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Predicting substance use behavior among South African adolescents: The role of leisure experiences across time

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Abstract

Using seven waves of data, collected twice a year from the 8th through the 11th grades in a low-resource community in Cape Town, South Africa, we aimed to describe the developmental trends in three specific leisure experiences (leisure boredom, new leisure interests, and healthy leisure) and substance use (cigarettes, alcohol, and marijuana) behaviors and to investigate the ways in which changes in leisure experiences predict changes in substance use behaviors over time. Results indicated that adolescents' substance use increased significantly across adolescence, but that leisure experiences remained fairly stable over time. We also found that adolescent leisure experiences predicted baseline substance use and that changes in leisure experiences predicted changes in substance use behaviors over time, with leisure boredom emerging as the most consistent and strongest predictor of alcohol, cigarette, and marijuana use. Implications for interventions that target time use and leisure experiences are discussed.

Keywords

adolescence; boredom; leisure; South Africa; substance use; time use

A significant body of research supports the case that adolescents have a heightened inclination to take risks (e.g., Chassin, Hussong, & Beltran, 2009; Farrington, 2003; Simons-Morton, Lerner, & Singer, 2005; Steinberg, 2008). There are ongoing debates in the literature about the likely causes of this increased risk. However, the neuroscience perspective (e.g., Casey, Getz, & Galvan, 2008), psychosocial theory (e.g., Erikson, 1968), and social and environmental theories of risk taking (Haugaard, 2001) all clearly suggest that adolescents seek out experiences that provide experimentation, sensation, novelty, and optimal experience. Studies that have explored adolescent experiences across different settings indicate that, compared to other daily-life settings, the leisure context offers a unique setting that can facilitate optimal experience (Coatsworth, Palen, Sharp, & Ferrer-Wreder, 2006; Dworkin, Larson, & Hansen, 2003; Hunter & Csikszentmihalyi, 2003; Larson, 2000). Likewise, positive leisure activities may decrease adolescents' need to seek these experiences in more risky behaviors like substance use (Caldwell & Darling, 1999; Caldwell & Smith, 2006). In the current study, we examined the longitudinal associations

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among key leisure experiences (leisure boredom, new leisure interests, and healthy leisure) and the substance use behaviors of a cohort of South African youth living in a low-resource, high-risk environment.

Little research has been done on the leisure experiences of adolescents in developing countries. The degree of opportunity and risk in an adolescent's life varies across contexts and societies. Understanding the associations between leisure experiences and risk behaviors may be particularly important in developing countries like South Africa, where there is increasing concern about adolescent risk (Flisher, Mathews, Mukoma, Ahmed, & Lombard, 2006; Parry et al., 2004; Reddy, Resnicow, Omardien, & Kambaran, 2007) coupled with evidence of relatively high numbers of unoccupied hours in adolescents' daily lives (Kingdon & Knight, 2004; Wegner & Magner, 2002). Results from this study can inform prevention and intervention programming targeting the leisure context.

Defining leisure

The leisure context has been described as a critical "fourth environment" for adolescents beyond home, school, and work (Caldwell, Smith, Shaw, & Kleiber, 1994; Silbereisen & Todt, 1994). This "fourth environment" has been identified by theory and empirical evidence as a unique developmental context where adolescents are more likely to participate in exploratory behaviors, novel experiences, and sensation seeking than in other environments (Hunter & Csikszentmihalyi, 2003; Kleiber, 1999; Larson, 2000; Silbereisen & Todt, 1994). Interest in leisure has increased with the growth of the Positive Youth Development (PYD) framework, which highlights person-in-context experiences that encourage health, wellness, and thriving, while buffering against participation in risk behaviors (Damon, 2004; Lerner, 2004). Studies in adolescent leisure have confirmed that leisure experiences are associated with a variety of indicators of positive development (Caldwell & Baldwin, 2003; Mahoney, Larson, & Eccles, 2005; Wilson, Gottfredson, Cross, Rorie, & Connell, 2010). However, exploration of this literature reveals that leisure has been defined in several different ways: free time use, activity participation, and subjective experience (Kleiber, 1999). Each of these conceptualizations has strengths and has contributed to understanding youth experiences in this "fourth environment."

The first definition we will explore is free time or any time that is spent outside of school and work. Studies from this perspective have contributed to an understanding of how youth spend their free time, differences and similarities in free-time use across cultures and sexes, and opportunities and risks associated with different free-time uses (e.g., Larson & Verma, 1999; Verma & Larson, 2003). One limitation of this conceptualization of leisure is that it includes both activities that are freely chosen and obligatory activities (e.g., house cleaning, taking care of siblings). Thus, in this definition there are some free-time activities that are not "leisurely," but are done in the space of unobligated time and likely do not offer the same kinds of developmental benefits (Csikszentmihalyi & Kleiber, 1991).

