HHS Public Access

Author manuscript

GeoJournal. Author manuscript; available in PMC 2020 October 30.

Published in final edited form as:

GeoJournal. 2019 ; 2019: . doi:10.1007/s10708-019-10059-5.

Activity Spaces: Assessing Differences in Alcohol Exposures and Alcohol Use for Parents

Bridget Freisthler, Ph.D.,
College of Social Work, The Ohio State University, 340C Stillman Hall, 1947 College Rd. N, Columbus, OH 43210

Nancy J. Kepple, Ph.D. [Assistant Professor],
University of Kansas, School of Social Welfare, 1545 Lilac Lane, 113 Twente, Lawrence, KS 66047

Jennifer Price Wolf, Ph.D.,
Division of Social Work, California State University, Sacramento, Mariposa Hall 5035, 6000 J Street, Sacramento, CA 95819-6090

Leslie Carson, MSW, MPH
College of Social Work, The Ohio State University, 1947 College Rd. N, Columbus, OH 43210

Abstract

Parental alcohol use and alcohol outlet densities in residential areas are related to risk for child maltreatment. However, some parents spend significant time outside of their residential neighborhood. Thus, we may not be accurately assessing how alcohol environments are related to risks for problematic parenting. Here, we examine how residential environments and activity spaces are related to outlet density and whether drinking events in our sample of parents differ by location (e.g., routine vs. rare locations) and whether their children are present. We conducted semi-structured interviews with 60 parents living in four cities in the San Francisco Bay area who provided information on where they spent time, where they drank, and whether children were present. We constructed measures of activity spaces (e.g., convex hull polygons) and activity patterns (e.g., shortest network distance) and calculated outlet density in each. Density of alcohol outlets for residential Census tract was not related to density of the activity space and activity pattern measures. Alcohol use occurred more frequently (regardless of whether their children were present) inside activity spaces operationalized as convex hull polygons or two standard deviational ellipses. Measures that capture larger activity space areas (e.g., convex hull polygons, two standard deviational ellipses) may better model where people spend time, regardless of whether the location is routine or rare. By continuing to use activity spaces to explore relationships between outlet densities, drinking behaviors, and problems, we can start to ascertain those mechanisms by which outlets may affect local problems.

T: 614-282-2856, F: 614-292-6940, freisthler.19@osu.edu.

Keywords

Child abuse and neglect; alcohol outlet density; activity spaces; activity patterns; drinking

Recent advances in the incorporation of geography methods into social science studies have renewed interest in studying environments to understand social and physical harms (Burton & Jarrett, 2000; Freisthler, Merritt, & LaScala, 2006; Leventhal & Brooks-Gunn, 2000). The general consensus is that the larger environment matters, but the mechanisms by which environmental influences affect individual exposure or behaviors that contribute to these social and physical harms remain largely unknown (Jones & Pebly, 2014). However, as the methods to examine where people go and how they use their environment have become more sophisticated, the ability to synthesize and analyze the data have been limited by the lack of theoretical advancement. For example, continuous GPS monitoring of a person's movement for a week provides copious amounts of data, but these data generally are characterized using path areas or path routes (Patterson & Farber, 2015; Morrison et al., 2019).

Without a strong conceptual model or theoretical framework, analyses of these data are more likely to approach data mining as opposed to a greater understanding of how and why individuals use their environments. For example, Morrison and colleagues (2019) assessed a variety of residential neighborhood areas, activity spaces (defined by the surrounding environment to which they are exposed and operationalized by polygons/areas) and activity patterns (defined by the paths people travel and operationalized by networks/roadways/linear distance) to understand how density of alcohol outlets was related to youth drinking behaviors. They found that while most of the activity pattern locations and some of the residential neighborhoods were related to alcohol consumption, these findings were inconsistent and largely based on method of measurement. This phenomenon of not knowing which spatial unit is best for the study of a particular problem is the called the uncertain geographic context problem, which refers to the lack of ability to know which contexts, both spatially and temporally, are most likely to affect behavior (Kwan 2012a; 2012b).

