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Adolescent religiousness and its influence on substance use: preliminary findings from the Mid-Atlantic School Age Twin Study

Brian M D'Onofrio[1], Lenn Murrelle[1], Lindon J Eaves[1], Michael E McCullough[2], Jessica L Landis[1] and Hermine H Maes[1]

[1]Virginia Institute for Psychiatric and Behavioral Genetics, Virginia Commonwealth University, Richmond, VA
[2]National Institute for Healthcare Research, Rockville, MD, USA

Research has consistently shown that religiousness is associated with lower levels of alcohol and drug use, but little is known about the nature of adolescent religiousness or the mechanisms through which it influences problem behavior in this age group. This paper presents preliminary results from the Mid-Atlantic School Age Twin Study, a prospective, population-based study of 6–18-year-old twins and their mothers. Factor analysis of a scale developed to characterize adolescent religiousness, the Religious Attitudes and Practices Inventory (RAPI), revealed three factors: theism, religious/spiritual practices, and peer religiousness. Twin correlations and univariate behavior-genetic models for these factors and a measure of belief that drug use is sinful reveal in 357 twin pairs that common environmental factors significantly influence these traits, but a minor influence of genetic factors could not be discounted. Correlations between the multiple factors of adolescent religiousness and substance use, comorbid problem behavior, mood disorders, and selected risk factors for substance involvement are also presented. Structural equation modeling illustrates that specific religious beliefs about the sinfulness of drugs and level of peer religiousness mediate the relationship between theistic beliefs and religious/spiritual practices on substance use. Limitations and future analyses are discussed.

Keywords: religion, spirituality, alcohol, drug use, adolescents, twins, behavior genetics, behavior problems, mood disorders

Studies have consistently shown that religiousness, measured primarily through the frequency of church attendance and the personal salience of religion, is modestly associated with lower levels of both alcohol and drug use (see reviews[1–4]). Although this relationship is well established, researchers have noted that 'the overall literature on substance use/abuse makes only token acknowledgement of religion as an important explanatory variable, and then only as one of many possible cultural influences'.[5]

A common dilemma faced by those studying religiousness is the difficulty in defining this complex phenotype.[5] Inconsistent findings between many studies of religiousness are due in part to the different measures employed to capture this construct.[6] Most studies examining the link between alcohol/drugs and religion are restricted to measures of religious affiliation, church attendance, or religious salience,[4] thus reducing the vast range of religious experience to one or few variables. A number of researchers have noted that religiousness is a multidimensional construct.[5,7–12] The Intrinsic/Extrinsic (I/E) religious orientation typology, originally proposed by Allport and Ross,[8] is perhaps the most well-characterized multidimensional framework in the study of religion. Donahue remarks that, 'no approach to religiousness has had greater impact on the empirical psychology of religion'.[13] The Religious Orientation Scale (ROS), which measures I/E religious orientation, has been adjusted in order to make it age-universal[14] and revised to specify two types of extrinsic religiosity.[15] These efforts have made the ROS a reliable, standard measure of religiousness, even among children and adolescents.[16]

However, the I/E measure suffers from a number of theoretical and methodological problems, including a lack of conceptual clarity and a changing factorial structure.[17] Specifically, the difficulty of studying religiousness without studying 'belief content' renders the I/E typology inefficient as a measure of religiousness in some epidemiological contexts. Research has shown that a primary avenue through which religion influences the lives of adolescents is through act-specific beliefs.[18,19] Furthermore, new surveys should include measures of spirituality, as a recent movement in the field of the psychology of

Correspondence: Dr Lindon J Eaves, Virginia Institute for Psychiatric and Behavioral Genetics, Virginia Commonwealth University, PO Box 980003, Richmond, VA 23298-0003, USA. Tel: (804) 828 8155; Fax: (804) 828 8801; E-mail: eaves@hsc.vcu.edu
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religion has stressed that spirituality is a distinct dimension although it is correlated with religious beliefs and practices.[20,21] A theoretically and scientifically sound instrument which measured both religiousness and spirituality would enable researchers to reveal the relationships and pathways between specific dimensions of religiousness/spirituality and behavioral and psychological problems, thus providing greater information about the specific role of these constructs in the etiology and perpetuation of clinical outcomes.

The behavior-genetic research paradigm provides a unique approach to measuring the impact of environmental factors which is not possible in most psychological, sociological, and epidemiological studies.[22,23] By separating the influence of genes and the environment, research in the field has provided novel insight into the etiology and transmission of behavior and psychological constructs, including personality,[24–27] intelligence,[28–30] adolescent psychopathology,[31,32] and adolescent substance abuse.[33–37] This list is by no means exhaustive; reviews of the field are available.[38,39]

Although it has been presumed that genetic factors have no influence on religion,[40] twin and adoption studies report that genetic factors contribute moderately to individual differences in some religious attitudes and practices.[41] However, many of the existing behavior genetic studies are hindered by methodological problems, principal among which are inadequate measures of religious constructs. In addition, most of the work in this field has been restricted to adult samples. These findings may not generalize to children, as behavior genetic studies on intelligence[42] and social attitudes[43] have shown that the determinants of child and adolescent constructs are different from those in adults.

To our knowledge, there have been only two twin studies of adolescent religiousness. Loehlin and Nichols,[44] in their study of twins from the National Merit Scholarship Tests, utilized a measure of religious activity which included the frequency of prayer, saying grace, and reading the Bible. The results from one sub-sample of the adolescent twins suggested no genetic contribution to this measure but rather a large influence of shared environmental factors. However, correlations from the second subsample suggest a moderate genetic influence ($a^2 = 0.40$), implying that genes may play a role in individual variation in this trait. Carver and Udry[45] also report moderate heritability ($a^2 = 0.30$) in their indicator of adolescent religiosity, a measure which included three standard items tapping religiousness: church attendance in the past year, the frequency of prayer, and the overall personal importance of religion. However, these studies did not include measures of multiple dimensions of religiousness and are hindered by either small or selected samples.

