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Longitudinal Associations Among Religiousness, Delay Discounting, and Substance Use Initiation in Early Adolescence

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Abstract

Prior research indicates that religiousness is related negatively to adolescent health risk behaviors, yet how such protective effects operate is not well understood. This study examined the longitudinal associations among organizational and personal religiousness, delay discounting, and substance use initiation (alcohol, cigarette, and marijuana use). The sample comprised 106 early adolescents (10-13 years of age, 52% female) who were not using substances at Time 1. Path analyses suggested that high levels of personal religiousness at Time 1 were related to low levels of substance use at Time 2 (2.4 years later), mediated by low levels of delay discounting. Delay discounting appears to be an important contributor to the protective effect of religiousness on the development of substance use among adolescents.

Keywords

Religiousness; Delay Discounting; Adolescent Substance Use Initiation

Adolescence is the time of greatest risk for initiation of substance use and the development of substance use problems (McCord, 1990). Adolescents' substance use represents a major public health concern because it poses a critical—and potentially preventable—risk to health and functioning. Religiousness is believed to have a beneficial effect on adolescent substance use inasmuch as adolescents with higher religiousness are less likely to use substances (Mason & Spoth, 2011). However, how these effects operate is not well understood. We proposed that the negative associations of religiousness and substance use

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initiation may occur because religiousness affects impulse control in the form of delay discounting (Carter, McCullough, Kim-Spoon, Corrales, & Blake, 2012; McCullough & Willoughby, 2009).

Delay discounting describes the process by which future reinforcers are devalued as a function of the amount of time until those rewards can be obtained and is thought to underlie some forms of impulsive decision-making (Madden & Bickel, 2010). Prior research suggests a link between delay discounting and various health risk behaviors including addictive disorders, substance use problems, and risky sexual behaviors (Bickel et al., 2010). Religion might promote willingness to forego small, short-term rewards in order to obtain larger rewards later by encouraging religious behaviors that strengthen self-regulatory abilities. Research has shown that conscientiousness, one of the Big Five personality traits, tends to be positively correlated with religiousness (McCullough & Willoughby, 2009, Saroglou, 2010). Conscientiousness involves the ability to adapt one's behavior to task demands and may have some common elements with delay of gratification (e.g., looking out for a better future outcome, resisting temptation to indulge in present pleasure). In particular, religion can foster beliefs (e.g., belief in the afterlife, belief in morally concerned supernatural watcher) that seem to reduce delay discounting (Carter, McCullough, & Carver, 2012; Norenzayan & Shariff, 2008).

Neurodevelopmental processes that underlie delay discounting seem to have implications for the development of substance use in adolescence. Neuroimaging work has suggested that the neural network sensitive to reward is stimulated by a dramatic increase in dopaminergic activity during adolescence, whereas the neural network associated with cognitive control (especially regions of the prefrontal cortex) undergoes slower change throughout adolescence and into early adulthood (Paus, 2005). These two systems appear to interact with each other to contribute to impulse control as measured by delay discounting (Bickel et al., 2007; McClure, Laibson, Loewenstein, & Cohen, 2004). In extant literature, studies on delay discounting and adolescent substance use are rare but the few available studies demonstrate that monetary discounting is associated with cigarette consumption among participants in mid-adolescence to young adulthood (Audrain-McGovern et al., 2009; Reynolds, Karraker, Horn, & Richards, 2003).

In the current study, we examined two dimensions of religiousness and expected them to be related to adolescent substance use for different reasons. Organizational religiousness represents involvement in formal religious institutions, and personal religiousness represents the importance of religious faith in the individual's life. Social control theory (Hirschi & Stark, 1969; Smith, 2003) characterizes religious communities as social networks of relationships that facilitate control of adolescents by adults who care about them and who model prosocial behavior. According to this view, organizational religiousness is expected to be related negatively to adolescent substance use by acting as a form of social control. In their reformulation of the social control theory, Gottfredson and Hirschi (1990) proposed that low self-control, and not low social control, is the root cause of delinquent behaviors. They postulated that adolescents must be taught by adults to internalize the rules and principles of their societies so that they consider the full range of consequences of their behaviors. When this socialization fails, adolescents develop preferences for smaller-sooner

rewards over larger-later rewards, which may take the form of criminal engagement and other deviant behaviors. According to this view, adolescents who internalize religious principles and regulations that become personally meaningful are likely to use them to guide thought and action.