Currently, the prevailing assessment method in neighborhood effects research for the study of parenting, especially for child maltreatment outcomes (c.f., Coulton et al., 2007; Freisthler et al., 2006), has been to use an individual's residential Census tract to understand the role of environmental influences in maladaptive parenting behaviors. These neighborhoods are generally operationalized using administrative units, such as Census tracts or zip codes, and dependent upon the geographic information available on the problem behaviors, such as hospital discharges of child maltreatment (Freisthler et al., 2008; Wolf et al., 2016). Neighborhood units are often static, in the sense that they only refer to a limited, fixed area around where the person resides. For some populations whose daily living activities are contained within these static units (e.g., children, see Chambers et al., 2017), these neighborhood influences may be highly relevant. For other populations, however, these units may not accurately reflect where a person spends time and what risks they are exposed to on a daily basis. For example, a person who cleans homes for a living will likely leave their home early in the morning and travel to various work sites throughout the day, which

are likely outside of the administrative geographic unit where he or she lives. In addition, this person may run errands after work and not return home until later in the evening. Throughout the day, he or she may traverse a number of Census tracts, where exposures to a variety of environmental influences may be vastly different from where he or she lives. This speaks to the need for measures that better assess where a person spends time, not just where the individual lives.

In this study, we seek to understand (1) how residential environments, activity spaces, and activity patterns are related to alcohol outlet density among a sample of parents; and (2) whether drinking events in our sample of parents differ by location (e.g., routine activity spaces or rare locations) and whether their children are present. Thus, we extend the work of Morrison et al. (2019) by examining outlet density in another population (parents) and explore whether drinking events occur within daily routine activities or occur at special locations. The overarching goal of this line of research is to begin the process of identifying how best to describe environmental exposures that lead to drinking behaviors resulting in maladaptive parenting behaviors.

The Specific Example of Alcohol Exposure and Associated Behaviors

Our ability to assess activity patterns and spaces of parents has been advanced by technology that enables the collection of data that can be analyzed in a way that allows for the meaningful construction of activity patterns and spaces. For example, use of GPS tracking and survey-based methods have allowed researchers to look beyond where individuals live. These alternate exposures may better assess how individuals' use of their environments is related to alcohol-related problems, including those that relate to parenting.

Historically, the role of the alcohol environment has been primarily measured by alcohol outlet density in the residential neighborhood, although more recently this work has been extended to consider distance-based measures (e.g., distance to nearest alcohol outlet) or spatially-based accessibility measures (e.g., spatially weighted population-based measures) (c.f. Morrison et al., 2019; Sacks et al., 2019). Residential neighborhoods are likely inadequate to assess the role of alcohol exposure on children maltreatment completely. Prior work on child maltreatment outcomes assume the geographic availability of alcohol where one lives is likely to exert the greatest influence on alcohol-related problems; the prevailing thought is that greater availability of alcohol where one lives provides an individual with more opportunities to purchase and consume alcohol. Using these methods, greater outlet densities are related to higher rates of child abuse and neglect, intimate partner violence, and assaults (Cunradi, Mair, Ponicki, & Remer, 2011; Freisthler, Gruenewald, Remer, Lery, & Needell, 2007; Gruenewald & Remer, 2006). This method is, however, devoid of any information on the context of one's drinking such as where, with whom one likes to drink, and under what conditions a person chooses to drink. We know these drinking contexts present different risks for drinking quantities and frequencies (Gruenewald & Mair, 2015), child physical abuse (Freisthler & Gruenewald, 2013), supervisory neglect (Freisthler, Wolf, Johnson-Motoyama, 2015), and intimate partner violence (Mair, Cunradi, Gruenewald, Todd, & Remer, 2013). Thus, by better refining how we measure alcohol exposures, we will be able to better assess and quantify alcohol-related risks.

As described above, one concern with previous work that primarily focuses on residential neighborhood is that the risks for harmful drinking (as measured by exposures to alcohol outlets and drinking contexts) may not be identified. A person who primarily drinks during happy hour after work with co-workers in a location miles away from his or her residential neighborhood may have greater risks for alcohol-related traffic crashes outside of where they live. Indeed, risks for traffic crashes generally occur in areas adjacent to those areas with higher densities of restaurants that serve alcohol (Lipton, Gaidus, Ponicki, & Gruenewald, 2018). In this case, outlet density where a person lives would not identify his or her risk for alcohol-related traffic crashes. Here, activity spaces that capture common locations (e.g., convex hulls or standard deviational ellipses, described in more detail below), like where a person works, may better identify his or her risk for alcohol-related traffic crashes.

