



# HHS Public Access

Author manuscript

*Health Place*. Author manuscript; available in PMC 2016 July 01.

Published in final edited form as:

*Health Place*. 2015 July ; 34: 143–149. doi:10.1016/j.healthplace.2015.04.005.

## Young Adolescents' Perceived Activity Space Risk, Peer Networks, and Substance use

Michael Mason, Jeremy Mennis, Thomas Way, John Light, Julie Rusby, Erika Westling, Stephanie Crewe, Brian Flay, Leah Campbell, Nikola Zaharakis, and Chantal McHenry

### Abstract

Adolescent substance use is a developmentally contingent social practice that is constituted within the routine social-environment of adolescents' lives. Few studies have examined peer networks, perceived activity space risk (risk of substance use at routine locations), and substance use. We examined the moderating influence of peer network characteristics on the relationship between perceived activity space risk and substance use among a sample of 250 urban adolescents. Significant interactions were found between peer networks and perceived activity space risk on tobacco and marijuana use, such that protective peer networks reduced the effect of activity place risk on substance use. A significant 3-way interaction was found on marijuana use indicating that gender moderated peer network's effect on activity space risk. Conditional effect analysis found that boys' peer networks moderated the effect of perceived activity space risk on marijuana use, whereas for girls, the effect of perceived activity space risk on marijuana use was not moderated by their peer networks. These findings could advance theoretical models to inform social-environmental research among adolescents.

### Keywords

Urban adolescents; substance use; peer networks; activity space; gender differences Young Urban Adolescents' Activity Spaces; Peers; Substance use

---

Adolescent substance use persists as a health issue of national concern, with illicit drug use steadily increasing over the last two years among a national sample of high school students (Johnston, O'Malley, Bachman, & Schulenberg, 2013a). Urban youth are particularly vulnerable to early use and future problematic use of alcohol and illicit drugs (Martino, Ellickson, & McCaffrey, 2008; Wright, 2004), as many of these youth are disproportionately exposed to trauma (e.g., violence, crime) which increases vulnerability to substance use (e.g., Lee, 2012; Zinzow et al., 2009). The present study aims to extend the literature by examining the moderating influence of peer networks (peers with whom one affiliates) on the relationship between perceived activity space risk (risk of substance use at routine

---

Correspondence to: Michael J. Mason, Ph.D., Department of Psychiatry, Commonwealth Institute for Child & Family Studies, Virginia Commonwealth University, PO Box 980489, Richmond, VA 23298-0489; Mjmason@vcu.edu.

**Publisher's Disclaimer:** This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

locations) and substance use among urban youth. Based on ecological theories, contextual models that examine the influence of social and environmental factors on an individual have been used to study criminality, health, and behaviors (Winkel, Saegert, & Evans, 2009). To adequately understand individual development and change, the interplay of social and geographical niches in which the individual is embedded must be considered. Ecological models can be applied to investigate the social, intrapersonal, and environmental influences on risky health behaviors of adolescents, such as substance use (Flay, 1999; Flay, Synder & Petraitis, 2009).

## Substance Use Among Urban Youth

In the United States substance use among adolescents occurs across all race/ethnicities. Recent data from the Monitoring the Future study indicate 30-day prevalence of daily cigarette use is 1.6 % for African American 8<sup>th</sup> grade students compared to 2.4 % among White students (Johnston, O'Malley, Bachman and Schulenberg, 2013b). Almost 3 % of 8<sup>th</sup> grade African American students reported being drunk in the last 30 days compared to 4 % of White students. Thirty-day prevalence for marijuana use is 7.6 % for African Americans compared to 5.3 % for White 8<sup>th</sup> grade students (Johnston et al., 2013b). However, while African American adolescent substance use patterns may be comparable to White youth, tremendous disparities in adverse outcomes associated with substance use exist. African Americans are more likely to lack access to substance abuse treatment, and suffer adverse outcomes associated with drug use such as criminal punishment and health problems (Alegria, Carson, Goncalves, & Keefe, 2011; Green, Doherty, Stuart, & Ensminger, 2010; Rovner, 2014; Zapolski, Pedersen, McCarthy, & Smith, 2014).

## Gender Differences and Substance Use

Historically, adolescent boys have used substances at higher rates than adolescent girls. The difference in use, however has recently grown more narrow. For example, while boys overall substance use is higher for older adolescents than girls (Johnston et al., 2013b), there are minimal differences in marijuana prevalence in 8<sup>th</sup> grade between boys and girls (16.5 % to 13.6% respectively). However, 8<sup>th</sup> grade girls have reported more alcohol use than boys since 2002, and higher rates of cigarette smoking in the past two years (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2014). Essentially, young adolescent girls and boys use these three substances at similar rates, yet the timing and strength of risk factors appear to differ by gender. The literature on peer effects on substance use suggest that socialization and peer selection contribute to alcohol initiation (Light et al., 2013) and to marijuana use (Haye, Green, Kennedy, Pollard, & Tucker, 2013) in both adolescent girls and boys, though some study results suggest that selection and socialization effects vary for boys and girls. For example, the selection of peers with similar alcohol use was stronger for boys during early adolescence and for girls during late adolescence (Burke, van der Vorst, Kerr, & Stattin, 2012). Moreover, evidence shows that girls and boys may be differentially affected by their peers and social situations (Crick & Zahn-Waxler, 2003; Rudolph & Hammen, 1999), which has implications for the strength of peer influence on substance use. Research has shown that although peers had an influence on adolescent substance use, the influence was stronger for girls than boys (Kung & Farrell, 2000) and that boys derive differing

benefits from their peer networks (Mennis & Mason, 2011). Given the equivocal findings on gender differences in adolescent substance use, as well as possible gender differences in the impact of peer socialization and selection on substance use, further study is needed in this area.

## Peer Networks

Social networks have been identified in the literature as a robust predictor of substance use (e.g., Valente, Unger, & Johnson, 2005). We will use the term peer networks to identify close friends that represent meaningful relationships. Extensive research has shown that peer context predicts tobacco, alcohol, and drug use (Bauman & Ennett, 1996; Knecht, Burk, Weesie, & Steglich, 2010; Light, Greenan, Rusby, Nies & Snijders, 2013; Valente et al., 2005). Much less evidence is available for prosocial effects of peer networks. Supportive friendship has been studied as a moderator or protective influence against psychological and behavioral problems often associated with peer rejection (Lansford et al., 2007) or with negative experiences within families (Bolger, Patterson, & Kupersmidt, 1998), both of which are linked to substance use uptake.