Second, leisure has been defined as participation in activities such as school clubs or organized sports. Even within this literature, there is disagreement about how to operationalize "activities" (see Busseri & Rose-Krasnor, 2010). Research from this perspective has focused mainly on youth involvement in school-based extracurricular activities or structured community activities, and excluded things like hobbies and social activities. This body of work indicates significant associations among involvement in organized activities and academic achievement, educational attainment, behavior, substance use, and school dropout (e.g.,Mahoney et al., 2005). This area of research has also explored both program characteristics and individual characteristics as mechanisms linking participation to outcomes (e.g., Eccles, Barber, Stone, & Hunt, 2003). One limitation of this

approach is that most research suggests that only about one-third of adolescents participate in structured, extracurricular activities (Carnegie Council on Adolescent Development, 1992; Larson & Verma, 1999). Therefore, focusing exclusively on this type of leisure may neglect a broader range of activities and experiences in leisure that may facilitate growth and reduce risk.

Finally, leisure has been conceptualized as experience. Leisure scholars have traditionally defined leisure based solely on the subjective perspectives and experiences of the individual (e.g., Kleiber, 1999). In this case, leisure is defined as any experience, outside of work and school, that is viewed by an individual as freely chosen and done for its own sake (i.e., interest, enjoyment, or personal goal; Caldwell & Smith, 2006; Csikszentmihalyi & Kleiber, 1991). Leisure scholars have written about an "activity bias" and argued that the positive value of unstructured activities has been underresearched; some argue that organized activities could actually undermine intrinsic motivation and self-expression (Caldwell & Smith, 2006; Kleiber, 1999). Defining leisure by one's subjective experience can be problematic because activities such as drug use or vandalism may be considered leisure if the individual engaging in them defines them as such. However, studies of subjective experiences in leisure activities have generally found that risky activities during leisure are associated with experiences of boredom and disengagement and not interest, pleasure, or expressiveness (Sharp, Coatsworth, Darling, Cumsille, & Ranieri, 2007; The National Center on Addiction and Substance Abuse, 2003). Further, leisure scholars have hypothesized that adolescents are more likely to use substances in leisure when their leisure experiences are not satisfying their developmental need for optimal arousal and interest (Iso-Ahola & Crowley, 1991; Iso-Ahola & Weissinger, 1990; Kleiber, 1999).

Linking leisure experiences to substance use behaviors

In this study, we focused on three specific subjective experiences in leisure: leisure boredom, new leisure interests, and healthy leisure. Leisure boredom and new leisure interests map well onto the broader experiences of optimal sensation and novelty that adolescents are thought to seek during this transitional stage of life (Lerner & Steinberg, 2009). Experiencing leisure as being healthy was included in order to explore whether perceptions of health associated with leisure would protect against engagement in substance use.

Developmental neuroscience offers a theoretical foundation explaining the adolescent quest for optimal sensations and novelty (Dahl, 2004; Steinberg, 2008). In recent years, research on the adolescent brain has suggested that due to rapid changes in the emotional and regulatory controls of the brain, adolescents, more than other age groups, are biologically driven to seek out novelty, heightened sensations, and immediate rewards (Dahl, 2004; Steinberg, 2008). This perspective suggests that adolescents may be more likely to engage in risk-taking behaviors like substance use if they are not having new experiences, developing new interests, or feeling optimal sensations. This theoretical notion has gained some support from empirical work on leisure boredom. For example, research has labeled boredom as one of the "triple threats" of substance use (The National Center of Addiction and Substance Abuse, 2003), and studies focused on adolescent leisure have found that youth who experience leisure boredom are at a higher risk for delinquency, smoking, drinking, and drug use (Caldwell & Smith, 1995; Gordon & Caltabiano, 1996; Wegner & Flisher, 2009). The evidence suggests that the combination of leisure boredom along with developmentally appropriate novelty and sensation seeking contributes to adolescent substance use.

In addition to the neuroscience perspective, Erikson's (1968) theory of psychosocial development places identity formation as the central developmental task of adolescence.