In a more recent review, McCullough and Willoughby (2009) proposed that religiousness obtains its positive associations with health and well-being partly by fostering self-control. Similar to social control theory, they emphasized that religion influences self-control because religious communities, as moralistic audiences, make people monitor their behavior in light of relevant goals and standards (i.e., self-monitoring), thereby promoting self-control. In addition, they suggested that perceived interaction with supernatural entities fosters self-monitoring by bolstering people's awareness of their own behaviors. That is, feeling that one is being watched by God or a higher power is likely to make people more conscious of their behaviors, the possible consequences of their behaviors, and the discrepancies between their behaviors and their own goals or standards for their behaviors. Similarly, Saroglou (2011) proposed that religion promotes impersonal morality including strong self-control of impulsivity-related behaviors, which consequently benefits health and well-being. Therefore, compared to nonreligious adolescents, religious adolescents might show better impulse control that is useful for deterring risk behavior.

The current study makes several unique contributions to our understanding of protective factors for adolescent substance use. First, no systematic study has examined the role of delay discounting in the initiation of substance use among early adolescents. Most prior studies of delay discounting investigated drug dependence or addiction in adults. Second, this study is the first to examine the association between delay discounting and adolescents' initiation of substances other than cigarettes. Third, factors that influence substance use via delay discounting are not extensively known, except working memory capacity (Yi, Mitchell, & Bickel, 2010). Finally, this study is the first to systematically examine delay discounting as a mediator of the association of religiousness with substance use initiation. In particular, we used a prospective longitudinal design to test whether earlier religiousness serves as a protective factor against later substance use by reducing delay discounting. Given that individuals who use substances before age 15 are significantly more likely to have substance abuse problems as adults (e.g., Grant & Dawson, 1997), examining the roles of religiousness and delay discounting in substance use initiation in early adolescence is critical to identify variables that may enhance early preventive intervention efforts.

Method

Participants

Participants were 106 adolescents (52% female) aged 10 to 13 years at Time 1 (M = 11.59, SD = 0.70) and 12 to 14 years at Time 2 (M = 13.79, SD = 0.71). About 85% were White, 11% were African American, 2% were Hispanic, and 2% were in other ethnic groups. Families' mean annual incomes ranged from $35,000 - $49,999.

Measures

Religiousness at Time 1—Religiousness was assessed by adolescents' self-reports with six items from published measures (Fetzer & NIA, 1999; Jessor & Jessor, 1977). Organizational religiousness (α = .70) was measured with a composite calculated by averaging two items reflecting participation in organized religious activities (e.g., how often they attend religious services). Personal religiousness (α = .89) was assessed with a composite calculated by averaging four items indicating the importance of religious faith (e.g., how important they think it is "to believe in God").

Delay Discounting at Time 2—We used the Monetary Choice Questionnaire (MCQ: Kirby, Petry, & Bickel, 1999) to measure discounting of future rewards as a function of time. Each question asked the respondent to choose between a smaller, immediate reward and a larger, delayed reward. From these responses, we calculated a discounting rate (*k*), a parameter that reflected the degree to which future rewards are diminished in value as a function of the delay. The choice of smaller, sooner monetary rewards over larger, later rewards implied varying degrees of impulsivity. To make the tasks more realistic, all participants were given a 1-in-30 chance of receiving one of the rewards they chose over the 27 trials. Values for *k*, the hyperbolic control parameter, were log-transformed and averaged across small, medium, and large rewards (as in Carter, McCullough, Kim-Spoon, et al., 2012).

Substance use at Time 1 and Time 2—Adolescent substance use was a composite averaging adolescents' reports of frequencies of alcohol (beer, wine, hard liquor, or mixed drinks), cigarette, and marijuana use using a 6-point scale (1 = *never used* to 6 = *usually use every day*).

Procedure

The procedure for the original longitudinal study from which participants for the current study were drawn has been previously described (Kim-Spoon, Longo, & McCullough, 2012). Participants were recruited from Southwestern Virginia by diverse advertisement methods including flyers, recruitment letters, and e-mail distributions. Families that were interested in the study were asked to call the research office. Research assistants described the nature of the study to the interested individuals over the telephone and invited them to participate. Data collection took place at the university's offices where adolescents and their parents were interviewed by trained research assistants and received monetary compensation for participating.

The participants were invited back for a follow-up study approximately 2.4 years later. The current sample included 106 adolescents who participated in both Time 1 and Time 2. There were 52 participants who dropped out between Times 1 and 2 for reasons including: a busy schedule (n = 5), moving out of the study area (n = 6), inability to be located (n = 37), and disinterest in continuing study participation (n = 4). We performed multivariate general linear modeling (GLM) analyses to predict attrition (participated at Time 2 or not) based on demographic variables. Attrition analyses indicated that participants who did not participate in Time 2 (n = 52), compared to those who did (n = 106), were more likely to be boys (*p* = .