Peer networks establish group norms that define peer culture, for both prosocial as well as antisocial behavior. The two primary mechanisms that are used to understand the behavioral relationship between individuals and peer groups are selection and influence or socialization. Selection refers to the tendency of people with similar characteristics and behaviors to form social bonds. Influence or socialization refers to the extent to which a person's behavior is influenced to some degree by that person's social contacts (Mason, 2014). Research has established that both of these mechanisms are salient and may be more prominent with varying substances (Cruz, Emery, & Turkheimer, 2012). For example, Pearson, and colleagues (2006) found that selection effects were more prominent among drinkers and tobacco smokers and influence effects were more prominent among cannabis users. Even when controlling for genetic and shared environmental differences, peer network substance use predicts future individual substance use, with stronger effects occurring within high-intensity/best friendships (Cruz, et al., 2012). Thus, the need exists to study peer networks across risk and protective dimensions.

## Activity Space

An important construct that provides methodological guidance for addressing the interaction of the social and spatial dimensions of adolescents' lives is activity space. Activity space can be defined as comprising all the locations that an individual has direct contact with as a result of his or her daily activities (Miller, 1991). More broadly, activity spaces are the manifestation of our spatial lives, serving as an index representing routine locations and all the accompanying psychological, social, and health-related experiences of these places (Golledge & Stimson, 1997; Sherman et al., 2005). Multiple approaches to measuring activity space have been used to capture location data within a given time-frame such as travel diaries (Goodchild & Janelle 1984), structured interviews (Mason, Cheung, & Walker, 2004), and using Geographic Information System (Kwan, 2013).

Research has shown that youth, and urban adolescents in particular, spend their time in a variety of geographically dispersed activity spaces that are not delimited by conventional geographic boundaries, such as census tracts, zip codes, political wards, or even home neighborhood (Browning & Soller, 2014). Neighborhood characteristics are known to influence adolescents' perceptions of safety and risk and are associated with substance use and mental health outcomes (Mason & Korpela, 2009), underscoring the importance of this construct for understanding urban youth. Research on activity spaces has also suggested that the places a person frequents outside the home may expose him or her to a variety of psychological, social, and geographic factors that likely influence substance use, but that may not be observed within the home (Wong & Shaw, 2011; Zenk et al., 2011). Hence, there remains a need to capture activity space data, particularly among urban youth, to better understand the important influence of context on substance use.

Based on this review and on our previous work (Mason et al., 2009b; Mennis & Mason, 2011), we hypothesize that the effect of an adolescent's perceived place-based risk on substance use is moderated by that subject's peer network, such that adolescents with greater peer network protective characteristics (support, encouragement for pro-social behavior) will be affected to a lesser degree by the perceived riskiness associated with the places they frequent for school, leisure, and other activities. Further, we hypothesize that this peer network moderating effect will differ between girls and boys, where girls will be more prone to the peer network moderating effect than boys.

## Method

This study examined baseline data from the Social-Spatial Adolescent Study, a longitudinal study of the interacting effects of peer networks, activity space, and substance use. Participants for the study were recruited between November 2012 and February 2014. The majority of participants were recruited from an urban adolescent medicine outpatient clinic at a large academic medical institution in Richmond, VA. This ambulatory care clinic provides comprehensive primary and adolescent-specific specialty care services to over 3,000 patients annually between ages 12-22 years. Age-eligible adolescents presenting to the adolescent clinic for routine or acute care were approached and invited to participate in this study by a research assistant while in the clinic's waiting room or pending arrival of the physician into the patient's exam room after nurse triage. Participants were also recruited from Richmond City Health District satellite clinics. These clinics, located within city-subsidized housing developments, offer limited primary care and adolescent-specific health programs (e.g., sexual health education groups) to adolescents and families at little or no cost. These participants were recruited by referral to the study team from the primary Patient Advocate at each of the satellite clinics. The Patient Advocate provided information about the study to all teens presenting to the satellite clinic who met the age criteria (13 to 14 years old). The name and phone number of interested teens was then provided to the study's project manager for follow-up by phone. Over 400 adolescents and parents were either approached at the outpatient hospital clinic or referred from the satellite clinics; of these, 57% enrolled in the study (N=250). Enrollment and data collection procedures were the same across sites. All procedures (consent/assent, and baseline survey) were completed in one visit; all participants completed the 30-minute baseline survey on a study laptop. The

majority of the sample (72%) was recruited from the outpatient clinic. Chi-square tests revealed no significant differences in age, sex, or race of participants between the recruitment sites. Data collection procedures were the same across sites.

Adolescents who met eligibility requirements (i.e., age 13 or 14 years old, registered clinic patient, and Richmond area resident) were recruited to participate. Written informed consent was obtained from all parents and adolescent participants prior to conducting any research activities. The first authors' university and the Richmond City Health Department's institutional review boards approved the research protocol, and the study received a federal Certificate of Confidentiality from the National Institutes of Health. At enrollment, participants completed an initial survey in a private room separate from parents and any clinic staff. Participants received nominal incentives for their time and effort.

## Measures

### Demographics

Participants (N=250) reported on their age, sex, and race during the initial survey at enrollment. Age was not used in our models due to the lack of variation (inclusion criteria of age 13 or 14). Sex was coded as 0 = girls, 1 = boys. Race was recoded as dichotomous (black = 1, not black = 0) because the sample was 88% African American.

