operationalizes meaning in life, religiousness,

*Corresponding author. Email: michael_f_steger@yahoo.com

ISSN 1743–9760 print/ISSN 1743–9779 online

DOI: 10.1080/17439760.2011.569172
http://www.informaworld.com

and spirituality as people's responses to somewhat standardized questionnaires about broad attitudes, is limited to providing information about people's general endorsement of these topics, rather than their more visceral experience and expressions of meaning, religion, and spirituality.

In a related vein, even among trait approaches, such as the one taken in this study, meaning, religiousness, and spirituality are often seen as multidimensional. For example, meaning in life has been said to consist of making sense of one's existence and finding a purpose for one's life as well as the motivation to seek meaning in life (Steger, 2009), but other approaches have included additional dimensions such as death attitudes (Reker, 1992). Religiousness, too, has been sorted into (at least) two general orientations. Intrinsic religiousness refers to a mature and internalized adoption of religious attitudes and beliefs, whereas extrinsic religiousness refers to a conformist or utilitarian approach to religion in which secondary reasons dominate people's motivations to participate in religion. Distinctions have also been made between religious practices and religious attitudes and beliefs, although several measures combine the two types of items (e.g., Worthington et al., 2003). Finally, spirituality has also been viewed as a multidimensional construct (e.g., MacDonald, 2000). In this study, we focused on the two meaning dimensions of experiencing meaning in life and searching for meaning in life, on intrinsically adopted religious attitudes and practices, and on cognitive and experiential spirituality dimensions.

One compelling reason for studying these variables is the consistent link between these variables and well-being (Emmons, 2003; Pargament, 2002). Researchers have considered the possibility that religious traditions emphasize some effective health practices (e.g., reduced alcohol or drug use) and may provide people with social connectedness and support (Pargament, 2002; Powell, Shahabi, & Thoresen, 2003). Religion may be related to well-being for psychological reasons as well. Research has shown that people's sense of meaning in life mediates the relation between religiousness, or religious activities, and well-being (Steger & Frazier, 2005). Thus, religion may contribute to the psychological conditions necessary for well-being.

An alternative possibility is that people's religiousness, spirituality, and meaning in life are related at a more fundamental level. These three variables may be correlated because of common genetic or familial factors. Knowing the relative contributions to these phenotypes of genetic and environmental factors would move toward addressing this hypothesis. Indications of substantial genetic influences would imply that existential attitudes are heritable and that differences among people are rooted in their differing biological composition. Indications of substantial environmental influences would imply that differences among people in existential attitudes are rooted in their unique experiences, such as their peer groups or prevailing community attitudes toward religion, spirituality, or meaning in life.

Most of the relevant heritability research has focused on religiousness. Across several studies, the magnitude of heritability estimates for a range of religious attitudes, values, and behaviors ranges from 21% to 52%, depending on how religiousness has been measured and conceptualized (see D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999, for review). Variations in heritability estimates suggest differing influences of environmental factors and may reveal different etiologies for different phenotypes. For example, studies of religious attitudes and behaviors generally show substantial genetic influence by adulthood (e.g., D'Onofrio et al., 1999; Koenig, McGue, Krueger, & Bouchard, 2007; Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990). In contrast, there is greater evidence of shared environmental influences and lesser evidence of genetic influences for religious affiliation (e.g., Kendler, Gardner, & Prescott, 1997; also D'Onofrio et al., 1999 provide a review). In addition, the heritability of religiousness appears to increase with age (Koenig, McGue, & Iacono, 2008).

Heritability research on spirituality and meaning in life is much more sparse. Evidence of genetic influence has been found for self-transcendence, which is related to spirituality by virtue of their shared emphasis on connecting with some entity larger than one's self (44% heritable; Gillespie, Cloninger, Heath, & Martin, 2003; 48% heritable; Kirk, Eaves, & Martin, 1999). Finally, one previous study has reported that spirituality is moderately heritable, using a different measure of spirituality, but the same sample as this study (Steger, Hicks, Kashdan, Krueger, & Bouchard, 2007).[1]

Overall, previous research suggests that basic religious attitudes may have their roots in genetic factors, and that more specific manifestations of religiousness – like church affiliation – may be more strongly influenced by environmental factors. Although religiousness has received ample behavior genetic attention, the conceptually related attitudes, spirituality, has received considerably less, and meaning in life has received none. This may be an important gap in the literature to address because spirituality and meaning in life appear more similar to basic religious attitudes than they do to more specific religious variables like church affiliation. Thus, it seems particularly likely that they would reveal genetic influences, a finding that would suggest that these variables are indicators of a broader trait construct with genetic underpinnings. Evidence of shared genetic influences among meaning in life, spirituality,

and religiousness would suggest the necessity of a re-orientation in how these variables are viewed. Although this study cannot shed light on philosophical and theological questions like whether religions are 'right', whether any person's life truly is meaningful, or whether there is one seamless source of energy woven through all existence, it can shed light on whether there is a basic disposition to believe that there is something significant about existence. If people's answers to questions about whether they are religious, attend services, believe in some cosmic meaning, or feel like they have a purpose in life are linked at a genetic level, then it may make sense to view all of these variables as distinct expressions of the same psychological variable. In part, this would bring religious variables more securely within the scientific scope of psychology, as well as point the way toward a potentially more parsimonious way of understanding their relations with well-being.