The analyses presented here were conducted on data from the Mid-Atlantic School Age Twin Study, a study of behavioral and emotional problems in an epidemiological sample of adolescent twins and their mothers, ascertained through public and private schools in North Carolina and Virginia. This paper presents preliminary factor analyses of the Religious Attitudes and Practices Inventory (RAPI), a multidimensional measure of religiousness/spirituality. Analyses will also examine the relationship between these measures and age, gender and denomination, variables which are known to covary with religious behavior. The genetic and environmental contributions to the variation of the empirically derived factors will also be explored. Finally, these analyses investigate the relationship of these dimensions of religiousness with adolescent substance use and its associated problem behaviors and risk factors. Structural equation models will test whether content-specific religious beliefs related to drug use and peer religiousness mediate the relationship between adolescent religiousness and substance use, a theory which has been partially supported.[18,19]

Methods

Participants

Subjects were enrolled in the Mid-Atlantic Twin Registry and were participating in the Mid-Atlantic School Age Twin Study (MASATS), an ongoing epidemiological study of childhood and adolescent developmental problems in twins and their parents. The MASATS utilizes mailed questionnaires to a population-based sample of twins in North Carolina and Virginia. The questionnaires include measures of risk and protective factors for adolescent externalizing and internalizing problems. The mothers received a questionnaire in which they were asked to give informed consent for questionnaires to be sent to their 11 to 18-year-old adolescent twins. Initial psychometric analyses were conducted on data from a pilot sample of 656 mothers and 448 adolescent twins in order to reduce the length of each questionnaire. Analyses presented here were based on 1127 adolescent twins (including 357 twin pairs with known zygosity) who have completed questionnaires which included the RAPI. This sample represents a 65% response rate for adolescents to whom questionnaires with a RAPI were mailed. The ages ranged from 11.5 to 19.5 years, with a mean of 14.6 years, a majority (60.5%) of the adolescents being female. The MASATS is a current research project and the analyses presented here are preliminary, as the sample on which they are based is

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limited to approximately 75% of the total sample which will eventually be targeted.

Measures

Religious factors and items The authors set out to create a theoretically-based, multi-dimensional scale of religiousness by including in it religious and spiritual items which are salient to adolescents. Items were pooled from earlier adult and adolescent religiousness questionnaires[46–48] or created by the authors to measure the relevant domains. Since the influence of peers has been shown to affect adolescents' religiousness,[46,49] items related to peer religious activity were included. Items regarding spirituality, separate from common theologically oriented questions centered on a belief in God, were included to determine whether theistic beliefs represent a separate dimension from spiritual beliefs, interests and activities. After preliminary analysis of RAPI data from a small convenience sample of high school students, the measure was reduced to a total of 21 questions which were answered on a four-point Likert scale ranging from 'definitely true for me' to 'definitely not true for me'. An explanation of the factor solution is given in the results section.

Specific views on drugs and alcohol use were included in the adolescent questionnaire since the MASATS was designed as an epidemiological study focusing on behavior problems in adolescents. Burkett and his colleagues[18,19] have found that religiousness influences adolescents' drinking and drug use through content-specific beliefs. Three items were therefore included in the questionnaire ('I believe smoking cigarettes is a sin', 'I believe smoking marijuana is a sin', and 'I believe drinking alcohol is a sin') also answered on a four-point Likert scale. These items had strong internal consistency (α = 0.88) and were totaled to create a Drug Use as Sinful scale.

Religious denomination was based on maternal report. The mothers were asked to select one of 16 denominations, 'no preference', or 'atheist'. Based on earlier analyses,[47] the denominations were reduced to five categories corresponding to increasing 'religious fundamentalism':

1) Fundamentalist Protestants (including Disciples of Christ, Churches of Christ, Pentecostal, Latter Day Saints, and other Protestant);
2) Baptists;
3) Main-line Protestants (such as Presbyterian, Episcopal, Methodist, Lutheran, and United Church of Christ);
4) Roman Catholics; and
5) no preference or atheist.

Those selecting Judaism, Eastern Orthodox, or other religion (5% of the sample) were excluded from the analyses based on denomination due to the small numbers of participants.

Drug and alcohol use Questions concerning the frequency of alcohol and drug use were based on surveys used in the current Monitoring the Future Study.[50] The adolescents were asked to record the number of times they had used cigarettes, alcohol, inhalants, chewing tobacco, marijuana, other drugs, and were drunk in the past 30 days, the past year, and in their lifetime. The adolescents could select one of six response categories from '0' to '20+.'

Externalizing behavior Items corresponding to symptoms of conduct disorder and oppositional defiant disorder were based on the DSM-IV[51] criteria for these disorders. The frequency of these items in the past year was measured on a four-point Likert scale. Those who answered more than 75% of the questions had their scores imputed, and those who did not were scored as missing. The oppositional defiant scale included seven items (α = 0.81), and after psychometric analyses of the pilot data, the conduct disorder measure was reduced to six items (α = 0.80). These two measures were moderately correlated (r = 0.36).

Internalizing problems Depressive symptomatology was measured using 12 items from the Mood and Feelings Questionnaire (MFQ).[52] Similarly, the measure of anxiety was taken from the Multi-Dimensional Anxiety Scale for Children (MASC)[53] and included four items reflecting the physical symptoms of anxiety. Both measures (depression and anxiety) exhibited high levels of internal consistency in this sample (α = 0.91 and 0.92, respectively). These two measures were highly correlated (r = 0.62).