023), and tended to have lower family incomes ($p < .001$) at Time 1. However, our longitudinal sample had a family income level representative of the Southwestern Virginia region (including five counties and two cities; U.S. Census Bureau, 2012). No significant differences were found regarding age ($p = .509$) or ethnicity (White vs. non-White, $p = .219$). All procedures were approved by the institutional review board of the university.

Statistical Analyses

We estimated a series of path analyses using Mplus 7.0 (Muthén & Muthén, 2012) based on maximum likelihood estimation to evaluate the longitudinal associations among adolescent organizational and personal religiousness, delay discounting, and substance use. One missing datum was found in Time 2 alcohol use for one participant. We used full information maximum likelihood (FIML) methods because they allow data from all individuals regardless of their pattern of missing data and are more appropriate than other commonly used methods such as mean substitution (Arbuckle, 1996). We first fit a model where both the direct and indirect effects of religiousness on substance use were estimated. Next, we performed a nested model comparison to test whether the direct effects were not significantly different from zero. We then examined whether the hypothesized associations varied across different substances. Significance of indirect effects was tested using the bootstrapping method (Preacher & Hayes, 2008).

Results

Descriptive statistics and correlations for all study variables appear in Table 1. Adolescent substance use levels were assessed at both Times 1 and 2. However, at Time 1, no adolescent reported cigarette and marijuana use, and only three adolescents reported alcohol use. Therefore, we excluded the three participants using alcohol at Time 1 from the path analyses and tested whether delay discounting mediated the effects of religiousness on the *initiation* of substance use. Multivariate general linear modeling (GLM) analyses revealed no significant effects of demographic characteristics on the study variables, including gender ($p = .083$), ethnicity ($p = .865$), and family income ($p = .134$). Because age showed significant effects in GLM ($p = .002$), it was included in the path analysis as a covariate.

We first tested the direct effects of Time 1 organizational and personal religiousness on Time 2 substance use as well as the mediated effects via Time 2 delay discounting, which was a fully saturated model (i.e., $\chi^2 = 0$, $df = 0$). Direct effects of organizational religiousness (b* = -.16, $p = .110$) and personal religiousness (b* = .03, $p = .823$) were not significant. Fixing the direct effects of religiousness on substance use to zero did not significantly degrade the model fit ($\Delta\chi^2 = 2.46$, $\Delta df = 2$, $p = .292$), suggesting that the association between religiousness and substance use was primarily mediated through delay discounting. As Figure 1 shows, higher personal religiousness at Time 1 was associated with lower delay discounting at Time 2 (b* = −.33, $p = .002$), which in turn was related to lower substance use at Time 2 (b* = .22, $p = .018$). The indirect effect of personal religiousness on substance use through delay discounting was significant (b = −.03, $SE = .01$, $p = .016$, 95% CI [−0.050, −0.005]). Organizational religiousness was not related to delay discounting.

Results were not substantively different when cigarette, alcohol, and marijuana use were tested separately.

Discussion

Understanding the developmental processes by which protective factors influence adolescent substance use is vital for prevention and intervention efforts. To better understand how adolescent religiousness may exert its protective effects on substance use, we examined whether religiousness and delay discounting jointly predicted substance use initiation among early adolescents. We hypothesized that religiousness fostered impulse control so that religious adolescents were more likely to be willing to delay gratification and consequently, refrain from substance use to a greater extent than their less religious peers. Our data indicated that early adolescents who were low in personal religiousness showed high delay discounting later, which in turn explained why adolescents low in personal religiousness tended to increase their substance use. For all three substances individually, as well as their composite, the protective effects of religiousness on substance use were mediated through low delay discounting. Taken together, the current results extend prior research that is consistent with the claim that religiousness has protective effects against adolescent risky behaviors through promoting self-control (Walker, Ainette, Wills, & Mendoza, 2007). One caveat is that although the direct effect of personal religiousness on adolescent substance use was not statistically significant, this finding does not necessarily suggest that the association between personal religiousness and substance use was fully or solely mediated by delay discounting.