### Substance Use

Substance involvement was measured using the Adolescent Alcohol and Drug Involvement Scale (AADIS) (Moberg, & Hahn, 1991). We used the drug use history section (part A) of the AADIS to measure the frequency with which participants engaged in use of tobacco, alcohol, and marijuana. Frequency of use of substances were coded as 1= never used, 2=tried but quit, 3=several times a year, 4= several times monthly, 5= weekends only, 6=several times a week, 7=daily, 8 = use several times per day. Scores range from 1 to 8 for each substance measured. The AADIS has a favorable internal consistency (Cronbach's alpha of .83), correlates highly with self-reported substance use ( $r=.72$ ) and with clinical assessments ( $r=.75$ ), as well as participants' perception of the severity of their own drug use problem (Moberg, & Hahn, 1991). For part A, higher scores indicate greater frequency of drug and alcohol involvement.

### Activity Space Risk

The Ecological Interview (Mason, Cheung, & Walker, 2004) is a measure that produces a geographical listing of the participant's routine activity locations, as well as evaluative descriptions of these various environments which are used to characterize their geography of risk and protection. The Ecological Interview produces accurate and valid geographic data with previous studies successfully identifying (geocoding specific locations) 90% of the collected location data (Mason et al., 2004). For this study, participants were asked to "Think of your typical week and about the places you go, excluding your home." Participants then selected types of places they frequent most often during a typical week from a list of eight places including an option for other places not listed. The types of places are: school, friend's home, city places (mall, stores, restaurant, movies), religious site, park/

nature, recreation/sports center, work/job, other place. The participant then rated the likelihood that they would use tobacco, alcohol, and marijuana at each of their selected locations. The ratings were coded on an eight-point scale, from 1 = Not at all likely to 8 = Very likely. A participant's activity space risk score is a summation of their ratings at each location, such that a teen could select up to 8 places producing scores ranging from 3 to 192 (e.g., 1 location rated as 1 for each substance = 3, to 8 locations rated as 8 for each substance = 192). Higher scores indicate greater risk of using substances at participant identified activity spaces. For this study, we were not measuring temporal or spatial dimensions of geocoded activity space, but rather, participant identified types of locations and the corresponding rating of each location's level of risk to use particular substances.

### Peer Network Characteristics

Peer network data were gathered using the Adolescent Social Network Assessment (ASNA) (Mason et al., 2004). The ASNA is a 13 item assessment that collects information on each participant's three closest friends, representing their peer network. Because our study focused on the influence of close peer networks, we aligned the number of nominated close to friends to three as this is within the range commonly reported for close peer network size (3 to 5), and because close friends have more influence on substance use than general peer networks (Beckmeyer, 2014; Cruz, et al., 2012; Haas, Schaefer, & Kornienko, 2010). The ASNA captures information on each subject's close personal contacts, which constitute their personal or egocentric peer network. Adolescents were asked to think of up to 3 close friends. Respondents provided information about each of their close peer's substance use, influence on behavior, and types of activities. Specifically, subjects were asked about negative/risky activities such as whether they know if each nominated peer uses substances, if the peer is a daily user, and whether the subject has been directly or indirectly influenced to use or not to use substances by each peer, as well as participating in illegal, violent, or dangerous behaviors. In addition, subjects were also asked about positive/protective activities with their peer affiliates such as receiving help with school or transportation, or providing support by talking through problems. These items create a total score for each peer and are based upon a weighted scoring procedure, with scores ranging from -14 to 14. Weights are based upon our previous research that has shown, for example, that risk for substance use increases with one substance user in a network, and risk for mental health problems is elevated with one daily substance user in a network (e.g., 3 fold increase) (Mason et al., 2004). Given these data, we developed the following weighted scoring procedures: risk quality: substance user = -1, daily user = -3, negative activity = -4, influence to use = -6 and protective quality: non-substance user = 4, absence of negative activities = 4, influence not to use = 6. Each peer's score is summed. Assuming 3 peers per participant, total network quality scores range from -42 to 42. Higher scores indicate greater peer network protection, and lower scores indicate increased network risk. The ASNA has favorable internal reliability (Cronbach's alpha = .84) and correlates significantly in the expected direction with self-reported measures of substance use (any alcohol, marijuana or other substance) ( $r = -.64$ ), with self-reported alcohol use ( $r = -.66$ ) and with self-reported marijuana use ( $r = -.54$ ) (Mason et al., 2011).

## Analytic Plan

To test the hypothesis that peer network characteristics moderates the relationship between activity space and substance use, we created a series of regression models where variables were added in stages, adding in order demographic variables (gender and race), the predictor variable (perceived activity space risk), the moderator variable (peer network characteristics), and then the interaction term peer network  $\times$  activity space. Three moderation models were tested, regressing each substance of interest (tobacco, alcohol, and marijuana) on all variables. To facilitate interpretation we mean-centered peer network and activity space. Next, to test the hypothesis that gender will moderate the moderating effects of peer network on activity space's influence on substance use, we conducted a 3-way interaction analysis. Building on our initial model, we conducted moderation tests of each 2-way interaction at both levels of the third variable (gender: male, female). Finally, we estimated the conditional effect of perceived activity space risk on substance use as a function of peer network characteristics using an inferential test to better interpret the interaction (Hayes 2013). Specifically, we tested the conditional effects on the 3-way interaction with gender (male, female) interacting with peer network, moderating activity space's influence on substance use. This allows the moderation of activity space's effect on substance use by peer network characteristics to depend on gender (male/female). We conducted all analyses using IBM SPSS (2012, V21) and the Hayes (2013) Conditional Process Analysis program.

## Results

The study sample was 57 % female, 88 % black or African American, 9 % other or unknown, and 3% White. The mean age was 13.4 years old ( $SD = .49$ ) ranging from 13 to 14 years old. Tobacco use was reported by 16.1% of the sample, with a mean scale frequency score of 1.3 ( $SD = .83$ ) with a range of scores from 1 to 7. Alcohol use was reported by 13.7% of the sample, with a mean scale frequency score of 1.2 ( $SD = .49$ ), with a range of scores from 1 to 4. Marijuana use was reported by 11.2% of the sample, with a mean frequency score of 1.2 ( $SD = .84$ ) with a range of scores from 1 to 8. To put the substance use results into context, we compared the current sample's use of tobacco, alcohol, and marijuana to the U.S. National Survey on Drug Use and Health 8th grade 2012 data (SAMHSA, 2013). The study sample's lifetime tobacco use is 16.1% compared to 10.3% nationally, alcohol use is 13.7% compared to 20.4% nationally, and marijuana use is 11.2% compared to 7.8% nationally. The peer network mean score was 22 ( $SD = 10$ ) with a range of scores from -23 to 38. The perceived activity space risk mean score was 6.6 ( $SD = 11.2$ ) with a range of scores from 3 to 108.