Adolescents begin developing their identities by exploring new activities and interests. The leisure context is an ideal setting for novelty and exploratory behavior because it is here that adolescents can try new things and experiment with new interests (Dworkin et al., 2003; Kleiber, 1999). The goal of this kind of exploration and experimentation is for adolescents to begin to understand their unique qualities, abilities, interests, and beliefs (Waterman, 2004). Theoretical and empirical analysis argues that trying new activities and exploring new interests will contribute to a greater sense of personal identity that can help adolescents make better decisions, stave off peer pressure, and protect against delinquency and substance use (Adams & Marshall, 1996; Adams, Munro, Munro, Doherty-Poirer, & Edwards, 2005; Schwartz, Zamboanga, Weisskirch, & Rodriguez, 2009). Although identity formation becomes more salient as adolescents get older, and leisure experiences seem to facilitate the process, researchers have found that youth report less engagement in new interests and activities during leisure as they get older (Hunter & Csikszentmihalyi, 2003; Sharp, Caldwell, Graham, & Ridenour, 2006; Verma & Larson, 2003).

Given the increased media and curricular attention to improving health and well-being, and the potential role it might play as a protective factor, we also included healthy leisure as a construct in our study. From a curricular perspective, one set of standards mandated from the South Africa Department of Education includes “Health, Safety, and Physical Education.” These standards include targets such as knowing age appropriate drug information, and identifying health problems that can occur through life and describing ways to prevent them. The health, safety, and physical education standards also promote students’ understanding of the way healthy lifestyles and physical activity contribute to healthy development. Given the potential role leisure can play in healthy development, or in risk behavior, the healthy-leisure items were included to capture the health promotion and risk reduction aspects of leisure engagement. The healthy-leisure construct focused on experiencing leisure as personally “good” and “healthy.” Thus, students’ perceptions that their personal leisure is healthy may contribute to lower levels of substance use.

Current study

The primary aim of the current study was to examine longitudinal associations between three adolescent leisure experiences (leisure boredom, new leisure interests, and healthy leisure) and substance use behaviors. This study used seven waves of data collected across eighth and eleventh grades from a large cohort of adolescents living in a low-resource community in Cape Town, South Africa. Based on the literature, we tested the following hypotheses: (a) alcohol, cigarette, and marijuana use would increase significantly across time; (b) leisure boredom would increase across adolescence, while new leisure interests and healthy leisure would decrease; (c) leisure boredom would be positively related and new leisure interests and healthy leisure would be negatively related to substance use behaviors; and (d) changes in leisure experiences would predict significant changes in substance use behaviors over time, with increases in leisure boredom predicting substance use and increases in new leisure interests and healthy leisure predicting decreases in use. Although the existing literature did not support specific hypotheses, we were also interested in understanding whether one of these leisure experiences would emerge as a stronger and/or more consistent predictor of adolescent substance use behaviors over time.

Method

Participants—Data were drawn from a larger study (see Caldwell, Smith, et al., 2004) that involved four intervention and five control high schools in the Mitchell’s Plain area of Cape Town, South Africa. Mitchell’s Plain is a low-income, predominantly Coloured1 township established during the apartheid era. The goal in selecting schools was to choose from a pool that represented “adequately functioning” schools in the area, in order to increase the

potential for study completion and research fidelity. When the study was developed, there were 16 high schools in Mitchell's Plain, and we identified 12 schools that had adequate levels of functioning; from those 12 schools, four were randomly selected for the Health-Wise intervention treatment group and five were randomly selected for the control group. The present sample is limited to the no-treatment control group (N = 1,118) because we did not aim to test the effects of the intervention in this study. At baseline, 49% of the participants were male. Most participants identified themselves as Coloured (90%), with the remaining students identifying as Black (6%) or White (4%). Although data on socioeconomic status were not collected, socioeconomic indictors for Mitchell's Plain reveal that 44% of households earn approximately US$1,900 (R19,200) or less annually, and 39% of economically active adults are unemployed (Statistics South Africa, 2001).

The study was approved by the Institutional Review Boards of the universities affiliated with this study and by the participating schools. Passive parental consent and adolescent assent procedures were used. Assessments were conducted at the beginning and end of each school year, starting in the eighth grade (M age = 13.98). Seven waves of data were included in the analyses for the current paper. Questionnaires were administered using personal digital assistants (PDAs) during school hours.

Measures

Outcome variables—We examined three outcome variables: past 4 week alcohol, cigarette, and marijuana use. At each assessment, participants were asked if they had used each substance in their lifetime. Participants who indicated that they had used alcohol, cigarettes, or marijuana in their lifetime were presented with a follow-up question asking whether they had used each substance (yes/no) in the four weeks preceding the current assessment. We chose to use the past four-week use variables rather than the lifetime use variables in this study because our main interest was in predicting *changes* in substance use behaviors over time associated with changes in leisure experiences. Patterns of missingness across the substance use variables ranging from 9% at Wave 1 to 52% at Wave 7.