It is particularly important to examine the genetic covariation between religiousness/spirituality and meaning in life given the robust links between meaning in life and other measures of well-being (for a review, see Steger, 2009). Religious variables are also associated with well-being, but less consistently; finding a common genetically influenced core among meaning in life, religiousness, and spirituality might reinforce the supposition that the psychological 'benefits' of these variables are largely derived from the meaning component (Steger & Frazier, 2005). In addition, beyond simply charting another set of correlations among these variables, using a biometric approach represents an important step down the path of exploring *why* these variables are related to each other. For example, both religiousness (Chida, Steptoe, & Powell, 2009) and meaning in life (Boyle, Barnes, Buchman, & Bennett, 2009) are associated with greater longevity, and it may be that genetic factors explain these relationships with mortality, or that life events that impact how long people live also impact attitudes about religion or meaning in life. Twin studies can provide data about both genetic and environmental sources of influence. The first purpose of this study was simply to provide a starting place for exploring the genetic and environmental influences on spirituality and meaning in life. The second purpose of this study was to examine the inter-relations among religiousness, spirituality, and meaning in life, including the extent to which religiousness and spirituality share common genetic influences with meaning in life.

Method

Participants

Participants in this study were an average of 49 years old at the time of completion of the measures (52.2% female). Completed surveys were received from 51 matched monozygotic (MZ) pairs – who are 100% genetically identical – and 40 matched dizygotic (DZ) pairs – who are no more genetically similar than any other pair of siblings or parent–child dyads, as well as 154 unmatched individuals ($N = 336$). All matched and unmatched participants were from intact twin pairs.

Procedure

Upon enrollment in the Minnesota Twin Registry (for details on this sample, see Krueger & Johnson, 2002), twins completed a standard questionnaire about twin similarity to establish whether they were MZ or DZ twins. This method is 95% accurate compared to using blood samples (Lykken, Bouchard, McGue, & Tellegen, 1990). Potential participants for this study were identified by selecting a random sample of 400 pairs of male and female MZ and DZ twins (100 pairs of each, e.g., 100 female DZ twin pairs) from the Minnesota Twin Registry representing birth cohorts from 1950 to 1955. Potential participants received a packet containing consent and survey materials, a check for $7 as an incentive to participate, a pre-addressed business reply envelope, and a cover letter describing the nature and purpose of the study and inviting participation. Overall response rate was 42%, with 17 packets returned due to incorrect address. Due to the low response rate, we examined whether the twins who returned the questionnaires were systematically different from those who declined participation. This was done by comparing responders and non-responders on the 11 primary scales of the Multidimensional Personality Questionnaire (MPQ), a broad-band personality inventory that is completed by all members of the MTR. After adjusting p-values for the correlated twin observations, none of the comparisons were significantly different with the largest difference being a very modest effect size for the Aggression scale, $F(1,2198.08) = 3.61$, $p = 0.058$, $d = 0.16$. Based on these analyses, we concluded that at least in terms of self-report measures, participants for this study were representative of the larger MTR for the target birth years.

Materials

Religiousness and spirituality

The Expressions of Spirituality Inventory (ESI; MacDonald, 2000) was used to assess religiousness and several aspects of spirituality. The ESI 30-item measure consists of five, 6-item subscales: Cognitive Orientation Towards Spirituality (e.g., 'My life has benefitted from my spirituality'; 'Spirituality is an important part of who I am as a person'),