Table 1 shows the routine location frequency counts and percentages for 7 types of places. Participants in our study reported frequenting on average 2.4 ( $SD = 1.35$ ) locations per week, with a range of 1 to 6 locations. Out of the seven activity spaces listed, two of these locations were identified as most likely where substance use occurred. Alcohol use was most likely to occur at a friend's home and tobacco and marijuana use was most likely to occur in a park or out in nature.

Table 2 displays the results of the models regressing tobacco use on race, sex, activity space risk, and peer network quality. Model 1 accounted for 68% of the variance of tobacco use ( $p < .001$ ) and activity space risk had a significant main effect on tobacco use ( $p < .001$ ). Model 2 accounted for 69% of the variance ( $p < .001$ ) and shows a significant negative interaction between activity space and peer network ( $p < .001$ ). Activity space risk was less influential for tobacco use among teens with protective peer networks. Model 3 also accounted for 69% of the variance ( $p < .001$ ) in tobacco use, and shows that the 3-way interaction of activity space  $\times$  peer network  $\times$  gender was not significant. Gender did not significantly moderate peer network's moderation on activity space.

Table 3 displays the regression results for alcohol use. Model 1 shows that the overall model accounted for 31% of the variance ( $p < .001$ ). Gender had a significant main effect on alcohol use ( $p < .05$ ) as did activity space ( $p < .001$ ). Girls' alcohol use was higher than boys and their risky activity space risk was related to alcohol use. Model 2 accounted for 31% of the variance ( $p < .001$ ) and no significant interaction effects were found between peer network and activity space for alcohol. The effect of activity space risk on alcohol use is similar for those with risky and protective peer networks. Model 3 accounted for 42% of the variance, an 11% change in the R-squared ( $p < .001$ ) and no significant 3-way interaction effects were found for alcohol.

Table 4 displays the results for marijuana use. Model 1 accounted for 57% of the variance ( $p < .001$ ). Peer network ( $p < .05$ ) and activity space ( $p < .001$ ) had significant main effects on marijuana use. Model 2 accounted for 58% of the variance ( $p < .001$ ) finding a significant negative interaction between activity space and peer network ( $p < .01$ ) similar to tobacco use. The influence of activity space on marijuana use is greater for those teens with risky peer networks. Model 3 accounted for 62% of the variance ( $p < .001$ ) and the 3-way interaction of activity space  $\times$  peer network  $\times$  gender was significant ( $p < .001$ ). This interaction is shown graphically in Figure 1, as differences in marijuana use by perceived activity space risk (low, high) at four combinations of peer network (risky/protective) and gender (male/female). The moderating effect of peer network on the relationship between perceived activity space risk and marijuana use was observed for boys but not girls. Boys' peer networks moderated the influence of their activity space on marijuana use, whereas for girls, the influence of perceived activity space risk on marijuana use was not moderated by their peer networks.

## Discussion

This study examined social-spatial developmental processes of young adolescents on the cusp of a critical transitional period, where most initiation of substance use begins. Given the sample's age (13- and 14-year olds) these data describe the beginning of the important period where the interaction of individual, social, and environmental risk factors exert increasing levels of influence on urban youth (Mennis & Mason, 2011; Mennis & Mason, 2012). This study also provides evidence that ecological models incorporating variables such as perceived activity space risk and peer interactions are important components of substance use risk among urban youth, and that these effects appear to vary by gender.



Across all three substances studied, activity space risk strongly and significantly predicted substance use. Teens in the current study attributed specific behavioral risks at self-identified routine locations, highlighting the importance of the individual level activity space. We know from our earlier work that urban adolescents' peer networks affect their interpretative schemes of risk and protection on activity places (Mason, 2010), thus providing linkage among social relations and place, attribution of risk, and engagement in risky behaviors. For example, the current study found significant 2-way interactions among peer network and tobacco and marijuana use, where teens with risky networks are influenced to a greater degree by their perceived environment risk or protection. The results showed that tobacco and marijuana were more socially influenced than alcohol use, supporting our previous research with a national sample, where we found marijuana to be the most peer-influenced substance and alcohol to be the least (Mason, Mennis, Linker, Bares, & Zaharakis, 2014). This pattern could also be interpreted to imply that those teens with more protective networks are less influenced by their risky activity spaces, thus providing evidence of the salience for two related domains (networks and activity space) for understanding urban adolescents' social-spatial lives. Given that the adolescents in this sample used more tobacco, less alcohol, and more marijuana compared to their national counterparts, a place-based, peer network approach toward prevention appears to be warranted.

Overall, this sample routinely frequented between 2 and 3 locations per week and did not rate these places as very risky. These results are driven by many factors, including for example, age; teens are less mobile at ages 13 compared to age 16. The mean age of our sample is 13.4, just before the period of middle adolescence (15 to 16) when the rate of onset to substance abuse is typically maximal. The finding that boys' peer networks moderated their perceived activity space risk effect on marijuana use is noteworthy. Previous research has not found this gender result with marijuana, but recent research has found girls to be more susceptible to peer effects on tobacco use than boys (Mason et al., 2014; Mercken, Snijders, Steglich, Vertainen, & de Vries, 2010). Consequently, it is unclear exactly why boys in the present study were more sensitive to the moderating effects of their peer network on activity space regarding marijuana use. Boys in this sample were not using significantly more marijuana than girls ( $p > .05$ ) and did not differ significantly in their peer network risk or protection ( $p > .05$ ). Epidemiological research indicates that boys use more marijuana than girls (Johnston et al., 2013b). Accordingly, influence and selection may play a role in boys' networks, such that more boys are exposed to more peers who use marijuana and therefore have the opportunity to either be influenced to use or not use marijuana, and/or to select these peers into their networks. Additional work is needed to disentangle the social-spatial-gender interactions among different substances and levels of use.