Leisure experience variables—Three leisure experiences - leisure boredom, new leisure interests, and healthy leisure—were assessed using subscales of the Leisure Experience Battery for Adolescents (Caldwell & Weissinger, 1992). The item responses were measured on a 5-point Likert-type scale (0 = *strongly disagree* to 4 = *strongly agree*). *Leisure boredom* was constructed from the mean of three items ("Free time is boring," "Free time drags on and on," and "I usually don't like what I'm doing in my free time, but I don't know what else to do"), α = .60, and confidence intervals (CI; Maydeu-Olivares, Coffman, & Hartmann, 2007) were .56–.64. *New leisure interests* was constructed as the mean of four items beginning with "In the last six months …" (" …I learned a new activity," " …I developed an interest in a new activity that I do on a regular basis," " …I made a new friend through my free-time activities," and " …I developed a new hobby," α = .74, CI = .71–.76). *Healthy leisure* was constructed as the mean of four items ("The things that I do in my free time are healthy," "I get a lot of benefits [good things] from my free-time activities," "I feel good about myself in my free time," and "Having healthy free-time activities helps me avoid risk behavior," α = .73, CI = .70 –.76). If a participant did not respond to an item in the subscale, the participant's composite variable was created as the mean of the non-missing items. Patterns of missing data for the leisure variables ranged from 8% at Wave 1 to 49% at Wave 7.

[1]The Population Registration Act of 1950, which was repealed in 1991, divided South Africa's population into Black, White, Indian, and Coloured (derived from Asian, European, Khoisan, and African ancestry). The term Coloured referred to an ethnic group of mixed-race people who possess some sub-Saharan African ancestry, but not enough to be considered Black under South African law.

Analysis—We fit generalized linear mixed-effects models for binary outcomes 2 as implemented in SAS PROC NLMIXED to examine the relationship between leisure experiences and adolescent substance use, and whether changes in leisure experiences predicted changes in substance use behaviors over time. We obtained starting values for the fixed effects from a logistic regression analysis based on Hedeker and Gibbons (2006). For the random effects, we used multiple starting values from a range of reasonable values. Individuals were included in the analysis if they had a response on the outcome variable for *at least one* measurement occasion. The full information maximum-likelihood estimation procedure used for fitting the models allowed for missing data in the outcome variables under the assumption that it is missing at random (MAR; Little & Rubin, 2002). An advantage of a mixed-effects model using full information maximum likelihood is that it uses all observed data and only excludes individuals if they do not have data at any of the measurement occasions.

The random effect part of the generalized linear mixed-effects model represents the correlation among observations within an individual, and the estimate of variance of the random intercept which provides a summary of the degree of heterogeneity in the population. Because this is a conditional model, the interpretation of the fixed effects is subject specific, not population averaged (Fitzmaurice, Laird, & Ware, 2004; Hedeker & Gibbons, 2006). For each outcome variable (alcohol, cigarettes, and marijuana), we began by fitting a model in which time was the only predictor. We then fit a model with time and dummy-coded school variables, which were included because the students were nested within schools. It is currently not possible to estimate a three-level model in SAS PROC NLMIXED, and we were interested only in the individual level, not the school level. For each outcome, the dummy-coded school variables were significant; therefore, we included them as covariates in all final models. All models also included a random subject effect3 that accounted for individual variability in the outcome variables at baseline.

The primary goal of longitudinal analysis is to examine within-subject changes over time separately from between-subject effects (i.e., heterogeneity in the way individuals change over time). When there are no missing data, differences in the mean response over time measure the within-subject change over time. However, when data are missing, changes in the mean response over time may reflect attrition rather than within-subject change. To avoid confounding within- and between-subject effects, we estimated models that included separate parameters representing the within- and between-subject effects. Because the leisure experience variables were time-varying covariates (i.e., the values of these covariates can change over time for a given individual) and we wanted to separately assess the within- and between-subject effects of the leisure covariates, we included two covariates for each leisure experience variable in the models. One of the covariates was a time invariant covariate for the leisure experience variables at baseline, which accounts for individual differences at baseline. The second covariate was a time-varying covariate for the leisure experiences that was the difference between the baseline value and the value on the leisure variables at each specific time point. This covariate assesses the within-subject effects of the leisure experience variables (see Fitzmaurice et al., 2004; Hedeker & Gibbons, 2006; Singer & Willett, 2003, for details). In addition, we included the interaction between the time-varying leisure experience covariate and time in each of the models, but it was not significant in any of the models. This indicates that the effect of the time-varying leisure experience covariate on substance use did not change over time. Each of the leisure

[2]These models were fit using marginal maximum-likelihood estimation and Gauss-Hermite adaptive quadrature as recommended by Fitzmaurice et al. (2004). We used 25 quadrature points as recommended.