Experiential Dimension of Spirituality (e.g., 'I have had an experience in which I seemed to be deeply connected to everything'; 'I have had a mystical experience'), Existential Well-Being ('Much of what I do in life seems strained'; 'I am an unhappy person'), Paranormal Beliefs (e.g., 'It is possible to communicate with the dead'; 'I believe witchcraft is real'), and Religiousness ('I see myself as a religiously oriented person'; 'I believe that going to religious services is important'). Items are rated from 0 (*strongly disagree*) to 4 (*strongly agree*). Scores on each subscale range from 0 to 24, with higher scores indicating greater levels of specific dimensions of spirituality. We regard the Cognitive Orientations Towards Spirituality subscale as the core spirituality measure and the Religiousness subscale as the core Religiousness measure, although the other subscales provide additional dimensions of interest. Previous research has supported the reliability, and the convergent and structural validity of the ESI (α's between 0.85 and 0.97; MacDonald, 2000). The factor structure of the ESI was assessed through confirmatory factor analysis (CFA) using AMOS 17.0 (Arbuckle, 2008). The model specified allowed a general spirituality factor to load on all five subscales. The fit to the data was relatively poor (cf. Hu & Bentler, 1999; χ^2 (df = 401) = 1073.25, $p < 0.001$; TLI = 0.82; CFI = 0.88; RMSEA = 0.07, 90% C.I. RMSEA = 0.07, 0.08), which is not uncommon, as structural models of personality-type variables often do not fit well using CFA (Church & Burke, 1994). Several item loadings were of small magnitude. Because the ESI was developed and validated using factor analysis (MacDonald, 2000), and there are no other valid configurations, we tested the scales as they were published. However, the magnitude of correlation coefficients with the ESI subscales could be attenuated.

Meaning in life

The Meaning in Life Questionnaire (MLQ; Steger, Frazier, Oishi, & Kaler, 2006) was used to assess two dimensions of meaning in life. The Presence of Meaning subscale assesses the extent to which respondents feel their lives are meaningful (5 items; e.g., 'I understand my life's meaning'), and the Search for Meaning subscale assesses the extent to which they are actively seeking meaning in their lives (5 items, e.g., 'I am seeking a purpose or mission for my life'). Participants rated items from 1 (Absolutely Untrue) to 7 (Absolutely True). The two factor structure of the MLQ has been replicated via confirmatory factor analyses in multiple samples. Both subscales have demonstrated very good internal consistency in previous studies (α's between 0.82 and 0.88; Steger et al., 2006). The factor structure of the MLQ was assessed through CFA, with fit indices reflecting a good fit to the data (cf. Hu & Bentler, 1999; χ^2 (df = 34) = 102.79, $p < 0.001$; TLI = 0.96; CFI = 0.97; RMSEA = 0.08, 90% C.I. RMSEA = 0.06, 0.09).

Biometric modeling

Classical twin design models assume that variation of an observed phenotype is influenced by three sources of variance: additive genetic factors (A); environmental factors that siblings share, such as parental rearing styles (C); and non-shared environmental factors, those that are unique to individual siblings (E) (Neale & Cardon, 1992). Estimates of these factors are derived from comparisons of the correlations observed among members of MZ and DZ twin pairs. MZ twins are two individuals born of the same fertilized egg, and therefore have all their genes in common. In contrast, DZ twins are born of two distinct fertilized eggs, and therefore share on average half of their segregating genes. If genetic factors are implicated in a particular behavior or attitude, then we would expect MZ twins to be more similar than DZ twins, because MZ twins share substantially greater amounts of genetic material. Therefore, higher correlations among MZ than DZ twins indicate some level of similarity due to genetic factors. Shared environmental factors increase similarity among siblings, and a DZ correlation greater than one half the MZ correlation may be indicative of shared environmental contributions. MZ correlations less than 1.0 are indicative of non-shared environmental effects.

We fit standard univariate biometric models to the raw data using full information maximum likelihood estimation as implemented by the computer program Mx (Neale, 1997). Thus, we took into account cases with missing data, which allowed us to retain the unmatched members of a twin pair in the analysis while also yielding less biased parameter estimates compared to listwise or pairwise deletion methods. When fitting models to raw data, a model that freely estimated the variances, covariances, and means for the MZ and DZ twins was fit using the −2loglikelihood ($-2LL$) as a baseline index of fit. More restrictive ACE models were then fit to the data, with goodness of fit evaluated by comparing the change in the $-2LL$ relative to the base model. The difference in the $-2LL$ follows a χ^2 distribution, which allows for a likelihood ratio test between nested models. In addition to the ACE model, simpler models that removed A and C effects were tested to determine if a more parsimonious model could provide a comparable fit to the data. To further assist in identifying the best fitting model, results of the likelihood ratio test were converted to the Akaike information criterion (AIC; χ^2 −2df; Akaike, 1987). The AIC provides an index of overall model relative to the parsimony of the model with lower

Table 1. Correlations among measures.

	1	2	3	4	5	6	7
1 Presence of Meaning[a]							
2 Search for Meaning[a]	−0.27***						
3 Cognitive Orientation Towards Spirituality	0.35***	0.04					
4 Experiential Dimension of Spirituality	0.16**	0.28***	0.49***				
5 Existential Well-Being	0.52***	−0.41***	0.01	−0.07			
6 Paranormal Beliefs	0.09+	0.08	0.22***	0.49***	0.00		
7 Religiousness	0.35***	−0.00	0.84***	0.33***	0.06	0.14**	

Note: $+p<0.10$, $**p<0.01$, $***p<0.001$; [a]Subscale of MLQ.

values indicative of better, and is commonly used to assess comparative fit among biometric models.