The present study extends the literature in a number of ways. First, the application of both personal peer network and perceived activity space risk variables to characterize the social-environmental risk continuum among urban youth is an under-utilized approach in the study of the development of substance use problems. This study adds to the literature of place-based substance use research, advancing the salience of incorporating activity space into peer network studies. Second, few studies have reported the effect of gender on the

moderating quality of social networks in the context of activity space and the associated influence on specific substances. The current study provides insight into the varying differences of urban boys' and girls' peer networks, their different responses to environmental risk, and their vulnerability to tobacco, alcohol, and marijuana.

This sample's peer network scores indicated a positively skewed distribution, revealing a fairly common tendency for adolescents to evaluate their peer networks as more positive, in general, than negative or risky (Mason, Cheung, & Walker, 2004). A contribution of this study was the characterization of personal peer networks along a risk to protective continuum. These data provide insight into the gender-based, micro processes of protection enhancement and risk exacerbation among peers within the context of urban teens' self-identified routine locations. This level of ecological specificity can provide evidence for the need to differentiate research designs based upon gender and type of substances, which could produce more targeted and effective interventions. For example, African American early-adolescent boys may show better response to interventions targeting peer network counseling when addressing marijuana use. On the other hand, African American early-adolescent girls may respond better to interventions targeting locations of risk and protection when addressing alcohol use (see for example, Mason, Pate, Drapkin, & Sozinho, 2011).

There were limitations in this study that should be considered when interpreting these findings. First, the findings are based on baseline data only, thus temporal sequencing of our moderation models cannot be assessed. While our models were based upon previous research and guided by known theory, the cross sectional nature of these data inherently limit causal interpretations. Second, our sample was an urban, almost entirely African American sample and we did not employ random sampling strategies, so our findings may not apply to other populations. While this is an important population to study due to historic underrepresentation, replications with more diverse ethnic and geographic populations are needed. Third, the three-person peer networks were limited to close friends, thereby excluding peripheral friends and family members. We chose three as the literature suggests that closeness is an important network characteristic for both protective and risk enhancement among adolescents, and close peer networks range in size from 3 to 5 (Cruz, Emery, & Turkheimer, 2012; Haas, Schaefer, & Kornienko, 2010). The advantage of limiting the networks to three close friends, is reducing time and thus respondent fatigue when collecting a large amount of data from participants. A potential limitation is that for some participants, their close-friend network is larger than three, thus truncating the results. Finally, the routine locations generated by the Ecological Interview produced one result of potential concern. Only 175 out of 250 adolescents chose School as a location that they frequent on a typical week. This result does not represent a large number of drop outs or home-schooled youth. This is likely due to assessment taking place during the summer where most youth are not in school, and thus do not frequent this location. It may be a function of misinterpreting the item, or a random error. Future research may consider monitoring these typical responses to ensure confidence in the selected locations.

In all, these data provide unique insight into the social-spatial risk and protective factors for young urban adolescents on the cusp of important developmental transitions.

Bronfenbrenner (1979) highlighted the importance of attending to ecological transitions,

those movements in one's role or setting which occur throughout the life span. This idea is particularly salient with 13 and 14 year olds who are entering an educational transition via middle school to high school, for example. In as much as the present sample of adolescents were still establishing their longer-term peer networks, the effects of gender, age, peer network, and activity space will evolve, through such mechanisms as increased travel opportunities (car, bus passes), income (jobs), and new educational settings. For example, adolescents who are employed are more likely to use alcohol, tobacco, and other drugs compared to adolescents who do not work (Osilla, Hunter, Ewing, Ramchand, Miles, & D'Amico, 2013; Wu, Schlenger, & Galvin, 2003). Young adolescents' unique social-spatial influences on risk behaviors will continue to increase with age and thus will represent increased challenges and opportunities. Our findings add to the literature that purports adolescents' healthy ecological transitions are closely tied to the people with whom they interact, their attitudes, values, and behaviors; but also add consideration of likelihood of risk behaviors at specific routine locations.

## Acknowledgements

This research was supported by a grant, number 1R01 DA031724-01A1, from the National Institute on Drug Abuse to the first author. The findings and conclusions are those of the authors and do not necessarily represent the views of the National Institute on Drug Abuse, or National Institute of Health.

## References

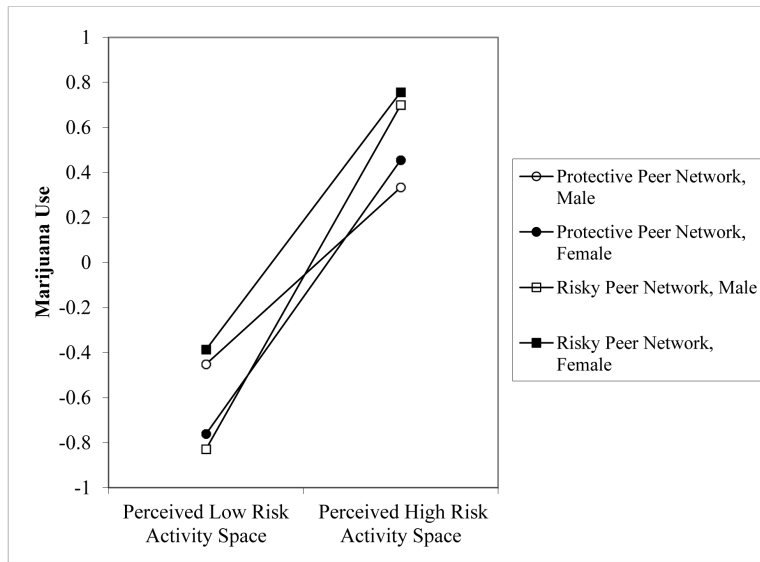
- Aiken, L.S.; West, S.G. *Multiple regression: Testing and interpreting interactions*. Sage; Thousand Oaks, California: 1991.
- Alegria M, Carson NJ, Goncalves M, Keefe K. Disparities in treatment for substance use disorders and co-occurring disorders for ethnic/racial minority youth. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2011; 50(1):22–31. DOI: 10.1016/j.jaac.2010.10.005. [PubMed: 21156267]
- Amaro H, Blake SM, Schwartz PM, Flinchbaugh LJ. Developing theory-based substance abuse prevention programs for young adolescent girls. *Journal of Early Adolescence*. 2012; 21:256–293. doi: 10.1177/0272431601021003002.
- Bauman KE, Ennett ST. On the importance of peer influence for adolescent drug use: commonly neglected considerations. *Addiction*. 1996; 91(2):185–198. doi: 10.1046/j.1360-0443.1996.9121852.x. [PubMed: 8835276]
- Beckmeyer, J. Comparing perceptions of how many peers' and friends' use alcohol: Associations with middle adolescents' own alcohol use. Paper presented at the annual meeting of the American Public Health Association; New Orleans, LA. Nov. 2014
- Bolger KE, Patterson CJ, Kupersmidt JB. Peer relationships and self-esteem among children who have been maltreated. *Child Development*. 1998; 69:4–1171. doi: 10.1111/j.1467-8624.1998.tb06166.x.
- Browning C, Soller B. Moving Beyond Neighborhood: Activity Spaces and Ecological Networks as Contexts for Youth Development. *Cityscape*. 2014; 16:165–196. [PubMed: 25105172]
- Bronfenbrenner, U. *The Ecology of Human Development*. Harvard Press; Cambridge, MA: 1979.
- Burk WJ, van der Vorst H, Kerr M, Stattin H. Alcohol use and friendship dynamics: Selection and socialization in early-, middle-, and late adolescent peer networks. *Journal of Studies on Alcohol & Drugs*. 2012; 73:89–98. [PubMed: 22152666]
- Crick NR, Zahn-Waxler C. The development of psychopathology in females and males: Current progress and future challenges. *Development and Psychopathology*. 2003; 15:719–742. [PubMed: 14582938]