[3]Including a random effect for slope, along with the intercept, was attempted in models but was not significant.

experience variables was examined separately; there were three models for each outcome variable.

Results

Developmental trends in substance use and leisure experiences

The observed proportions, odds, and logits of past 4 week alcohol, cigarette, and marijuana use across the seven waves of data for males and females are shown in Table 1. Time was a significant predictor: with each new wave of data collection, the odds of using alcohol in the past 4 weeks increased by 32% (CI: 27–39%), the odds of using cigarettes in the past 4 weeks increased by 65% (CI: 57–73%), and the odds of using marijuana in the past 4 weeks increased by 45%(CI: 38–52%). Males and females did not differ in rates of alcohol or cigarette use at baseline, but females were 59% (CI: 37–74%) less likely than males to have used marijuana in the previous 4 weeks at baseline. We also examined gender by time interactions and found that for each unit increase in time females were 11% (CI: 01–21%) more likely than males to have smoked cigarettes in the past 4 weeks. Gender by time interactions and gender were included as covariates in our generalized linear mixed-effects models.

Descriptive statistics for the three leisure experience variables (leisure boredom, new leisure interests, and healthy leisure) are provided in Table 2. ANOVA was used to examine whether there were significant differences in adolescent leisure experiences across the seven waves of data. Contrary to our expectations, the means for leisure boredom ($F(6, 5444 = 1.87$, $p = .08$), healthy leisure, ($F(6, 5453) = 1.63$, $p = .14$) and new leisure interests ($F(6, 5441) = 1.15$, $p = .33$) were not significantly different across the seven waves of data. Correlations among the leisure experience variables at Wave 1 are provided in Table 3. Leisure boredom was not significantly correlated with new leisure interests or healthy leisure. New leisure interests and healthy leisure were significantly and positively correlated ($r = .47$, $p < .001$). The patterns of correlations were similar across the seven waves of data.

Associations between leisure experiences and substance use

Findings are presented separately for each leisure experience variable, and a summary of these results are provided in Tables 4 and 5.

Leisure boredom—There were significant between- and within-subject effects for leisure boredom on alcohol, cigarette, and marijuana use. The between-subject component revealed that each unit increase in boredom at baseline was associated with a 21% (CI: 6–36%) increase in the likelihood of having used alcohol in the previous 4 weeks, a 62% (CI: 28–100%) increase in the likelihood of having used cigarettes in the previous 4 weeks, and a 55% (CI: 30–86%) increase in the likelihood of having used marijuana in the previous 4 weeks. Thus, controlling for all other effects (i.e., gender, gender by time, school, and random effects), those with a higher initial level of leisure boredom were significantly more likely to have used alcohol, cigarettes, and marijuana in the previous 4 weeks. The within-subject component revealed that a 1-unit increase in boredom for an individual relative to baseline (i.e., over time) was associated with a 14% (CI: 3–25%) increase in the likelihood of having used alcohol in the past month, a 23% (CI: 9–38%) increase in the likelihood of having used cigarettes in the past month, and a 36% (CI: 21–54%) increase in the likelihood of having used marijuana in the past month.

New leisure interests—There was a significant between-subject effect but no significant within-subject effect for new leisure interests in predicting marijuana use. The between-subject component revealed that each unit increase in new interests in leisure at baseline was

associated with a 20% (CI: 2–34%) decrease in the likelihood of having used marijuana in the previous 4 weeks. There were no significant between- or within-subject effects for alcohol or cigarette use.

Healthy leisure—The between-subject component for healthy leisure revealed that each unit increase in healthy leisure at baseline was associated with a 22% (CI: 9–33%) decrease in the likelihood of having used alcohol in the previous 4 weeks and a 40% (CI: 26–51%) decrease in the likelihood of having used marijuana in the previous 4 weeks. There was not a significant association between healthy leisure and using cigarettes in the past 4 weeks at baseline. The within-subject component revealed that a 1-unit increase in healthy leisure for an individual over time was associated with a 17% (CI: 7–27%) decrease in the likelihood of having used alcohol in the previous 4 weeks, a 24% (CI: 12–34%) decrease in the likelihood of having used cigarettes in the previous 4 weeks, and a 35% (CI: 24–43%) decrease in the likelihood of having used marijuana in the previous 4 weeks.