Friend drug use and conduct behavior Items measuring peer drug use and conduct problems were drawn from the Drug Use Screening Inventory[54] and Monitoring the Future Study.[50] Adolescents were asked to select the number of friends who had ever participated in deviant activities on a five-point Likert scale ranging from 'none' to 'all'. The Peer Conduct Disorder measure included seven items (α = 0.85), and the Peer Drug Use scale assessed eight activities associated with substance use (α = 0.94).

Sensation seeking Items from the Zuckerman Sensation Seeking Scale[55,56] were utilized to measure the personality construct of sensation seeking. After

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analysis of pilot data, the measure was reduced to 14 items which were internally consistent (α = 0.82). The items were measured on a four-point Likert scale from 'I agree strongly' to 'I disagree strongly.'

Zygosity The sample was drawn from the Mid-Atlantic Twin Registry, a registry which combines the Virginia, North Carolina, and South Carolina Twin Registries. These registries utilize questionnaire responses which have been shown to determine correctly the zygosity in greater than 90% of twins pairs.[57,58] Twins for whom these zygosity algorithms could not assign a probability-based 'definitive' zygosity were excluded from the genetic analyses.

Analyses

Exploratory factor analysis was conducted to help elucidate the underlying factor structure of the RAPI items. More extensive confirmatory factor analyses will be conducted on larger, more representative samples when they become available. The relationship between these factors and the drug use as sinful measure was explored. ANOVAs were conducted via the general linear model to investigate the effects of gender, age, and denomination on the religiousness factors (the children were separated into two groups: aged 11–15 and 16–18). This analysis will provide the proportion of variance of the religiousness factor which is explained by gender, age and denomination.[59] Least square means and Bonferroni-corrected significance tests, where necessary, were presented to show the nature and direction of the statistical differences.

The influence of age and sex was controlled and the residual scores for the religiousness factors were normalized using the SAS[60] rank (normal) procedure. Twin correlations were calculated using product–moment correlations for each zygosity group, as a series of simple comparisons can be utilized to gather preliminary information from the statistics of twins reared together.[61] Univariate genetic structural models were tested with the statistical software Mx[62] to determine the extent to which genetic, shared environmental, and unshared environmental latent factors contribute to individual differences in the religiousness measures.[63] The univariate models were fit to the raw data and were then compared to a saturated model specifying unique parameters for the variances, covariances, and means in each group. Twice the difference in log likelihood estimates is distributed as χ^2, with the degrees of freedom equal to the differences in the two models. Since the DZ twin correlations were never lower than half of the MZ correlations, models testing for the importance of the shared environment were preferred over those testing for dominance. Due to the small sample sizes, only two analyses were conducted for each group. The first model fitted to the data, known as the 'ACE' model, tested separate parameters for each gender for additive genetic (A), shared environmental (C), and specific environmental (E) factors to account for the variance. The second model restrained the parameters in the ACE model to be the same across both sexes, thus having three more degrees of freedom. Both models will be presented, rather than only the best-fitting model, because the sample sizes were rather small to detect heterogeneity. Similar approaches have been utilized in previous reports of adolescent characteristics and behavior.[31] Confidence intervals were presented to provide a greater understanding of the relative magnitude of each factor in the models.

Correlations, separated by gender and controlling for age, between the religious factors and measures of alcohol/drug involvement, associated problems, and risk factors will help delineate the nature of the relationship between these constructs. Finally, a series of structural equation models were fit to the religiousness and substance use measures to explain the underlying structure of the relationship between these variables after the influence of age had been controlled. The structural equation models were fitted to the covariance matrices of each gender and included different latent variables and causal paths.

Results

Factor analysis of the RAPI and inter-factor correlations

A three-factor solution was obtained based on the eigenvalue scores. The three factors accounted for 71% of the variance among the items, with the first factor explaining 59%. Table 1 shows the results of an oblique factor rotation using the promax method.[60] The first factor represents beliefs about God, and will subsequently be referred to as the Theism scale. The second factor includes items which are related to Religious/Spiritual Practices, and the last factor measures Peer Religiousness. Factor scores were created by using the standardized scoring coefficients through the SAS[60] Score procedure.

Table 2 displays the age-adjusted correlations between the three factors from the RAPI and the Drugs as Sinful measure independently for each gender. All correlations are significant at the $P < 0.0001$ level. The inter-factor correlations show similar trends across sexes, as the highest correlations for males (r = 0.61) and females (r = 0.71) are between the theism and religious/spiritual practices

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Table 1 Standard regression coefficients for the promax rotated factors of the RAPI personal religiousness items

Items	Factor 1	Factor 2	Factor 3
I believe in God	94	–34	12
I feel like I can always count on God	90	–4	3
My faith in God helps me through hard times	80	14	0
I ask God to help me make important decisions	74	12	3
I try to live how God wants me to live	70	22	0
Every day I see evidence that God is active in the world	70	21	3
I feel that without God, there would be no purpose in life	69	26	–6
My faith in God shapes how I think and act every day	61	37	–6
I take time for periods of private prayer or meditation	44	38	7
I often attend religious activities such as Bible study, choir practice, or youth group	–9	87	6
I go to Sunday school often	–12	85	0
I help others with their religious questions and struggles	11	74	–2
My friends and I often talk about religious matters	–14	72	23
I like to worship and pray with others	18	69	9
I know I can count on people from my church when I need help	23	68	–7
I seek out opportunities to help me grow spiritually	27	66	–5
Being with other people who share my religious views is important to me	22	58	12
Spiritual experiences are important to me	44	54	–7
I consider myself to be a very spiritual person	39	53	0
Most of my best friends go to church or other religious services	9	0	88
Most of my best friends are religious	2	15	83

Significant coefficients are in bold. The influence of age and sex were controlled in the factor analysis.