The twin methodology further allowed us to examine the genetic and environmental contributions to the covariance between meaning in life and spirituality measures by fitting ACE models to the cross-twin, cross-trait correlations for MZ and DZ twin pairs. These bivariate models provide estimates of the proportion of the covariance attributable to genetic or environmental factors as well as estimates of the genetic and environmental correlations. The genetic correlation (r_a) measures the amount of heritable variance that is shared between two traits (i.e., the genetic covariance between two traits standardized using their respective genetic variances), while the shared (r_c) and non-shared (r_e) environmental correlations provide comparable measures for the environmental variance.

Results

On the phenotypic level (observed scale scores), meaning in life, religiousness, and spirituality variables were inter-related with medium to large effect sizes, with some exceptions (Table 1). Phenotypic correlations of meaning in life (Presence of Meaning subscale) with religiousness (Religiousness subscale) and spirituality (Cognitive Orientation Towards Spirituality subscale) were consistent with previous finding regarding meaning and religiousness (*r*s 0.39–0.40; Steger & Frazier, 2005).

Results of the biometric modeling are provided in Table 2, which provides the model fit statistics, and Table 3 which provides the twin correlations and the parameter estimates for the full ACE models and the best fitting AE models. Examining the model fit statistics in Table 2, we could reject each E-only model (except Search for Meaning) indicating familial resemblance for each trait. Due to the small sample size, we could not detect a statistically significant difference in model fit to determine if the familial resemblance was due to genetic or shared environmental effects (two exceptions were for Existential Well-being and Paranormal Beliefs for which the CE model provided a significantly worse fit than the baseline model). In each case, however, the AE model provided the best relative fit. Additionally, the twin correlations reported in Table 3 are largely consistent with an AE model as most of the MZ correlations are at twice that of the DZ correlations, and estimates of C from the full ACE models are either zero or relatively modest, non-significant, and less than the estimates for A. Given all these factors and the notable increase in power to detect effects given a more parsimonious model, we focus our interpretations on results of the AE models.

Correlations among MZ twins are generally medium to large, whereas correlations among DZ twins are generally equal to zero or small (Table 3). Accordingly, estimates of genetic effects are substantial, particularly so for the ESI subscales. For example, variation in Paranormal Beliefs scale scores appears highly subject to genetic influence, at 68%. Only two scales exhibit DZ correlations that are greater than one half the MZ correlation (Search for Meaning and Religiousness), although, as has usually been the case, there were no indications of substantial shared environmental influence.

We next examined the genetic and environmental correlations between the five ESI subscales and the two MLQ subscales (Table 4). Consistent with our approach to the univariate models, we report results for AE bivariate models. This approach provided a more parsimonious model to account for associations among the meaning and spirituality as well as greater power to detect effects. Additionally, results for bivariate models that included C effects for scales those parameter estimates in the ACE models included $C>0$ were virtually identical to results for the AE bivariate models. The highest genetic correlations were between Existential Well-Being and Presence of Meaning ($r_g=0.60$) and search for meaning ($r_g=-0.62$), indicating that the genetic factors that account for these variables are highly related. In addition, the environmental correlations between

Table 2. Model fit statistics for univariate models.

	Model	χ^2	df	prob	AIC
Presence of Meaning	ACE	8.35	3	0.039	2.35
	AE	8.59	4	0.072	0.59
	CE	8.60	4	0.072	0.60
	E	22.09	5	<0.001	12.09
Search for Meaning	ACE	0.48	3	0.923	−5.52
	AE	0.57	4	0.966	−7.43
	CE	0.82	4	0.936	−7.10
	E	7.99	5	0.157	−2.01
Cognitive Orientation Towards Spirituality	ACE	1.54	3	0.673	−4.46
	AE	1.54	4	0.820	−6.46
	CE	5.44	4	0.245	−2.56
	E	21.03	5	<0.001	11.03
Experiential Dimension of Spirituality	ACE	4.03	3	0.258	−1.97
	AE	4.03	4	0.402	−3.97
	CE	7.68	4	0.104	−0.32
	E	12.24	5	0.032	2.24
Existential Well-Being	ACE	6.40	3	0.094	0.40
	AE	6.40	4	0.171	−1.60
	CE	10.98	4	0.027	2.98
	E	21.82	5	<0.001	11.82
Paranormal Beliefs	ACE	6.89	3	0.075	0.89
	AE	6.89	4	0.142	−1.11
	CE	21.94	4	<0.001	13.94
	E	41.39	5	<0.001	31.39
Religiousness	ACE	2.47	3	0.481	−3.53
	AE	2.60	4	0.627	−5.40
	CE	3.66	4	0.454	−4.34
	E	16.31	5	0.006	6.31