The activity patterns of individuals who consume alcohol regularly may provide enough information to identify both those locations and contexts that place them at greater risk for negative consequences related to alcohol use (Freisthler, Lipperman-Kreda, Bersamin, & Gruenewald, 2014). In this case, contextual cueing provides some insight about the influence of regular, passive exposure that may cue our brain to focus our attention on aspects of our environment in a non-random way by prioritizing cues with significant behavioral relevance (Brockmole, Castelhano, & Henderson, 2006; Chun & Jiang, 1998). Thus, what we see on a regular basis may affect our behaviors; particularly, how the environment is shaped to highlight specific elements of the space. For example, an individual may see alcohol advertisements on the way home that cue them to purchase alcohol, or even seek out a specific outlet after a stressful day.

Continuous GPS monitoring will provide precise information on a person’s movement throughout a week (called path analysis or approximated using shortest path distances), including places where alcohol use may be more likely to occur. Combined with ecological momentary assessment (EMA) throughout the day, we can obtain information about when drinking actually occurs and the context within which it takes place. As described above, this method requires a fair amount of resources, resulting in copious amounts of data that could be time intensive to analyze. Further, these methods may only identify risky contexts among frequent drinkers, unless GPS monitoring and EMA were conducted for longer time periods. This approach has been used in studies of adolescents, finding that having more risky places was related to increased substance use and that risk locations for substance abusers were closer to venues that sell alcohol, such as bars and restaurants (Mason et al., 2009; Mennis & Mason, 2010).

Infrequent drinkers may only drink at special occasions that may or may not be reflected in an activity space of common locations. This may be especially true for subgroups of drinkers, like parents, who often have special considerations when thinking about consuming alcohol, such as childcare during the drinking event. Among parents, 40.4% report infrequent drinking (less than once a month), with 22.2% reporting drinking more frequently or at least once a month (Freisthler, 2011). For those risks that occur at low levels of drinking or among infrequent drinkers, an additional consideration in understanding the usefulness of the exposure of alcohol outlets through activity spaces is the extent to which these one-time or less routine locations fall in or out of routine activity space areas. Thus,

attempts characterize the role of the alcohol exposures on risk behaviors might be better served by using methods that assess activity spaces through survey methods, where specific questions about where and when drinking occurs might enable a better assessment of drinking risks. Further, parents who do not drink regularly may choose to purchase alcohol when performing other errands. Destination nodes or buffers (described below) around locations may better describe where purchasing behaviors are most likely to occur.

Parenting, Activity Spaces, and Alcohol Use

Alcohol use is a contributing factor in as many as 11% of all cases of maltreatment in the general population (Sedlak et al., 2010). Alcohol-involved maltreatment appears to be much higher for children involved with the child welfare system, where it is estimated that 40–80% of parents have problems related to alcohol use (Child Welfare League of America, 1990) and are higher among individuals reporting heavy drinking (Berger, 2005; Famularo, Stone, Barnum, & Wharton, 1986; Murphy et al., 1991, Kelleher, Chaffin, Holleberg, & Fischer, 1994; Sun, Shillington, Hohman, & Jones, 2001).

Given the severity of this problem, better understanding of how alcohol exposures may differ by an individual's use of his or her environment could lead to better estimates of how they relate to drinking behaviors, which in turn lead to child abuse and neglect. However, various strands of this literature have used different techniques to assess environmental exposure to alcohol, with little understanding of how these methods compare to each other, and which might be more comprehensive in estimating risk. Features of a neighborhood's alcohol environment (as measured by density of alcohol outlets) are related to higher rates of child maltreatment (Freisthler, 2004; Freisthler et al., 2007). This relationship remains even after controlling for levels of neighborhood disadvantage (Freisthler, 2004). More recently, use of drinking locations, such as bars and parties, have been related to higher use of physically abusive parenting practices (Freisthler, 2011; Freisthler & Gruenewald, 2013). As described above, local bars and off-premise outlets (within 0.5 miles) are related to increased use of physical abuse and corporal punishment, respectively (Freisthler & Gruenewald, 2013). This may be explained through parents' use of alcohol in their local environments, exposure to alcohol in those activity spaces, and drinking locations and contexts within these spaces. Having activity spaces where alcohol is more available, using these drinking spaces more often by the parent and his or her friends, and having friends who use alcohol may increase harsh or neglectful parenting practices.