Table 2 Correlations among the adolescent religious measures

Measures	1	2	3	4
1. Theism	–	0.61	0.32	0.44
2. Religious/spiritual practices	0.71	–	0.39	0.42
3. Peer religiousness	0.35	0.42	–	0.21
4. Drug use as sinful	0.47	0.48	0.29	–

Correlations for males are above the diagonal (n=339). Females are below the diagonal (n=485). All correlations are significant at the P <0.0001 level. The influence of age was partialled.

factors and the lowest correlations are between peer religiousness and the drug use as sinful measures (r = 0.21 and 0.29, respectively).

Relationship between the measures of religiousness and gender, age, and denomination

Gender, age, and denomination were entered simultaneously into a general linear model for each of the religiousness measures (the three dimensions from the RAPI and the drug use as sinful measure). Table 3 provides the least square means and the proportion of variance explained for the religious measures by gender, age, and denomination. The inclusion of the categorical measures accounted for 10% of the total variance in the theism factor ($F(6,748) = 13.11$, $P < 0.0001$). The only categorical measure which reached individual statistical significance was denomination ($F(4,748) = 19.09$, $P < 0.0001$). Due to the high number of post hoc comparisons among the different denominations, a Bonferroni-corrected significance level ($P = 0.005$) was utilized to reduce the number of spurious Type I errors. Fundamentalist Protestants did not differ significantly from Baptists, but both reported higher theism scores than Mainline Protestants, Roman Catholics, and those indicating no religious preference. Mainline Protestants and Catholics did not differ statistically but reported higher levels of theism than those with no preference.

The adolescents' gender, age, and denomination accounted for 15% of the variance in the religious/spiritual practices measure ($F(6,748) = 21.16$, $P < 0.0001$). Once again, the only categorical measure which reached statistical significance was denomination ($F(4,748) = 31.60$, $P < 0.0001$). The mean scores for the religious/spiritual practices measure exhibit the same pattern of relationships as those for the theism scale. There is no statistical difference in mean scores for this scale among Fundamentalist Protestants and Baptists, and both reported higher levels than the other denominations. Mainline Protestants do not differ in their mean score from the Roman Catholics and both of these report higher levels of participation in these activities than those selecting no religion.

Table 3 Least square means and significance tests for gender, age, and denominational differences in adolescent religious measures

Measures	R^2	Gender		Age		Denomination				
		Male	Female	11–14	15–19	Fund.-Prot.	Baptist	Mainline Prot.	Roman Catholic	None
Theism	0.10	2.63	2.58	2.67	2.55	2.94	3.0	2.50	2.53	2.03
Religious/spiritual practices	0.15	1.28	1.24	1.29	1.22	1.85	1.69	1.27	1.04	0.44
Peer religiousness	0.04	1.92	2.11[a]	2.10	1.94[a]	2.21	2.18	2.08	1.91	1.70
Drug use as sinful	0.12	4.95	4.35[a]	5.29	4.01[a]	6.08	5.59	4.32	4.13	3.13

[a](P <0.05). Denominations which share an underline are not significantly different. See text for further explanation.

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Only 4% of the variance in the peer religiousness measure can be accounted for by one's gender, age, and denomination ($F(6,748) = 4.60$, $P < 0.0001$). There were significant age ($F(1,748) = 6.65$, $P < 0.05$), gender ($F(1,748) = 4.15$, $P < 0.05$), and denomination effects ($F(4,748) = 4.20$, $P < 0.005$). Females reported more religious friends, and older children reported that their friends were less religious. Those reporting a religious denomination report higher levels of religiousness in their friends than those selecting no religious denomination. There was no statistically significant difference between the means of Mainline Protestants, Roman Catholics, and individuals with no denomination.

Twelve percent of the drug use as sinful measure can be accounted for by gender, age and denomination ($F(6,782) = 18.28$, $P < 0.0001$). Males report a higher score on the measure than females ($F(1,782) = 8.62$, $P < 0.005$), and older adolescents report lower levels ($F(1,782) = 31.78$, $P < 0.0001$). A denominational effect was also found ($F(4,782) = 17.33$, $P < 0.0001$); Fundamentalist Protestants and Baptists were more likely to endorse the notion that drugs are sinful than those of other denominations. There was no difference in the scores for Mainline Protestants and Catholics. Likewise, there was no difference between Roman Catholics and those reporting no denomination.

Behavior-genetic analyses

Table 4 presents the Spearman product-moment twin correlations for the different religiousness measures by zygosity group after the main effects of age and gender were partialled out. In most cases, both the monozygotic (MZ) and dizygotic (DZ) correlations are quite high, suggesting that shared environmental characteristics are likely to be important. The correlations are all less than unity, suggesting the influence of the non-shared environment, which includes measurement error. For the theism measure the DZ correlation is slightly, but not significantly higher than the MZ correlation in the males, suggesting that genetic effects are not likely to be important. However, for the females, the DZ correlation is less than the MZ correlations, implying that there may be genetic influences on this trait among girls in addition to shared environmental effects. The religious/spiritual practices measure appears to be primarily explained by shared environmental influences as all of the correlations are quite high, with no differences between MZ and DZ correlations in either gender. Whereas there is no difference in the twin correlations for the peer religiousness scale for females, the DZ correlation is approximately half that of the MZ correlation among males. The most striking correlation related to the drug use as sinful measure is the rather low opposite-sex DZ correlation which is significantly lower than either of the same-sex correlations, signifying that different environments may influence this construct in males and females.

Table 4 Twin correlations and sample sizes for measures of religiousness

Zygosity group	Theism	Rel./spirit. practices	Peer rel.	Drug use as sinful
MZM	0.72 (63)	0.74 (63)	0.59 (63)	0.52 (67)
MZF	0.74 (99)	0.76 (99)	0.60 (99)	0.64 (112)
DZM	0.77 (32)	0.75 (32)	0.28 (32)	0.59 (33)
DZF	0.58 (54)	0.77 (54)	0.57 (54)	0.61 (60)
DZO	0.48 (78)	0.65 (78)	0.28 (78)	0.32 (85)

The influences of age and sex were controlled. Sample sizes are given in parentheses. MZM: monozygotic males; MZF: monozygotic females; DZM: dizygotic males; DZF: dizygotic females; DZO: dizygotic twins of opposite sex.