Existential Well-Being and the two MLQ scales were fairly high. This is perhaps unsurprising as the Existential Well-Being scale seems to have many depression and psychological distress-related items, and it has already been established that meaning in life is inversely related to psychological distress. Roughly half of the observed zero-order (phenotypic) correlation between Existential Well-Being and Presence of Meaning was attributed to genetic factors, with more of the phenotypic correlation between Existential Well-Being and Search for Meaning being attributed to genetic factors.

More interesting are the medium to large genetic correlations between Presence of Meaning and both Cognitive Orientations to Spirituality ($r_g = 0.42$) and Religiousness ($r_g = 0.38$). This finding affirms that religiousness and spirituality share common genetic factors with the more general trait, meaning in life, as well as common environmental factors as indicated by the medium-sized environmental correlations (r_es 0.28–0.30). Additionally, both Presence of Meaning and Search for Meaning share common genetic factors with Experiential Dimensions of Spirituality (r_gs = 0.38 and 0.45, respectively). Finally, for bivariate associations of very low magnitude, it is very difficult to parse how much the effect is due to genetic or environmental factors, therefore, we did not attempt to fit biometric models if the phenotypic correlation between a meaning and spirituality measure was not statistically significant.

Discussion

As psychologists extend inquiry into variables such as religion, spirituality, and meaning in life, it becomes important to know whether they are distinct traits or whether they share core features and etiologies. We used behavior genetic methods to shed light on the etiology of this group of variables addressing people's basic attitudes about the significance of existence. Our results affirm previous research suggesting that variability in such attitudes arise from a combination of considerable genetic influence and the impact of the way the environment affects each of us uniquely. Our estimates of medium to large genetic influences on religiousness and spirituality is in accord with previous, related research (D'Onofrio et al., 1999; Gillespie et al., 2003; Kirk et al., 1999; Steger et al., 2007). In addition, we helped extend this basic finding to the presence of meaning and the search for meaning.

In a further extension of previous work, we estimated the degree to which measures of religiousness and spirituality shared common genetic influences with meaning in life. Because religiousness and spirituality

Table 3. Twin correlations, variance components for ACE and AE models, and 95% confidence intervals.

	α	MZ	DZ	A	C	E	A	E
Presence of Meaning	0.91	0.44	0.21	0.22 (0.00, 0.55)	0.16 (0.00, 0.50)	0.62 (0.45, 0.82)	0.39 (0.19, 0.55)	0.61 (0.45, 0.81)
Search for Meaning	0.94	0.32	0.22	0.21 (0.00, 0.52)	0.11 (0.00, 0.44)	0.68 (0.48, 0.91)	0.33 (0.10, 0.52)	0.67 (0.48, 0.90)
Cognitive Orientation Towards Spirituality	0.69	0.53	0.24	0.55 (0.01, 0.69)	0.00 (0.00, 0.43)	0.45 (0.31, 0.66)	0.55 (0.34, 0.69)	0.45 (0.31, 0.66)
Experiential Dimension of Spirituality	0.86	0.44	−0.08	0.36 (0.00, 0.55)	0.00 (0.00, 0.27)	0.64 (0.45, 0.88)	0.36 (0.12, 0.55)	0.64 (0.45, 0.88)
Existential Well-Being	0.86	0.51	0.08	0.43 (0.05, 0.60)	0.00 (0.00, 0.29)	0.57 (0.40, 0.77)	0.43 (0.23, 0.60)	0.57 (0.40, 0.77)
Paranormal Beliefs	0.78	0.72	0.06	0.68 (0.45, 0.79)	0.00 (0.00, 0.17)	0.32 (0.21, 0.48)	0.68 (0.52, 0.79)	0.32 (0.21, 0.48)
Religiousness	0.80	0.42	0.30	0.37 (0.00, 0.64)	0.10 (0.00, 0.49)	0.53 (0.36, 0.79)	0.48 (0.25, 0.64)	0.52 (0.36, 0.75)

Note: A = additive genetic; C = shared environment; E = non-shared environment.

Table 4. Phenotypic (r_p), Genetic (r_g), and non-shared environmental (r_e) correlations, 95% confidence intervals, and percent of phenotypic correlation due to genetic variance (%g).