In the first study assessing activity spaces among parents, Freisthler and colleagues (2016) found that parents with smaller activity spaces were more likely to use punitive parenting techniques (e.g., yelling at a child, sending him or her to bed without a meal). Size of activity space may be an indicator of social isolation of the parents or lack of social supports, which may lead to use of harsh or punitive parenting (Thompson, 2015). We also know that parent activity spaces differ on weekends compared to those during the week and can be divided into adult vs. child-centric locations (Wolf, Freisthler, Kepple, & Chavez, 2017). Currently, we have no assessment of how a parent's drinking locations may be related to these activity spaces and whether or not drinking spaces occur in or outside of daily living activities. This is important as studies examining exposures to opportunities to drink is

focused on residential neighborhoods (Freisthler & Gruenewald, 2013; Freisthler et al., 2015) and not larger activity spaces, which may misrepresent actual risks for alcohol-related child maltreatment.

This paper examines how several measures of environmental exposure to alcohol (e.g., residential neighborhood, routine activity spaces, and activity patterns) correlate with each other in a sample of parents of young children. In addition, we investigate how parental alcohol use differs by type of location (e.g. routine or rare) and the presence of children. Here, we are interested in whether measures of activity spaces or patterns capture those places where parents drink.

Purpose of Study

In this study, we examine how alcohol outlet density differs using various conceptualizations of 'neighborhood' and activity spaces. In other words, do exposures to alcohol outlets differ based on where one lives vs. where one spends time? If alcohol exposures differ between residential neighborhood and activity spaces, it suggests that measurement bias may be present in studies of neighborhood effects and alcohol availability. If these measurements do not differ, then using the easier method to obtain residential address is more efficient. We also conduct preliminary analyses to examine the extent to which individuals' travel occurs largely within or outside their residential Census tract for routine activities (e.g., grocery shopping) or one-time/rare events (e.g., trip to a zoo) to assess whether alcohol use may vary for these rare or non-routine locations.

Methods

Study Design and Sampling Procedures.

For this study, we conducted semi-structured interviews with 60 parents living in four different cities in the San Francisco Bay area (15 per city area). The four cities were purposively sampled from a list of 16 mid-sized, non-contiguous cities within a 60 mile driving range of the primary investigator's research institution to vary in demographic characteristics, geographic locations, and size (ranging from 60,000 to 140,000 population based on the 2010 Census). Potential respondents were recruited through advertisements on Facebook and Craigslist and flyers posted at places that parents frequent with their children (e.g., libraries). Interested individuals were invited to call or email a member of the study team, who would conduct a short eligibility survey. Parents who lived in one of the study cities and who had a child 10 years old or younger that lived with him or her at least 50% of the time were eligible to complete the interview. The 90-minute interview was conducted at a location chosen by the respondent. Respondents provided verbal informed consent and were given a $50 incentive for participating in the interview.

Sample.

The final sample was 50% male and 50% female and was racially/ethnically representative of the Bay Area (38% White, 23% Asian/Pacific Islander, 18% Latino, 13% African American, 2% American Indian/Alaskan Native, and 5% Other). Seventy-five percent of the sample was currently married and/or cohabitating. Sixty-eight percent of the sample

reported an annual household income of $35,000 or above, and 63% reported having at least a degree from a four-year college. Finally, we observed a diverse range of employment statuses (45% full-time, 10% part-time, 10% self-employed, 8% out of work for less than one year, 13% homemaker, 8% student, and 5% unable to work).

Measures.

Researchers used semi-structured interviews based on the Ecological Interview (Mason et al., 2004) to obtain information on participant's activity spaces. Participants were asked to "free list" locations they had visited within the past day, past week, and past month in sequential order. The aim was to obtain a census of locations each participant utilized during these time periods. For each location, the interviewer prompted with open-ended questions about how often they frequented the locations, who they were with (including whether their child was with them), what they do there, and drinking behaviors (if applicable).