Table 5 presents the goodness of fit and parameter estimates for the univariate genetic models of religiousness. The χ^2 statistic (the difference in likelihood estimates between the genetic model and the saturated model fit to the raw data), the significance level, and the Akaike's Information Criterion (AIC) statistic for each model for the different measures of religiousness indicate that the models fit the data well. In the analyses of the theism scale, the restricted ACE model (AIC = –16.37) was a more parsimonious model but did not fit significantly better ($\Delta\chi^2(3) = 3.13$, $P = 0.37$) than the heterogeneity model (AIC = –13.50). The confidence intervals of the heritability estimates for theism in the restricted analyses ($a^2 = 0.13$, 0.00–0.33), males ($a^2 = 0.00$, 0.00–0.24) and females ($a^2 = 0.20$, 0.00–0.43) were wide and included zero. Shared environmental factors contributed a substantial amount of variability in the male (75%) and female (53%) and restricted models (60%) of theism. The contribution of the non-shared environment was moderate. A similar pattern appeared for the religious/spiritual practices measure, as the restricted model (AIC = –8.85) was more parsimonious ($\Delta\chi^2(3) = 5.94$, $P = 0.11$) than the heterogeneity model (AIC = –8.78). The confidence intervals of the heritability estimates for the restricted analyses ($a^2 = 0.13$, 0.00–0.31), males ($a^2 = 0.03$, 0.00–0.35) and females ($a^2 = 0.13$, 0.00–0.38) included zero, and the shared environment contributed a majority of the variance in the male, female, and restricted models (0.74, 0.62, 0.62, respectively).

Based on the AIC, the heterogeneity model (AIC = –10.67) fit the data better than the restricted model (AIC = –9.10) for the peer religiousness measure, although the change in χ^2 was not statistically significant ($\Delta\chi^2(3) = 7.58$, $P = 0.06$). Results of the heterogeneity model illustrated a substantial gender difference in the variance contributions to this

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Table 5 Goodness-of-fit statistics and standardized parameter estimates with 95% confidence intervals of the ACE models for the Adolescent Religiousness Measures

		Goodness-of-fit						Parameter estimates					
								Male			Female		
Measures	Model	χ^2	df	p	AIC	$\Delta\chi^2$	P	a^2	c^2	e^2	a^2	c^2	e^2
Theism	ACE	4.50	9	0.88	–13.50	–	–	0.00	0.75	0.25	0.20	0.53	0.27
								0.00–0.24	0.52–0.82	0.18–0.34	0.00–0.43	0.32–0.71	0.20–0.36
	ACEr	7.63	12	0.81	–16.37	3.13	0.37	0.13	0.60	0.27	–	–	–
								0.00–0.33	0.42–0.74	0.21–0.34	–	–	–
Religious/ spiritual practices	ACE	9.21	9	0.42	–8.78	–	–	0.03	0.74	0.22	0.13	0.62	0.25
								0.00–0.35	0.44–0.83	0.16–0.32	0.00–0.38	0.38–0.77	0.19–0.33
	ACEr	15.15	12	0.23	–8.85	5.94	0.11	0.13	0.63	0.24	–	–	–
								0.00–0.31	0.45–0.75	0.19–0.31	–	–	–
Peer religious-ness	ACE	7.33	9	0.60	–10.67	–	–	0.50	0.10	0.40	0.01	0.58	0.40
								0.16–0.69	0.00–0.38	0.28–0.57	0.00–0.34	0.28–0.68	0.31–0.51
	ACEr	14.91	12	0.25	–9.10	7.58	0.06	0.37	0.22	0.41	–	–	–
								0.09–0.65	0.00–0.45	0.33–0.51	–	–	–
Drug use as sinful	ACE	9.00	9	0.44	–9.00	–	–	0.09	0.43	0.48	0.12	0.53	0.35
								0.00–0.47	0.09–0.62	0.34–0.66	0.00–0.45	0.21–0.69	0.27–0.45
	ACEr	18.84	12	0.09	–5.17	9.84	0.02	0.15	0.44	0.40	–	–	–
								0.00–0.42	0.21–0.61	0.32–0.50	–	–	–

AIC: Akaike's Information Criterion; $\Delta\chi^2$: change in χ^2; a^2: proportion of variance explained by additive genetic factors; c^2: proportion of variance explained by shared environmental factors; e^2: proportion of variance explained by specific environmental factors; A: additive genetic factors; C: shared environmental factors; E: specific environmental factors; r: parameter estimates restricted to be equal across genders, estimates for males equally apply to females.

measure. The heritability estimate for males was 0.50 (0.16–0.69) and the contribution of the shared environment was 0.10 (0.00–0.38). This was in stark contrast to the negligible heritability estimate in females (a^2 = 0.01, 0.00–0.34) and large contribution (0.58) of the shared environment. Both models reported a moderate influence of the non-shared environment.

The heterogeneity model (AIC = –9.00) was a better fitting model than the restricted model (AIC = –5.17) for the drug use as sinful measure $\Delta\chi^2(3) = 9.84$, P = 0.02). In both males (a^2 = 0.09, 0.00–0.47) and females (a^2 = 0.12, 0.00–0.45), the heritability estimates were negligible, while in both genders the influence of the shared environment was statistically significant.