Discussion

Adolescence is a developmental period that is associated with a heightened inclination to take risks (Dahl, 2004; Steinberg, 2008). Several theoretical perspectives and empirical studies suggest that this is likely normative and developmentally linked to an increased need for exploration, novelty, and optimal sensation during this transitional period (Casey et al., 2008; Erikson, 1968; Haugaard, 2001). Our primary aim was to investigate the longitudinal relations between substance use and leisure experiences of boredom (the opposite of optimal sensation), new interests, and healthy leisure among a large cohort of South African adolescents. We were also interested in exploring the developmental trends in substance use behaviors and leisure experiences across adolescence.

Patterns of substance use highlight the increasing number of adolescents using alcohol, cigarettes, and marijuana in this South African community. Not surprisingly, substance use increased significantly with each measurement time point from the beginning of the eighth grade to the beginning of the eleventh grade. By eleventh grade, 64% of males and 58% of females reported having drunk alcohol in the previous 4 weeks, which is a higher percentage than reported in previous research in South Africa (Flisher et al., 2006; Flisher, Parry, Evans, Muller, & Lombard, 2003; Reddy et al., 2007). The higher prevalence of alcohol use in our study is likely due to our focus on Mitchell's Plain, a low-resource, high-risk community in South Africa. The number of youth in our study who reported smoking in the previous 4 weeks was substantial: 25% in eighth grade and over 40% in eleventh grade. While they are still cause for concern, rates of marijuana use were much lower than alcohol and cigarette use, particularly for females. By the eleventh grade, over one-fourth of male adolescents reported having used marijuana in the previous 4 weeks. The health, financial, and psychosocial consequences of using alcohol, cigarettes, and marijuana can be particularly serious for youth in high-risk settings. For example, studies suggest that substance use increases the likelihood that South African youth will engage in risky sexual practices (King et al., 2004; Palen, Smith, Flisher, Caldwell, & Mpofu, 2006), which could put a young person at risk for an unplanned pregnancy or contracting HIV.

Contrary to our expectations and previous research on leisure boredom conducted in the United States (Hunter & Csikszentmihalyi, 2003; Sharp et al., 2006), leisure experiences remained fairly stable over time in our study. Wegner, Flisher, Muller, and Lombard (2006) conducted a cross-sectional study of leisure boredom in a South African sample and found only a marginally significant difference between reports of leisure boredom by eighth-grade South African students, compared to eleventh-grade students; the higher mean was reported by the eighth graders. These contradictory findings across samples illustrate that

developmental context plays an important role in shaping expectations, choice, and opportunities around leisure. Verma and Larson (2003) suggest that diverse cultural values and practices create distinct patterns of adolescent leisure. However, little work has been done on leisure experiences in developing countries like South Africa. Stability in leisure experiences over time in this sample may be viewed as a positive finding, suggesting that the quality of youths' leisure experiences did not decline with age. However, this stability could also be interpreted more negatively, suggesting that adolescents living in this kind of low-resource community lack opportunity to opt in and out of activities and engage in varied experiences over time. Future work is needed to understand the ecological influences on leisure in this setting.

Our primary goal in this study was to investigate the association between leisure experiences and substance use; in particular, we were interested in how changes in leisure experiences over time influence adolescent substance use behaviors. Results from our mixed models suggest that adolescents who reported higher levels of leisure boredom in the beginning of eighth grade were also significantly more likely to report using substances at that time, while adolescents who reported greater participation in healthy-leisure activities were less likely to drink or smoke marijuana. Greater participation in new leisure interests during free time was associated with a decreased likelihood of using marijuana but had little impact on alcohol and cigarette use.

Over time, the likelihood of using all three substances—alcohol, cigarettes, and marijuana—in the previous 4 weeks was predicted by changes in adolescents' subjective experiences of leisure boredom and healthy leisure. The strength of these findings is compelling. For example, a 1-unit increase in leisure boredom over time increased the likelihood of using marijuana by 36%, while a 1-unit increase in healthy-leisure experiences decreased the likelihood of using marijuana by 35%. Contrary to expectations, establishing a new leisure interest did not have a significant impact on substance use behaviors over time. This may have to do with the relative lack of variability in new leisure interests due to limited resources in this geographic area.