	MLQ-presence				MLQ-search			
	r_p	r_g	r_e	%g	r_p	r_g	r_e	%g
Cognitive Orientation Towards Spirituality	0.34 (0.26, 0.42)	0.42 (0.12, 0.73)	0.28 (0.05, 0.48)	57	0.02 (−0.07, 0.11)			–
Experiential Dimension of Spirituality	0.14 (0.06, 0.23)	0.38 (−0.05, 0.98)	0.01 (−0.21, 0.24)	94	0.29 (0.20, 0.37)	0.45 (−0.05, 1.00)	0.20 (−0.03, 0.42)	53
Existential Well-Being	0.52 (0.46, 0.59)	0.60 (0.29, 0.81)	0.47 (0.29, 0.63)	47	−0.39 (−0.46, −0.31)	−0.62 (−0.98, −0.26)	−0.25 (−0.45, −0.03)	61
Paranormal Beliefs	0.07 (−0.02, 0.16)				0.07 (−0.02, 0.16)			
Religiousness	0.34 (0.25, 0.41)	0.38 (0.03, 0.68)	0.30 (0.08, 0.49)	49	−0.01 (−0.10, 0.08)			–

Note: If the phenotypic correlation between a meaning in life and spirituality measure was not statistically significant, we did not attempt to estimate the genetic and environmental contributions to the very small amount of covariance.

both refer to ways in which people pursue and experience meaning in their lives (e.g., Hill et al., 2000) we hypothesized that this common conceptual core can be accounted for by common genetic roots. Our results support for this notion, demonstrating that there were notable genetic correlations among core measures of religiousness, spirituality, and meaning in life. Given previous research showing that meaning in life mediated the relation between religiousness and well-being (Steger & Frazier, 2005), it seems possible that the genetic influences on religiousness, spirituality, and meaning in life are primarily responsible for people's sense of comprehension and purposefulness. It also seems possible that the psychological benefits of religiousness and spirituality – at least in terms of health and well-being – are tied to their ability to support comprehension and purposefulness.

One intriguing possibility is that meaning in life, religiousness, and spirituality are all outgrowths of the brain module responsible for what Bering (2002) calls the 'existential theory of mind'. It has been argued that one of the survival advantages of early humans was the theory of mind, which enabled humans to understand that other humans had minds that processed information in similar ways, and that stimulated behavior and action for specific reasons. In other words, one central advantage of being able to generate a theory of mind for others was that the intentions of others could be interpreted from their overt behavior. Angry, amorous, puzzled, or aloof expressions could be read for highly specific and useful information about what the entity wearing those expressions was thinking and intending. Bering postulated that the brain module responsible for theory of mind could have expanded beyond its original function to begin to interpret attitudes and intentions – and even 'entity-ness' – in other environmental stimuli. For example, if a theory of mind was applied to a severe thunderstorm that wipes out crops and shatters living quarters, one might interpret that the 'Weather' was angry and needed placating. As this 'existential theory of mind' ascribed order, intention, and entity-ness to ever-increasing numbers of environmental phenomenon, it could foster the sense that all of life was embodied with personality, desires, and deliberate consequences. It seems possible that the shared genetic core identified in this study arises from such an existential theory of mind-generating brain module.

A very basic conclusion that can be reached from these and other data is that meaning in life, religiousness, and spirituality are like other traits, at least phenotypically. This means that we should anticipate variation across populations in the degree to which religiousness and spirituality are expressed in individuals. It also means that we should anticipate that expression of these traits requires transactions among genes and environments. As environments change, the observed phenotype of religiousness and spirituality should also change. Perhaps changes to the cultural environment in the United States are partly responsible for shifts in how many people say they are 'Spiritual' rather than 'Religious' (Hill et al., 2000). Finally, it means that variations in religiousness and spirituality are probably linked to other traits through shared genetic substrates. Results from this study support meaning in life as one possibility, but there may be others, such as Absorption and Traditionalism (Tellegen, 1982), which have been shown to be related to spirituality (Steger, 2009). Interventions that utilize religiousness or spirituality may be more successful if they simultaneously target these related constructs.

Our results are consistent with the hypothesis that a basic orientation toward the significance of existence explains covariation among meaning in life, religiousness, and spirituality. However, an alternate explanation would point toward even more basic level of analysis to understand these relations. For example, the Existential Well-Being subscale, which contains items about being unhappy and finding life to be troublesome or strained, seems more like a measure of neuroticism or depression than a measure of existential adjustment. Meaning in life is inversely associated with both neuroticism and depression (Steger et al., 2006). As such, it may be that more basic personality traits like neuroticism (for heritability, Birley et al., 2006) or psychological syndromes like depression (for heritability, Kendler, Gatz, Gardner, & Pedersen, 2006) account for the heritability of scores on Existential Well-Being subscale, and perhaps the shared genetic overlap between meaning and this subscale. Similarly items on the paranormal beliefs subscale resemble some of the 'unconventional attitudes and behavior' subset of items from measures of psychoticism (Eaves & Eysenck, 1977). These items capture an exploratory approach to life experiences, and meaning in life has been linked to psychoticism (Pearson & Sheffield, 1989) as well as similar attitudes, like curiosity (Kashdan & Steger, 2007; Steger, Kashdan, Sullivan, & Lorentz, 2008). Previous research using this sample has shown genetic overlap using a different measure of spirituality and a multidimensional measure of personality (Steger et al., 2007). Thus, future research should investigate the possibility of a more fundamental set of personality characteristics underlying meaning, religiousness, and spirituality.