Correlations between religiousness measures and phenotypes associated with drug and alcohol use

Table 6 presents gender specific product–moment correlations between the adolescent religiousness measures and drug/alcohol use, disorders which are typically comorbid with drug involvement, and selected substance abuse risk factors. All of the religiousness measures are negatively correlated with cigarette, alcohol, and marijuana use, although there is some variability in the magnitude of correlations based on which measure of religiousness, gender, and specific drug involvement are considered. The correlations suggest a modest negative association between the dimensions of adolescent religiousness and the substance use measures, with

Table 6 Correlations between the adolescent religiousness measures and alcohol/drug use and associated conditions and risk factors

	Theism		Rel./spiritual practices		Peer religiousness		Drug use as sinful	
Scales	Male n=373	Female n=566	Male n=373	Female n=566	Male n=373	Female n=566	Male n=389	Female n=594
Drug/alcohol use								
Cigarette use (last year)	–0.12[a]	–0.19[f]	–0.06	–0.15[d]	–0.08	–0.22[f]	–0.17[c]	–0.25[f]
Alcohol use (last year)	–0.20[f]	–0.17[f]	–0.14[b]	–0.16[f]	–0.17[b]	–0.22[f]	–0.26[f]	–0.31[f]
Marijuana use (lifetime)	–0.13[a]	–0.18[f]	–0.18[d]	–0.19[f]	–0.12[a]	–0.24[f]	–0.20[f]	–0.21[f]
Comorbid disorders								
Conduct disorder	–0.08	–0.13[e]	–0.06	–0.08	–0.04	–0.17[f]	–0.17[c]	–0.15[d]
Oppositional defiant disorder	–0.14[b]	–0.13[c]	–0.09	–0.08	0.00	–0.09[a]	–0.08	–0.04
Depression	–0.15[c]	–0.07	–0.09	–0.04	–0.04	–0.03	0.04	0.01
Anxiety	–0.17[c]	–0.08[a]	–0.08	–0.05	–0.06	–0.06	–0.09	–0.04
Risk factors								
Peer drug use	–0.06	–0.18[f]	–0.02	–0.13[b]	–0.09	–0.19[f]	–0.21[f]	–0.32[f]
Peer conduct disorder	–0.08	–0.14[c]	–0.01	–0.07	–0.12[a]	–0.14[c]	–0.16[b]	–0.18[f]
Sensation seeking	0.17[c]	–0.34[f]	–0.01	–0.29[f]	–0.07	–0.19[f]	–0.19[d]	–0.40[f]

[a]P <0.05, [b]P <0.01, [c]P <0.005, [d]P <0.001, [e]P <0.0005, [f]P <0.0001. The influence of age was controlled.

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drug use as sinful showing the strongest relationship, especially in females (r = –0.21 to –0.31).

The relationship between the adolescent religiousness measures and conduct and oppositional defiant symptoms is less profound as a majority of these modest correlations failed to meet statistical significance. At most, there is a small, negative correlation between these measures. Once again, there is variability in the correlations based on the different measures of adolescent religiousness, gender, and specific drug outcome. The correlations between religiousness and internalizing symptomatology (depression and anxiety) reveal that there is not a strong relationship between these variables and the dimensions of religiousness, as the correlations failed to reach statistical significance except for theism in males (r = –0.15 and –0.17 for depression and anxiety, respectively).

The pattern of correlations between the religiousness measures and risk factors for drug use (peer characteristics and sensation seeking), suggest that there is a gender difference in the influence of religiousness as the correlations were larger and more likely to be statistically significant in the females. Most notable is the difference in the relationship of the religiousness measures and sensation seeking between males and females: theism (r = –0.17 and –0.34), religious/spiritual practices (r = –0.01 and –0.29), peer religiousness (r = –0.07 and –0.19), and drug use as sinful (r = –0.19 and –0.40). Once again, the drug use as sinful measure correlated more strongly with the other variables.

Models for the relationship between adolescent religiousness and substance use

A number of theoretical models were fit to the four adolescent religiousness measures and the self-report use of alcohol and cigarettes in the past year in order to determine the structure of these relationships. Models were tested to determine whether specific religious beliefs concerning drug use and peer religiousness mediate the relationship between adolescent religiousness and substance involvement. The first model (Figure 1) fit a one-factor solution to the four religiosity measures, representing a latent religiousness variable, and another latent variable which was represented by alcohol and cigarette use in the past year. Marijuana use in one's lifetime was originally included in this factor, but as it did not load highly, it was subsequently dropped. A causal path parameterized the relationship between the latent religiousness variable and the latent substance abuse variable. This model specified that the influence of the four measures of religiousness on substance use is mediated by a latent construct of religiousness. Different parameters were specified for each gender, but this model did not fit the data well $\Delta\chi^2(16) = 69.87$, $P < 0.001$, AIC = 37.87). Table 7 presents the goodness of fit statistics for the various models tested. The significance level was used to determine the overall fit and the AIC allowed for comparisons between the different models.

The second model specified a latent religiousness factor on which theism and religious/spiritual practices loaded and a latent substance use variable on which the cigarette and alcohol items loaded. A direct path from religiousness to substance use was included in addition to a mediating role between those two variables for the drug use as sinful and peer religiousness measures. This model fit the data better than the first model $\Delta\chi^2(4) = 31.68$, $P < 0.0001$). The third model constrained the parameters of the measures loading on the religiousness latent variable to be the same across both genders. This resulted in a more parsimonious model according to the AIC, as the difference in χ^2 between the two models $\Delta\chi^2(4) = 4.77$, $P = 0.32$) was not significant. The fourth model constrained the factor structure for the substance use latent variable in model three to be the same across both genders. The change in χ^2 (2) = 5.38, $P = 0.07$) approached the level of statistical significance. As the AIC for model