Our study focused on three specific aspects of leisure experiences that appear to be associated with substance use. Theory and research on the key developmental tasks of adolescence can begin to explain why leisure boredom, new leisure interests, and healthy leisure would influence the choices adolescents make about substance use. Adolescents are faced with the challenge of identifying their unique interests, strengths, and abilities as part of the process of identity formation. Leisure is a distinct context for youth to tackle this task; however, adolescents who are bored, missing out on exploring new interests and activities, or using their leisure to engage in unhealthy activities seem to be more prone to substance use (Adams et al., 2005; Erikson, 1968; Kleiber, 1999). Additionally, developmental neuroscience has highlighted the biological tendency for youth to seek novelty, immediate gratification, and optimal engagement (Dahl, 2004; Steinberg, 2008). It seems that when youth are interested (i.e., not bored), engaged in new interests and activities, and taking healthy risks during leisure they are protected against using substances to meet these developmentally normative needs. Future research will be important in exploring plausible mechanisms (e.g., self-determination, initiative, bonding with social institutions, and establishing peer and adult relationships) that may link leisure experiences to substance avoidance behaviors, and help us understand the relative effect of the kinds of subjective experiences measured in the current study.

With the expansion of neuroscience perspectives and methods in developmental research, future efforts could also be made to connect adolescent leisure experiences with brain maturation and functioning. This kind of work would be particularly useful in supporting or

refuting the theoretical notion that interesting and engaging leisure experiences can stimulate areas of the brain associated with optimal sensation and novelty, thereby decreasing the need for adolescents to seek these kinds of experiences through engagement in risk behaviors.

Limitations

There are a few limitations of this study that deserve consideration. First, all variables in the study were measured using adolescent self-reports because of our interest in adolescents' subjective experiences in their leisure. The associations found in this study may be inflated due to single-reporter bias. However, future studies could include multiple reporters and multiple methods of data collection to clarify these relations. Additionally, some of the reliability estimates were lower than expected for the leisure experience scales. These items have shown sufficient reliability in samples in the United States (e.g., Caldwell & Weissinger, 1992; Sharp et al., 2006). Future research could focus on the interpretation of these items in other cultures, and consider developing new items measuring each leisure scale to improve the measurement model and reduce measurement error. However, low reliability typically makes statistical tests more conservative, rather than inflating findings.

Second, although this study was longitudinal, caution is still warranted in making causal interpretations. For example, it may be that adolescents who are not engaged in substance use are less likely to report being bored in their leisure pursuits, rather than increased substance use being caused by leisure boredom. Future research could address more directly how manipulating leisure experiences impacts the substance use behaviors of adolescents.

Third, like many long-term longitudinal studies, particularly in vulnerable settings, our data included a substantial number of missing data points due to attrition. Data that is not missing at random may bias results. We used full information maximum-likelihood procedures, which is the recommended procedure for handling missing data (Allison, 2002; Little & Rubin, 2002; Schafer, 1997). In addition, recent work has suggested that meaningful conclusions from data can still be drawn with attrition rates as high as 50% when using full information maximum-likelihood estimations (Graham, 2009; Graham, Palen, Smith, & Caldwell, 2008). Although our missingness may be missing not at random (MNAR), simulation studies (Collins, Schafer, & Kam, 2001) and analyses based on the first five waves of data from this study (Graham et al., 2008) have shown that any bias in the estimates resulting from attrition has only a small impact on the study conclusions.

Last, our study examined global leisure experiences, rather than specific activities; thus, we were not able to assess variations in experiences within certain *types* of activities. An important next step in this work is to explore whether certain types of activities are better than others at engendering the novelty, interest, and engagement associated with risk-reducing leisure. Despite these limitations, results from this study contribute to the growing cross-national literature aimed at better understanding adolescent risk and opportunity in the context of leisure.

Implications for intervention

Our findings contribute to an understanding of the association between three distinct leisure experiences (leisure boredom, new leisure interests, and healthy leisure) and adolescent substance use behaviors over time. Thus, these findings have the potential to inform development of strategies that aim to decrease substance use by increasing the experiences of interest, pleasure, and engagement in leisure. Although limited, there is promising research to suggest that leisure experiences can be modified (Caldwell, Baldwin, Walls, & Smith, 2004) and that interventions targeting this context offer an effective approach for reducing substance use and supporting adolescent development. Particularly in low-resource

contexts, intervention efforts should aim to increase the awareness of the value of leisure in adolescent development, to expand activities and leisure opportunities available to youth, and to help youth develop strategies for finding healthy opportunities that provide interest, novelty, and optimal experience, thereby reducing the desire to seek sensation, adventure, and excitement in a risky alternative like substance use.