- Cruz J, Emery R, Turkheimer E. Peer network drinking predicts increased alcohol use from adolescence to early adulthood after controlling for genetic and shared environmental selection. *Developmental Psychology*. 2012; 48(5):1390–1402. [PubMed: 22390657]
- Flay BR, Hu FB, Siddiqui O, Day LE, Hedeker D, Petraitis J, Richardson J, Sussman S. Differential influence of parental smoking and friends' smoking on adolescent initiation and escalation of smoking. *Journal of Health & Social Behavior*. 1994; 35(3):248–265. [PubMed: 7983337]
- Flay B. Understanding environmental, situational, and intrapersonal risk and protective factors for youth tobacco use: the Theory of Triadic Influence. *Nicotine & Tobacco Research*. 1999; 1:S111–S114. [PubMed: 11768166]
- Flay, BR.; Snyder, FJ.; Petraitis, J. The Theory of Triadic Influence. In: DiClemente, RJ.; Kegler, MC.; Crosby, RA., editors. *Emerging Theories in Health Promotion Practice and Research*. Second. Jossey-Bass; New York: 2009. p. 451-510.
- Green KM, Doherty EE, Stuart EA, Ensminger ME. Does heavy adolescent marijuana use lead to criminal involvement in adulthood? Evidence from a multiwave longitudinal study of urban African Americans. *Drug and Alcohol Dependence*. 2010; 112:117–125. Doi: 10.1016/j.drugalcdep.2010.05.018. [PubMed: 20598815]
- Haye K, Green H, Kennedy D, Pollard M, Tucker J. Selection and Influence Mechanisms Associated With Marijuana Initiation and Use in Adolescent Friendship Networks. *Journal of Research on Adolescence*. 2013; 23:474–486. DOI: 10.1111/jora.12018.
- Hayes, AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis*. Guildford Press; New York, NY: 2013.
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. *Monitoring the Future National Results on Adolescent Drug Use: Overview of Key Findings, 2012*. Institute for Social Research, The University of Michigan; Ann Arbor: 2013a.
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. *Demographic Subgroup Trends Among Adolescents for Fifty-One Classes of Licit and Illicit Drugs, 1975–2012 (Monitoring the Future Occasional Paper No. 79)*. Institute for Social Research; Ann Arbor, MI: 2013b. Available: <http://www.monitoringthefuture.org/>
- Johnston, LD.; O'Malley, PM.; Miech, RA.; Bachman, JG.; Schulenberg, JE. *Monitoring the Future National Results on Drug Use: 1975-2013: Overview, Key Findings on Adolescent Drug Use*. Institute for Social Research, The University of Michigan; Ann Arbor: 2014.
- Knecht AB, Burk WJ, Weesie J, Steglich CEG. Friendship and alcohol use in early adolescence: A multilevel social network approach. *Journal of Research on Adolescence*. 2010; 21:475–487. DOI: 10.1111/j.1532-7795.2010.00685.x.
- Kirke DM. Chain reactions in adolescents' cigarette, alcohol and drug use: similarity through peer influence or the patterning of ties in peer networks? *Social Networks*. 2004; 26:3–28. doi: 10.1016/j.socnet.2003.12.001.
- Kung EM, Farrell AD. The role of parents and peers in early adolescent substance use: An examination of mediating and moderating effects. *Journal of Child and Family Studies*. 2000; 9:509–528.
- Kwan M. Beyond space (as we knew it): Toward temporally integrated geographies of segregation, health, and accessibility. *Annals of the Association of American Geographers*. 2013; 103(5):1078–1086.
- Lansford JE, Miller-Johnson S, Berlin LJ, Dodge KA, Bates JE, Pettit GS. Early physical abuse and later violent delinquency: A prospective longitudinal study. *Child Maltreatment*. 2007; 12:233–245. [PubMed: 17631623]
- Lee R. Community violence exposure and adolescent substance use: Does monitoring and positive parenting moderate risk in urban communities? *Journal of Community Psychology*. 2012; 40:406–421. doi: 10.1002/jcop.20520.
- Light JM, Greenan C, Rusby JC, Nies KM, Snijders TAB. Onset to First Alcohol Use in Early Adolescence: A Network Diffusion Model. *Journal of Research on Adolescence*. 2013; 23:487–499. [PubMed: 24039379]