Although both organizational and personal religiousness showed significant longitudinal correlations with substance use, our path analyses revealed that only personal religiousness was related to delay discounting over time, which in turn was predictive of substance use. In extant literature, the effects of organizational religiousness on substance use have been more frequently documented than the effects of personal religiousness (Chitwood, Weiss, & Leukefeld, 2008), which may be in part due to the fact that organizational religiousness was the most frequently utilized dimension of religiousness. Prior research examining independent effects of organizational and personal religiousness found that personal religiousness, but not organizational religiousness, was related to adolescent substance use (Walker et al., 2007). In this study, organizational and personal religiousness were examined in separate analyses; thus it is possible that the significant effects of personal religiousness were partially due to shared variance with organizational religiousness. In the current analyses, we examined *relative* effects of organizational and personal religiousness on adolescent substance use (i.e., while statistically controlling for the other dimension's effects).

Our finding indicated that personal beliefs instead of behavioral or ritualistic manifestations of religiousness were influential for promoting delay of gratification among adolescents. More specifically, consistent with the viewpoint emphasizing self-control (rather than social control) in the protective effects of religiousness (Gottfredson & Hirschi, 1990), adolescents who internalized religious beliefs in a personally meaningful way showed better impulse control over time. This improved impulse control was not observed for adolescents who

reported frequent involvement in organized religious activities. It is plausible that participation in religious services and activities may reflect more extrinsically motivated behaviors among adolescents in this developmental period (e.g., conforming to parental expectations or pursuing social opportunities). Therefore, it was not surprising that adolescents' organizational religiousness was not significantly associated with their self-regulatory abilities. Indeed, it has been suggested that religion may foster implicit self-regulation that is flexible, efficient, and largely unconscious, particularly among people who fully internalize their religion's standards (Koole, McCullough, Kuhl, & Roelofsma, 2010).

Furthermore, our finding regarding the role of delay discounting suggests that the development of temporal decision making processes may have implications for adolescent substance use. Empirical evidence from neuroimaging studies indicated that a cognitive control network interacts with the valuation of rewards to determine impulse control shown in delay discounting, and also that this cognitive control network is under-developed during adolescence (Bickel et al., 2007; Casey, Getz, & Galvan, 2008). Our data demonstrated that there were significant individual differences in delay discounting among early adolescents that were predictive of initiation and increases in substance use, and adolescent personal religiousness appeared to be a significant contributor influencing the development of delay discounting. Although the amount of variance in adolescent substance use explained by religiousness and delay discounting was relatively small (6%, see Figure 1), it should be noted, of course, that there are many risk and protective factors that determine substance use initiation. Furthermore, it has been suggested that statistical significance (e.g., effect size) does not indicate clinical meaningfulness, and even small effect sizes are important if they have clear implications for significant theoretical and practical issues (Abelson, 1995).

The current sample has some strengths as well as limitations. We examined relatively young adolescents, which may be a unique contribution to the field given the lack of knowledge regarding the roles of religiousness and delay discounting in early adolescence. The composition of the current sample was typical of the Appalachian (Southwestern Virginia) region. The study of adolescents from this region is important because they are from an understudied rural area. Moreover, some research suggests higher prevalence of drug abuse in this area compared to the national average (Appalachian Regional Commission, 2010). Nevertheless, generalizability of the findings to more culturally and ethnically diverse population awaits further study. Additionally, the small sample size precluded us from using latent factors for the study constructs, which could have provided increased construct validity by reducing measurement errors.

Another limitation of the current study is that we measured religiousness only in the two dimensions of organizational and personal religiousness. Future investigations should consider involving additional dimensions (e.g., God concept, religious practices such as prayer and meditation, religious social support) to represent the multifaceted construct of religiousness in a more comprehensive fashion. In addition, we used the MCQ (Kirby et al., 1999) to measure discounting of future monetary rewards as a function of time. Monetary rewards were used because of their nearly universal appeal and likely commensurability across participants (Kirby et al., 1999), and delay discounting measured by the MCQ has been shown to be stable enough to predict future behavior including substance use (Kirby,

2009). Even so, future studies are needed to investigate whether adolescents' discount rates may vary depending on the choice of rewards or across different situational contexts. Finally, our longitudinal design was limited by using only two-wave data, which could contribute to bias in estimating mediation effects (Cole & Maxwell, 2003). It is also important to note that causality in relations could not be verified in our model. The mediation effects found in this study warrant further replications using multiple-wave data.