There are several limitations to this study that constrain the conclusions that can be drawn from the results. First, the sample size is relatively small for twins studies. The small number of matched pairs resulted in fairly large confidence intervals around the estimates of genetic and environmental correlations. The small size of the sample can be attributed to the low response rate (42%), which contributes to the difficulty of drawing conclusions from these data. It is

always important to replicate behavior genetic findings in multiple samples. It may be particularly important with regard to the present findings. Second, estimates of genetic and environmental influences reflect the contributions of these factors within a specific sample at a specific time. Therefore data are needed from more diverse samples. Finally, the measures used in this study may not reflect the multidimensional nature of some of the variables in this study. For example, the Religiousness subscale has only six items, with only two of the six items referring to behavioral markers such as attending religious services and uses of prayer. A related measurement weakness is that the Existential Well-Being subscale may not assess anything particularly 'existential', and may instead be a simple depression or psychological distress measure. Statements made regarding the heritability of these constructs may be limited to the dimensions captured by these specific items.

Finding a relationship between the basic, genetic influences, and the highest existential aspirations of humanity presents a provocative juxtaposition. This does not make religious, spiritual, or meaning-rich experiences any more or less real, authentic, or true. Although few would suggest that there is a single gene that is responsible for faith or skepticism, it is reassuring to know that religiousness and spirituality are linked, along with most human expressions of thought and behavior, to our fundamental biology. Experiences of meaning in life may provide a powerful entry point for understanding this group of variables.

Acknowledgments

This study was supported by a grant from the Manuel D. and Rhoda Mayerson Foundation and the Values in Action Institute, administered by Dr Neal H. Mayerson, to Michael Steger. We appreciatively acknowledge assistance from Chris Peterson and Martin Seligman.

Note

1. This study examined the genetic covariation between basic personality and character strengths, one of which is spirituality.

References

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

Arbuckle, J.L. (2008). *AMOS 17.0* [Software]. Crawfordville, FL: AMOS Development Corp.

Bering, J.M. (2002). The existential theory of mind. *Review of General Psychology, 6*, 3–24.

Birley, A., Gillespie, N., Heath, A., Sullivan, P.F., Boomsma, D.I, & Martin, N.G. (2006). Heritability and nineteen-year stability of long and short EPQ-R neuroticism scales. *Personality and Individual Differences, 40*, 737–747.

Boyle, P.A., Barnes, L.L., Buchman, A.S., & Bennett, D.A. (2009). Purpose in life is associated with mortality among community-dwelling older persons. *Psychosomatic Medicine, 71*, 574–579.

Chida, Y., Steptoe, A., & Powell, L.H. (2009). Religiosity/spirituality and mortality: A systematic quantitative review. *Psychotherapy and Psychosomatics, 78*, 81–90.

Church, A.T., & Burke, P.J. (1994). Exploratory and confirmatory tests of the Big Five and Tellegen's three- and four-dimensional models. *Journal of Personality and Social Psychology, 66*, 93–114.

D'Onofrio, B.M., Eaves, L.J., Murrelle, L., Maes, H.H., & Spilka, B. (1999). Understanding biological and social influences on religious affiliation, attitudes, and behaviors: A behavior genetic perspective. *Journal of Personality, 67*, 953–984.

Eaves, L.J., & Eysenck, H.J. (1977). A genotype-environmental model for psychoticism. *Advances in Behaviour Research and Therapy, 1*, 5–26.

Emmons, R.A. (2003). Personal goals, life meaning, and virtue: Wellsprings of a positive life. In C.L.M. Keyes & J. Haidt (Eds.), *Flourishing: Positive psychology and the life well-lived* (pp. 105–128). Washington, DC: American Psychological Association.

Frankl, V.E. (1963). *Man's search for meaning: An introduction to logotherapy*. New York: Washington Square Press.

Gillespie, N.A., Cloninger, C.R., Heath, A.C., & Martin, N.G. (2003). The genetic and environmental relationship between Cloninger's dimensions of temperament and character. *Personality and Individual Differences, 35*, 1931–1946.