On a final note, our results suggest that prevention programming targeting leisure could impact alcohol, cigarette, and marijuana use in similar ways. In a recent report from the Monitoring the Future study, Johnston, O'Malley, Bachman, and Schulenberg (2007) suggest that substance use prevention may need to occur drug by drug because youth may not generalize the adverse consequences of one drug to another drug. This kind of drug-by-drug approach to prevention may not be feasible, particularly in communities with limited resources. However, our results suggest that targeting leisure experiences could affect a broad range of substance use behaviors in similar ways. South Africa is already facing the economic strain and limited success of drug treatment approaches to deal with the increasing numbers of young people affected by problematic substance use (Myers, Louw, & Fakier, 2008).

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Table 1

Observed proportions, odds, and logits for substance use in the previous 4 weeks for males/females

Substance use	Wave	Observed proportion	Odds	Logit
Alcohol use	1	0.34/0.33	0.52/0.49	−0.29/−0.31
	2	0.36/0.34	0.56/0.52	−0.25/−0.29
	3	0.40/0.35	0.67/0.54	−0.18/−0.27
	4	0.51/0.41	1.04/0.70	0.02/−0.16
	5	0.56/0.53	1.27/1.13	0.11/0.05
	6	0.61/0.45	1.56/0.82	0.19/−0.09
	7	0.64/0.58	1.78/1.38	0.25/0.14
Cigarette use	1	0.24/0.24	0.32/0.32	−0.50/−0.50
	2	0.31/0.30	0.45/0.43	−0.35/−0.37
	3	0.33/0.34	0.49/0.52	−0.31/−0.29
	4	0.36/0.44	0.56/0.79	−0.25/−0.11
	5	0.41/0.45	0.70/0.82	−0.16/−0.09
	6	0.35/0.48	0.54/0.92	−0.27/−0.04
	7	0.41/0.47	0.70/0.89	−0.16/−0.05
Marijuana use	1	0.08/0.04	0.09/0.04	−1.06/−1.38
	2	0.11/0.05	0.12/0.05	−0.91/−1.28
	3	0.16/0.08	0.19/0.09	−0.72/−1.06
	4	0.16/0.12	0.19/0.14	−0.72/−0.87
	5	0.18/0.12	0.22/0.14	−0.66/−0.87
	6	0.23/0.12	0.30/0.14	−-0.53/−0.90
	7	0.27/0.12	0.37/0.14	−0.43/−0.90

Table 2

Means (and standard deviations) for leisure experience variables by wave

Variable	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Leisure boredom	1.61 (0.97)	1.54 (0.98)	1.57 (0.99)	1.52 (0.97)	1.49 (0.97)	1.50 (0.97)	1.47 (0.97)
New leisure interests	2.64 (0.83)	2.65 (0.88)	2.60 (0.91)	2.57 (0.91)	2.56 (0.92)	2.61 (0.92)	2.62 (0.90)
Healthy leisure	2.79 (0.81)	2.79 (0.83)	2.78 (0.85)	2.81 (0.78)	2.70 (0.83)	2.77 (0.80)	2.83 (0.74)

Note. For each leisure experience variable, Min. = 0 and Max. = 4.0. Wave 1: beginning of 8th grade; Wave 2: end of 8th grade; Wave 3: beginning of 9th grade; Wave 4: end of 9th grade; Wave 5: beginning of 10th grade; Wave 6: end of 10th grade; Wave 7: beginning of 11th grade. Bonferroni post hoc tests were conducted but none were significant.

Table 3

Zero-order correlations among leisure variables at Wave 1

Variable	1.	2.	3.
1. Leisure boredom	1.00		
2. New leisure interests	0.02	1.00	
3. Healthy leisure	−0.09	0.47***	1.00

Note.

* $p < .05$;

** $p < .01$;

*** $p < .001$.

Table 4

Odds of substance use predicted by differences in leisure experiences at baseline (between-subjects component)

Outcome (past 4 weeks)	Leisure boredom	New leisure interests	Healthy leisure
Alcohol use	21% ↑	NS	22% ↓
Cigarette use	62% ↑	NS	NS
Marijuana use	55% ↑	20% ↓	40% ↓

Note. Percentages represent increases or decreases in the odds of using a substance at baseline for each unit increase in the leisure experience variable at baseline.

Table 5

Odds of substance use predicted by individual changes in leisure experiences (within-subject component)

Outcome (past 4 weeks)	Leisure boredom	New leisure interests	Healthy leisure
Alcohol use	14% ↑	NS	17% ↓
Cigarette use	23% ↑	NS	24% ↓
Marijuana use	36% ↑	NS	35% ↓

Note. Percentages represent increases or decreases in the odds of using a substance in the past 4 weeks based on a one-unit increase in the leisure experience variable over time.