The results contribute to expanding knowledge regarding the association between religiousness and health by illustrating that religious adolescents show a stronger preference for later, larger rewards than do their less religious counterparts and that such enhanced delay discounting abilities appear to deter their engagement in substance use. The findings also have important implications for preventive intervention against adolescent substance use. Given that early onset of substance use is a significant predictor of drug-related problems later in development, our findings provide preliminary evidence suggesting that prevention efforts that involve personal religiousness and delay discounting may be particularly beneficial. Our findings related to personal religiousness support prior research suggesting the important role of personal religiousness in abstinence and recovery from substance use problems (Benda & McGovern, 2006). Our results further suggest that delay discounting could serve as a mediating process through which personal religiousness exerts protective effects on the development of substance use in adolescence. Acknowledging the significance of personal religiousness may facilitate the effectiveness of prevention and intervention programs by strengthening adolescents' abilities to resist temptation to engage in substance use. Additionally, delay discounting can be targeted as a behavioral process that can be modified (for example, through working memory training as shown by Bickel, Yi, Landes, Hill, & Baxter, 2011) so that adolescent substance users can learn to value delayed (abstinence-related) rewards.

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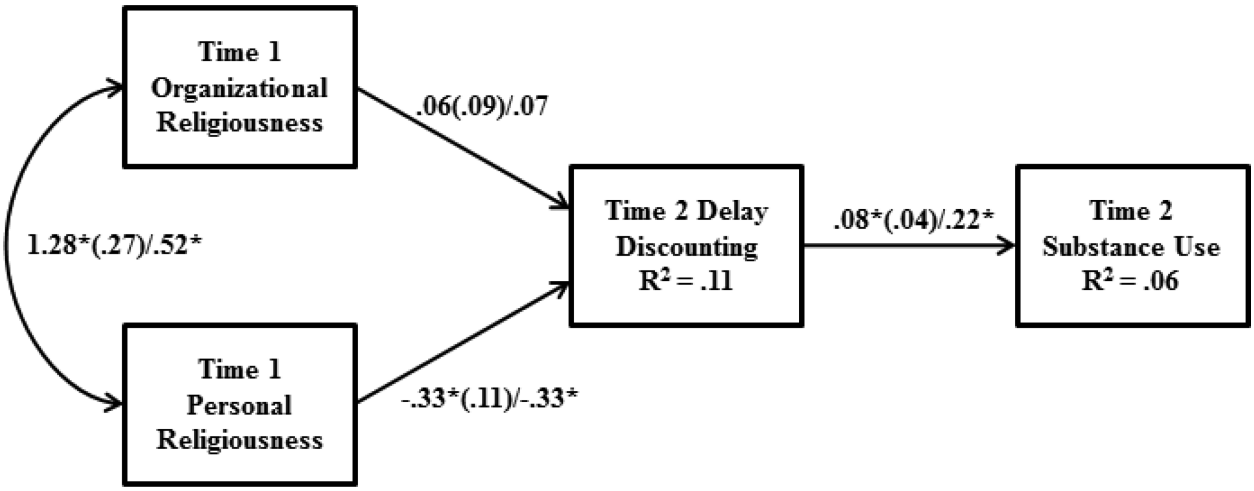

Figure 1.

Summarized model fitting results of the associations among adolescent religiousness, delay discounting, and substance use.

Note. Model fit: $\chi^2 = 2.49$, $df = 2$, $p = .288$, RMSEA = .05, CFI = .97. Unstandardized parameter estimates (SE)/Standardized parameter estimates are presented. For clarity of presentation, coefficients related to the age covariate are not shown: age ↔ organizational religiousness = −.26*(.12)/−.21*, $p = .034$; age ↔ personal religiousness = −.29*(.10)/−.29*, $p = .004$; age → delay discounting = −.51*(.20)/−.25*, $p = .009$; and age → time 2 substance use = .12(.07)/.16, $p = .096$.

* $p < .05$.

Table 1

Descriptive Statistics and Bivariate Correlations of Adolescent Religiousness, Delay Discounting, and Substance Use

	Variables	1	2	3	4	5	6	*M (SD)*
1.	Time 1 Organizational Religiousness							3.67 (1.35)
2.	Time 1 Personal Religiousness	.57**						3.15 (0.75)
3.	Time 2 Delay Discounting (*k*)	−.06	.24**					−4.94 (1.44)
4.	Time 2 Alcohol Use	−.20*	−.30**	.22**				1.51 (0.83)
5.	Time 2 Cigarette Use	−.18*	−.19*	.22*	.70**			1.20 (0.54)
6.	Time 2 Marijuana Use	−.31**	−.20*	.20*	.45**	.63**		1.22 (0.83)
7.	Time 2 Substance Use	−.28**	−.28**	.25**	.85**	.88**	.82**	1.31 (0.62)

* $p < .01$ (one-tailed)

** $p < .05$ (one-tailed).