- Martino SC, Ellickson PL, McCaffrey DF. Developmental trajectories of substance use from early to late adolescence: A comparison of rural and urban youth. *Journal of Studies on Alcohol and Drugs*. 2008; 69:430–440. [PubMed: 18432386]
- Mason, M. Peer Networks. In: Sloboda, Z.; Petras, H., editors. *Defining Prevention Science*. Springer Press; New York, NY: 2014. p. 171–193.
- Mason M, Cheung I, Walker L. Substance use, social networks, and the geography of urban adolescents. *Substance Use & Misuse*. 2004; 39:1751–1777. [PubMed: 15587950]
- Mason MJ, Korpela K. Activity spaces and urban adolescent substance use and emotional health. *Journal of Adolescence*. 2009a; 32:925–939. doi: 10.1016/j.adolescence.2008.08.004. [PubMed: 18851877]
- Mason M, Mennis J, Lawrence F, Coatsworth JD, Valente T, Pate P. The Relationship of Place to Substance use and Perceptions of Risk and Safety in Urban Adolescents. *Journal of Environmental Psychology*. 2009b; 29(4):485–492. doi:10.1016/j.jenvp.2009.08.004. [PubMed: 20161426]
- Mason M. Attributing Activity Space as Risky and Safe: The Social Dimension to the Meaning of Place for Urban Adolescents. *Health and Place*. 2010; 16:926–933. doi:10.1016/j.healthplace.2010.05.004. [PubMed: 20537934]
- Mason M, Mennis J. An Exploratory Study of the Effects of Neighborhood Characteristics on Adolescent Substance Use. *Addiction Research & Theory*. 2010; 18:33–50. doi: 10.3109/16066350903019897.
- Mason M, Mennis J, Schmidt C. A Social Operational Model of Urban Adolescents' Tobacco and Substance Use: A Mediational Analysis. *Journal of Adolescence*. 2011; 43:1055–1063. DOI: 10.1016/j.adolescence.2010.11.002. [PubMed: 21144577]
- Mason M, Pate P, Drapkin M, Sozinho K. Motivational Interviewing Integrated with a Social Network Intervention for Female Adolescents: A Randomized Pilot Study in Urban Primary Care. *Journal of Substance Abuse Treatment*. 2011; 41(2):148–155. DOI: 10.1016/j.jsat.2011.02.009. [PubMed: 21489741]
- Mason M, Mennis J, Linker J, Bares C, Zaharakis N. Peer Attitudes Effects on Adolescent Substance Use: The Moderating Role of Race and Gender. *Prevention Science*. 2014; 15:56–64. doi: 10.1007/s11121-012-0353-7. [PubMed: 23404666]
- McLafferty CL Jr. Examining unproven assumptions of Galton's nature-nurture paradigm. *The American Psychologist*. 2006; 61:177–8. doi:10.1037/0003-066X.61.2.177. [PubMed: 16478364]
- Mennis J, Mason M. People, Places, and Adolescent Substance Use: Integrating Activity Space and Social Network Data for Analyzing Health Behavior. *The Annals of the Association of American Geographers*. 2011; 101(2):272–291.
- McLafferty CL Jr. Examining unproven assumptions of Galton's nature-nurture paradigm. *The American Psychologist*. 2006; 61:177–8. doi:10.1037/0003-066X.61.2.177. [PubMed: 16478364]
- Mennis J, Mason MJ. People, places, and adolescent substance use: Integrating activity space and social network data for analyzing health behavior. *Annals of the Association of American Geographers*. 2011; 101:272–291. DOI:10.1080/00045608.2010.534712.
- Mennis J, Mason M. Social and geographic contexts of adolescent substance use: the moderating effects of age and gender: The Moderating Effects of Age and Gender Social Networks. *Social Networks*. 2012; 34:150–157.
- Mercken L, Snijders TAB, Steglich C, Vertiainen E, de Vries H. Smoking-based selection and influence in gender-segregated friendship networks: a social network analysis of adolescent smoking. *Addiction*. 2010; 105:1280–1289. DOI: 10.1111/j.1360-0443.2010.02930.x. [PubMed: 20456296]
- Miller HJ. Modelling accessibility using space-time prism concepts within geographical information systems. *International Journal of Geographical Information System*. 1991; 5:287–301. DOI: 10.1080/02693799108927856.
- Moberg DP, Hahn L. The adolescent drug involvement scale. *Journal of Adolescent Chemical Dependency*. 1991; 2:75–88.
- Pandina, R.J.; Johnson, V.L.; White, H.R. Peer Influences on Substance Use During Adolescence and Emerging Adulthood. In: Schier, L.M., editor. *Handbook of Drug Use Etiology: Theory, Methods,*

and Empirical Findings. American Psychological Association; Washington, D.C.: 2010. p. 383-401.