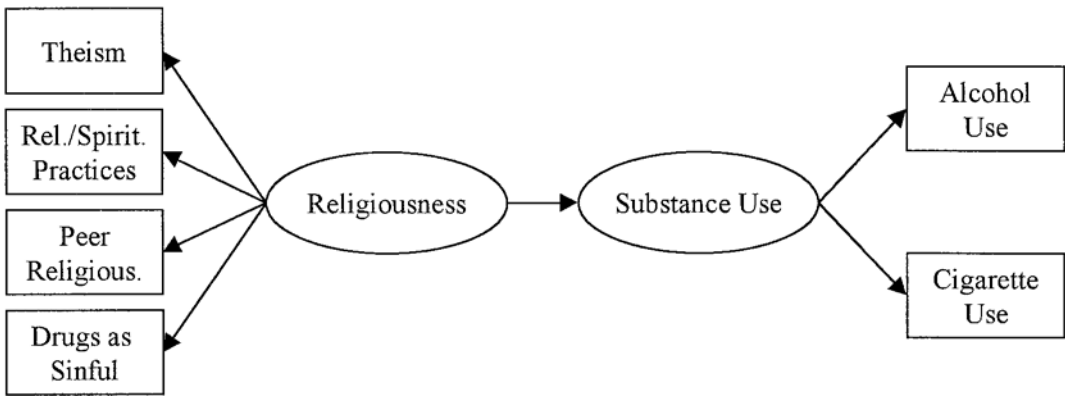

Figure 1 Initial model of the relationship between adolescent religiousness and substance use

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Table 7 Goodness-of-fit statistics for models explaining the relationship between adolescent religiousness and alcohol use

Model	χ^2	df	P	AIC
1 Religiousness → substance use	69.87	16	0.000	37.87
2 Religiousness → drug use as sinful and peer Religiousness → substance use	38.19	12	0.001	14.19
3 Model 2. Homogeneous religiousness factor	42.96	16	0.003	10.95
4 Model 3. Homogeneous substance use factor	48.34	18	0.001	12.34
5 Model 3. Homogeneous causal paths to substance use	44.08	19	0.009	6.08
6 Model 5. Dropping direct religiousness → substance use[a]	45.56	20	0.009	5.55

See text for a detailed description of each model; [a]Best fitting model.

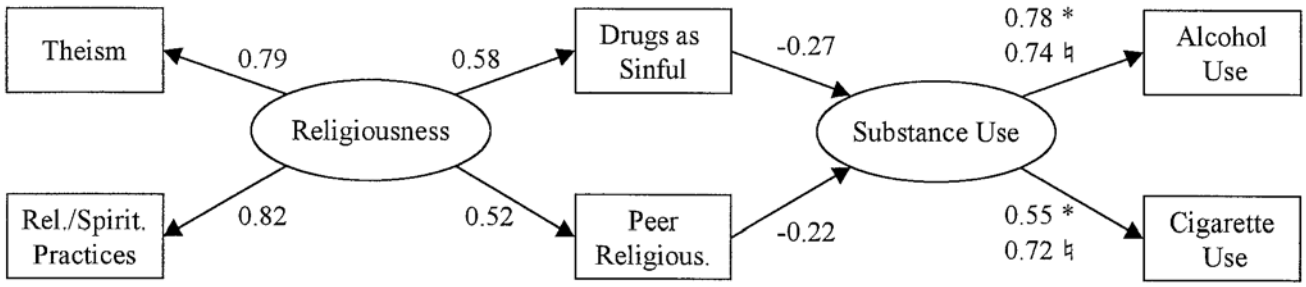
three (10.95) is lower than that of model four (12.34), model three was used for testing subsequent hypotheses.

Model five tested whether the causal paths from the adolescent religiousness, drug use as sinful, and peer religiousness variables to substance abuse differed by gender by constraining the parameters to be the same in both sexes. The difference in the two models $\Delta\chi^2(3) = 1.12$, P = 0.77) was not statistically significant, and resulted in a lower AIC. Thus, the structure of the relationship between the religiousness measures and substance use did not differ by gender in this sample. Model six tested whether the mediating role of the drug use as sinful measure and peer religiousness explained the relationship between religiousness and substance use by dropping the direct causal path between the two latent variables. The change in χ^2 (1) = 1.48, P = 0.22) was not significant, suggesting that the path was not statistically significant. Subsequent models (not shown) specified reciprocal causal paths from the substance use latent variable to the drug use as sinful and peer religiousness variables, but these paths did not result in a better fitting model.

Figure 2 presents the standardized parameter estimates from the best fitting model. The theism scale and the religious/spiritual practices inventory both loaded highly on the adolescent religiousness latent factor. Causal paths between this variable and the drug use as sinful measure and peer religiousness were quite high (0.58 and 0.52). Both of these variables were moderately negatively associated with substance use in adolescents, whereas the direct path between adolescent religiousness and substance use was not significant. The alcohol and cigarette use in the past year variables loaded highly on the substance use latent variable, although there was some variability across gender.

Discussion

This report presents preliminary analyses of the RAPI, an instrument designed to characterize the multiple dimensions of adolescent religiousness, including an exploratory factor analysis, behavior–genetic analyses, and an examination of the relationship between the dimensions of adolescent religiousness and drug and alcohol use and some of its known risk factors. An exploratory factor analysis revealed three factors: theism, religious/spiritual practices, and peer religiousness. Caution must be taken not to equate the first two dimensions with Allport's[8,64,65] concept of intrinsic and extrinsic religiousness, as these apply to individual motivation for participation in religious activities. The items assessing spirituality, as separate from belief in God, loaded on a separate factor along with participation in religious activities. Due to the scientific



Note. * Parameter estimates specifically for males.
♮ Parameter estimates specifically for females.
Error parameters for each variable have been omitted.