Hill, P.C., Pargament, K.I., Hood Jr, R.W., McCullough, M.E., Swyers, J.P., Larson, D.B., & Zinnbauer, B.J. (2000). Conceptualizing religion and spirituality: Points of commonality, points of departure. *Journal for the Theory of Social Behavior, 30*, 51–77.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

James, W. (1902). *The varieties of religious experience*. Toronto, CA: Random House.

Kashdan, T.B., & Steger, M.F. (2007). Curiosity and stable and pathways to well-being and meaning in life: Traits, states, and everyday behaviors. *Motivation and Emotion, 31*, 159–173.

Kendler, K.S., Gardner, C.O., & Prescott, C.A. (1997). Religion, psychopathology, and substance use and abuse: A multi-measure, genetic-epidemiologic study. *The American Journal of Psychiatry, 154*, 322–329.

Kendler, K.S., Gatz, M., Gardner, C.O., & Pedersen, N.L. (2006). A Swedish national twin study of lifetime major depression. *American Journal of Psychiatry, 163*, 109–114.

Kirk, K.M., Eaves, L.J., & Martin, N.G. (1999). Self-transcendence as a measure of spirituality in a sample of older Australian twins. *Twin Research, 2*, 81–87.

Koenig, L.B., McGue, M., Krueger, R.F., & Bouchard Jr, T.J. (2007). Religiousness, antisocial behavior, and altruism: Genetic and environmental mediation. *Journal of Personality, 75*, 265–290.

Koenig, L.B., McGue, M., & Lacono, W.G. (2008). Stability and change in religiousness during emerging adulthood. *Developmental Psychology, 44*, 532–543.

Krueger, R.F., & Johnson, W. (2002). The Minnesota Twin Registry: Current status and future directions. *Twin Research, 5*, 488–492.

Lykken, D.T., Bouchard Jr, T.J., McGue, M., & Tellegen, A. (1990). The Minnesota Twin Family Registry: Some initial findings. *Acta Geneticae Medicae et Gemellologicae, 39*, 35–70.

MacDonald, D.A. (2000). Spirituality: Description, measurement, and relation to the five factor model of personality. *Journal of Personality, 68*, 153–197.

Neale, M.C. (1997). *Mx: Statistical modeling* (4th ed.). Unpublished computer program, Department of Psychiatry, Medical College of Virginia.

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

Pargament, K.I. (2002). The bitter and the sweet: An evaluation of the costs and benefits of religiousness. *Psychological Inquiry, 13*, 168–181.

Pearson, P.R., & Sheffield, B.F. (1989). Psychoticism and purpose in life. *Personality and Individual Differences, 10*, 1321–1322.

Powell, L.H., Shahabi, L., & Thoresen, C.E. (2003). Religion and spirituality: Linkages to physical health. *American Psychologist, 58*, 36–52.

Reker, G.T. (1992). *Manual: Life Attitude Profile – Revised*. Peterborough, ON: Student Psychologists Press.

Steger, M.F. (2009). Meaning in life. In S.J. Lopez (Ed.), *Oxford handbook of positive psychology* (2nd ed., pp. 679–687). Oxford, UK: Oxford University Press.

Steger, M.F., & Frazier, P. (2005). Meaning in life: One link in the chain from religion to well-being. *Journal of Counseling Psychology, 52*, 574–582.

Steger, M.F., Frazier, P., Oishi, S., & Kaler, M. (2006). The meaning in life questionnaire: Assessing the presence of and search for meaning in life. *Journal of Counseling Psychology, 53*, 80–93.

Steger, M.F., Hicks, B.M., Kashdan, T.B., Krueger, R.F., & Bouchard Jr, T.J. (2007). Genetic and environmental influences on the positive traits of the Values in Action classification, and biometric covariance with normal personality. *Journal of Research in Personality, 41*, 524–539.

Steger, M.F., Kashdan, T.B., Sullivan, B.A., & Lorentz, D. (2008). Understanding the search for meaning in life: Personality, cognitive style, and the dynamic between seeking and experiencing meaning. *Journal of Personality, 76*, 199–228.

Tellegen, A. (1982). *Brief manual for the multidimensional personality questionnaire*. Unpublished manuscript, University of Minnesota, Minneapolis.

Waller, N.G., Kojetin, B.A., Bouchard Jr, T.J., Lykken, D.T., & Tellegen, A. (1990). Genetic and environmental influences on religious interests, attitudes, and values: A study of twins reared apart and together. *Psychological Science, 1*, 138–142.

Worthington Jr, E.L., Wade, N.G., Hight, T.L., Ripley, J.S., McCullough, M., Berry, J.W., . . . , O'Connor, L. (2003). The religious commitment inventory–10: Development, refinement, and validation of a brief scale for research and counseling. *Journal of Counseling Psychology, 50*, 84–96.