- Pearson M, Steglich C, Snijders T. Homophily and assimilation among sport-active adolescent substance users. *Connections*. 2006; 27(1):47–63.
- Pedersen S, Vitaro F, Barker ED, Borge AI. The timing of Middle-Childhood peer rejection and friendship: Linking early behavior to Early-Adolescent adjustment. *Child Development*. 2007; 78:1037–1051. doi: 10.1111/j.1467-8624.2007.01051.x. [PubMed: 17650124]
- Rovner, J. Disproportionate Minority Contact in the Juvenile Justice System. The Sentencing Project. May. 2014 Retrieved from: [http://www.sentencingproject.org/doc/publications/jj\\_Disproportionate%20Minority%20Contact.pdf](http://www.sentencingproject.org/doc/publications/jj_Disproportionate%20Minority%20Contact.pdf)
- Rudolph KD, Hammen C. Age and gender as determinants of stress exposure, generation, and reactions in youngsters: A transactional perspective. *Child Development*. 1999; 70:660–677. [PubMed: 10368914]
- Substance Abuse and Mental Health Services Administration. Results from the 2012 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-46, HHS Publication No. (SMA) 13-4795. Substance Abuse and Mental Health Services Administration; Rockville, MD: 2013.
- Valente TW, Unger JB, Johnson CA. Do popular students smoke? The association between popularity and smoking among middle school students. *Journal of Adolescent Health*. 2005; 37:323–329. DOI: 10.1016/j.jadohealth.2004.10.016. [PubMed: 16182143]
- Vaquera E, Kao G. Do you like me as much as I like you? Friendship reciprocity and its effects on school outcomes among adolescents. *Social Science Research*. 2008; 37(1):55–72. doi:10.1016/j.ssresearch.2006.11.002. [PubMed: 18443653]
- Whaley RB, Hayes-Smith J, Hayes-Smith R. Gendered pathways? Gender, mediating factors, and the gap in boys' and girls' substance use. *Crime & Delinquency*. 2013; 59:651–669. doi: 10.1177/0011128710389581.
- White HR, Fleming CB, Kim MJ, Catalano RF, McMorris B. Identifying two potential mechanisms for changes in alcohol use among college-attending and non-attending emerging adults. *Developmental Psychology*. 2008; 44:1625–1639. [PubMed: 18999326]
- Winkel G, Saegert S, Evans GW. An ecological perspective on theory, methods, and analysis in environmental psychology: Advances and challenges. *Journal of Environmental Psychology*. 2009; 29:318–328. doi:10.1016/j.jenvp.2009.02.005.
- Wright, D. State Estimates of Substance Use from the 2002 National Survey on Drug Use and Health (DHHS Publication No. SMA 04-3907, NSDUH Series H-23). Substance Abuse and Mental Health Services Administration, Office of Applied Studies; Rockville, MD: 2004.
- Wong D, Shaw S. Measuring segregation: an activity space approach. *Journal of Geographic Systems*. 2011; 13(2):127–145. doi:10.1007/s10109-010-0112-x.
- Zapolski TC, Pedersen SL, McCarthy DM, Smith GT. Less drinking, yet more problems: Understanding African American drinking and related problems. *Psychological Bulletin*. 2013; 140(1):188–223. doi: 10.1037/a0032113. [PubMed: 23477449]
- Zenk SN, Schulz AJ, Matthews SA, Odoms-Young A, Wilbur J, Wegrzyn L, Stokes C. Activity space environment and dietary and physical activity behaviors: a pilot study. *Health & Place*. 2011; 17:1150–1161. DOI: 10.1016/j.healthplace.2011.05.001. [PubMed: 21696995]
- Zinzow HM, Ruggiero KJ, Resnick HS, Hanson R, Smith D, Saunders B, Kilpatrick DG. Prevalence and mental health correlates of witnessed parental and community violence in a national sample of adolescents. *Journal of Child Psychology and Psychiatry*. 2009; 50:441–450. DOI: 10.1111/j.1469-7610.2008.02004.x. [PubMed: 19220624]



**Figure 1.** Conditional 3-way interaction with perceived activity space risk predicting marijuana use at four combinations of peer network (risky/protective) and gender (male/female).

**Table 1**

Routine Locations of Participants. Routine Locations

	<b>n</b>	<b>%</b>
School	175	69.4
Friend's Home	128	50.8
City	106	42.1
Recreation Center	79	31.3
Religious	47	18.7
Park/Nature	27	10.7
Work	5	2

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript



**Table 2**

## Regression Models Predicting Tobacco Use

Predictor Variables	Model 1 $\beta$ (SE)	Model 2 $\beta$ (SE)	Model 3 $\beta$ (SE)
Gender	-.01 (.07)	.01 (.04)	.01 (.04)
Race	.03 (.10)	.01 (.04)	.01 (.04)
Activity Space	.80 (.00)***	.68*** (.06)	.66*** (.07)
Peer Network	-.07 (.00)	-.04 (.04)	-.03 (.04)
Activity Space $\times$ Peer Network		-.09*** (.03)	-.10*** (.03)
Activity Space $\times$ Gender			.02 (.06)
Peer Network $\times$ Gender			.07 (.04)
Activity Space $\times$ Peer Network $\times$ Gender			-.01 (.03)
Constant	1.02 (.17)***	-.04 (.04)	-.03 (.04)
F statistic	122.12***	109.99***	68.99***
Adjusted R <sup>2</sup>	.68	.69	.69

\*= $p < .05$ ; \*\*= $p < .01$ ;\*\*\*= $p < .001$

**Table 3**

## Regression Models Predicting Alcohol Use

Predictor Variables	Model 1 $\beta$ (SE)	Model 2 $\beta$ (SE)	Model 3 $\beta$ (SE)
Gender	-.14* (.06)	-.14 (.05)*	-.12 (.05)*
Race	-.05 (.09)	-.07 (.05)	-.08 (.05)
Activity Space	.50*** (.00)	.45*** (.08)	.66 (.09)***
Peer Network	-.14 (.00)	-.12* (.06)	-.09 (.06)
Activity Space $\times$ Peer Network		-.04 (.04)	.02 (.04)
Activity Space $\times$ Gender			-.27 (.08)***
Peer Network $\times$ Gender			-.02 (.06)
Activity Space $\times$ Peer Network $\times$ Gender			.05 (.04)
Constant	1.24*** (.10)	-.01 (.06)	.04 (.05)
F statistic	26.42***	22.21***	21.60***
Adjusted R <sup>2</sup>	.31	.31	.42

\*\*=p&lt;.01;

\*=p&lt;.05;

\*\*\*=p&lt;.001

**Table 4**

## Regression Models Predicting Marijuana Use

Predictor Variables	Model 1 $\beta$ (SE)	Model 2 $\beta$ (SE)	Model 3 $\beta$ (SE)
Gender	-.03 (.08)	-.01 (.04)	-.04 (.04)
Race	.00 (.12)	-.01 (.04)	-.01 (.04)
Activity Space	.70 (.00)***	.60 (.06)***	.58 (.08)***
Peer Network	-.14 (.00)**	-.10 (.46)	-.08 (.05)
Activity Space $\times$ Peer Network		-.08 (.03)**	-.08 (.03)**
Activity Space $\times$ Gender			-.01 (.07)
Peer Network $\times$ Gender			.08 (.05)
Activity Space $\times$ Peer Network $\times$ Gender			-.10 (.03)***
Constant	1.07 (.17)***	-.03 (.04)	-.02 (.04)
F statistic	76.69***	66.69***	48.80***
Adjusted R <sup>2</sup>	.57	.58	.62

\* =p&lt;.05;

\*\* =p&lt;.01;

\*\*\* =p&lt;.001