Figure 2 Standardized parameter estimates for the best fitting model

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goals of the MASATS, a scale measuring the extent to which adolescents believe that drug use is sinful was also included. As is found in most studies examining multiple levels of religiousness (see McCullough & Larson, this issue), the different measures of religiousness were highly inter-correlated.

Surprisingly, no gender or age differences were found in theism or religious/spiritual practices. This does not corroborate prior findings that female adolescents are more religious than males of the same age.[66] Further, females did not report greater peer religiousness than males, but males were more likely to think drug and alcohol use was sinful. Peer religiousness and the degree to which adolescents believe drug use is sinful declined in the older subgroup.

Sixteen denominations reported by the mothers were collapsed into five categories according to degree of religious fundamentalism. This schema is based on earlier analyses of adult twin data[47] on institutional conservatism. The following categories were ranked in order of theoretical decreasing conservatism: Fundamentalist Protestant, Baptist, Mainline Protestant, Roman Catholic, and no religious affiliation. A clear pattern of decreasing adolescent religiousness corresponded to these categories, although statistically significant differences were not found between every group.

The relatively small number of complete twin pairs available in this preliminary sample limited the univariate behavior-genetic analyses of the religiousness items. For most of the measures, shared environmental experiences contribute the majority of the variance. This replicates prior research which underscores the importance of the shared environment on religious behavior in adult and adolescent twins,[41] although it is difficult to compare studies due to variation in the religious measures utilized. However, a small genetic component could not be ruled out, given that the confidence intervals on the estimates were quite large. The two existing studies on adolescent religiousness likewise found small to moderate heritability estimates for religious traits, but as they did not include confidence intervals on the estimates, it is difficult to determine whether our data confirm their results. The one exception in our data relates to the peer religiousness measure in males, as a large genetic component was found for this dimension. Nonetheless, adolescent religiousness appears to be primarily influenced by environmental influences.

Correlations with the four religiousness factors revealed that adolescent religiousness was modestly to moderately inversely correlated with drug and alcohol use and other behavior problems (ie symptoms associated with conduct disorder and oppositional defiant disorder). However, current adolescent religiousness did not correlate significantly with either depressive or anxious symptoms. The religiousness factors were associated with lower levels of risk factors for drug and alcohol use, namely peer conduct problems and drug use, although the strongest negative correlation was with sensation seeking, particularly among females. The data suggest that adolescent religiousness may be a stronger protective factor for females than males for a number of high risk behaviors.

The negative relationship between the measures of adolescent religiousness and substance use corroborates the existing literature in the field.[1–5] However, the behavior genetic analyses of the adolescent religiousness measures, specifically the importance of shared environmental factors, may provide some insight into the role that these factors have in the etiology of substance use. Religiousness may be more important in protecting against initial adolescent substance use, a phenotype which is primarily influenced by shared environmental factors, than later problem drinking or substance abuse, traits which are known to have a larger genetic component.[33]

Structural equation modeling was utilized to test hypotheses about the nature of the relationship between the religious constructs and substance use. A single latent religiousness factor could not explain the relationship between the adolescent religiousness factors and substance use, a measure including alcohol and cigarette use. Subsequent models tested whether the belief that drug use was sinful and peer religiousness mediated the relationship between adolescent religiousness and substance use. The best fitting model specified a latent adolescent religiousness factor on which theism and religious/spiritual practices loaded. The influence of this variable on substance use, a latent variable including alcohol and cigarette use, was mediated by the cognition of drugs being sinful and peer religiousness. A number of different models could be fitted to the data, especially if other risk and protective factors were included, but the results encourage further research into the role of content-specific religious beliefs and the role of peer selection/peer influence to explain the mechanisms through which religiousness influences substance use.

There are a number of limitations in these analyses which must be considered. Although the current sample was drawn from a population-based registry, these findings represent only individuals who responded to initial mailings. Subjects who did not return the survey, both among mothers and adolescent twins, may differ considerably on the variables of interest from responders. The sample was also drawn from states in the southeastern United States. This is an area of high adolescent religious salience

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and participation,[67] particularly in Christian churches and households, and the results may not generalize to other geographic areas or religions.

A variety of statistical issues also necessitate caution about the adoption of any structural model. Sequential testing of several models may lead to over-interpretation of the pattern of correlations. Likewise, violations of the assumptions of multivariate normality may result in erroneous tests of significance, and treating twins as individuals in our multivariate analysis underestimates the variance of parameter estimates. Such reservations not withstanding, our preliminary analyses of data from the MASATS yield some initial insight about the role of genetic and social factors in adolescent religiousness and the role religiousness plays in risk of early substance involvement and related problems.

The results of these analyses provoke more questions than they provide answers. Based on the current results, researchers must be cautious to characterize spirituality as separate from theistic beliefs or practices in adolescents for a number of reasons. The correlations between the two measures were quite high, and the two measures exhibited the same age, gender, and denominational trends. Likewise, the pattern of genetic and environmental components of the two measures was quite similar, suggesting that there was no difference in the 'method' of transmission of these traits. Confirmatory factor analyses on larger samples will permit comparisons of how different theoretical models (eg spirituality as distinct from religious practices) fit the data.

Future multivariate behavior-genetic analyses will provide some insight into the nature of the correlations between the different factors of adolescent religiousness (eg whether the phenotypic correlations are due to the same or different genes, shared environment, or non-shared environment). Future research will also need to examine how these religious constructs affect other known risk and protective factors and where in the developmental process adolescent religiousness influences substance involvement (eg initiation versus progression). Do other shared and non-shared risk and protective factors (eg peer characteristics, family interactions, or personality constructs) mediate or moderate the relationship between religiousness or spirituality and behavior problems, such as conduct disorder and substance use?

Behavior-genetic studies provide the opportunity to characterize the role of adolescent religiousness more accurately. Further work is needed to understand how this multifaceted and pervasive societal characteristic influences the lives of children and adolescents.

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