The interview transcripts were quantitatively coded by two research assistants to construct activity spaces. To ensure reliability, 50% of transcripts were double-coded by both research assistants. All transcripts were first reviewed, highlighting any references to place or locations visited, as well as the address or descriptive information that would assist in geocoding. This initial reading resulted in the development of a coding system which was then systematically applied during a second review of the transcripts. Coders documented type of location (e.g., home, work, child care/school, relative/friend home, commercial store by type, indoor recreation, outdoor recreation, etc.). Participants reported the time of their last visit to each location (i.e., today, yesterday, within the last week, within the last month, or within the last year), frequency of visits (i.e., daily, at least weekly, at least monthly, or less than once per month), and who was present at the visit (i.e., relatives, their children). Coders also assessed whether or not drinking occurred at a given location based on the context provided in the transcript. Routine activity spaces were coded when locations were visited at least once a month and within the past month. In contrast, one-time or rare events were coded as locations visited less than once a month and/or last visited within the past year, but not the past month.

Data on alcohol outlets were obtained from the California Department of Alcoholic Beverage Control (ABC). ABC provides yearly licenses for venues that are allowed to serve or sell alcoholic beverages within the state. We created a density of alcohol outlet measures that included off-premise alcohol outlets (places where alcohol is sold but must be consumed elsewhere) using license types 20 and 21, restaurants that served alcohol (license types 41 and 47) and bars/pubs with license types 23, 40, 42, 48, 61, and 75. Alcohol outlet density was denominated by area (in square meters), depending on how activity space was conceptualized and measured.

Analysis Procedures.

All addresses were geocoded using ArcGIS 10.3. A total of 1556 locations were successfully geocoded from the 60 transcripts (85% of total reported locations). Missing information typically occurred when respondents could not fully remember or refused to disclose

specific information for the reported the location and these missing locations were predominantly visited at a frequency of one month or less (77.1%).

We created a variety of activity space and activity pattern measures using ArcGIS 10.3: 1) convex hull polygons; 2) one standard deviational ellipse; 3) two standard deviational ellipse; 4) shortest network distance based on the underlying street network; and 5) destination nodes. We should note that these measures are not an exhaustive list of activity spaces or patterns. Our selection of measures for activity spaces was guided by the work of Noah (2015) who discusses how different definitions of activity spaces may be related to parenting and Jones and Pebley (2014) who discuss the use of destination nodes in understanding exposures. These measures are compared to residential Census tracts, the primary neighborhood measure in child maltreatment research (Coulton et al., 2007; Freisthler et al., 2006). Convex hulls, also called minimum convex polygon, create a polygon that encompasses all of the x, y coordinates for a person's activity space, using a minimum distance where all the angles point inward and no angle is greater than 180 degrees. This measure assumes individuals purchase and consume alcohol primarily within the area where they conduct daily living activities as a measure of opportunities to drink. Standard deviational ellipses create ellipse polygons that take into account the location and spread of activity space points may be another measure of opportunities to drink within activity spaces. One standard deviational ellipses will include approximately 68% of an individual's activity space points. Two standard deviational ellipses will include about 95% of the activity space points. These measures of activity spaces assume that drinking purchases and events will be near to those daily activities, but not necessarily within the same polygon as all of the activities. The shortest network distance is created by determining the number of miles on the shortest route (shortest accumulated line length between the origin and destination) using all these activity space locations. We then created a 500-meter buffer around that path to create an area polygon. For this operationalization of activity space, we assume that individual's use roadways to obtain alcohol and primarily purchase and consume alcohol at locations close to the paths they take as part of their daily activities due to the cueing effect. Destination nodes were created by identifying all the Census tracts that contained the points in each person's activity space. These nodes reflect the fact that alcohol purchase behaviors are likely to be bundled with other activities near the locations where these activities occur. We then calculated the area (in square meters) for each activity space.

To assess differences in alcohol outlet densities using the various operationalization of activity spaces and residential neighborhood, we conducted bivariate correlations. We used chi-square analyses to understand how alcohol use with and without their child present may be different between non-routine locations that occurred in and outside the activity space or pattern and routine locations.

Results

Table 1 presents the results of the bivariate correlations examining the relationship between alcohol outlet density for residential neighborhoods as measured by Census tract of residence, destination nodes, activity patterns (measured using shortest distance between activity locations), and activity spaces using three different measurements: convex polygons,

one standard deviational ellipse, and two standard deviational ellipse. The alcohol outlet density in each of the activity space measures was not correlated with residential neighborhood. In addition to the lack of statistical significance, the magnitude of the correlation was fairly small. In contrast, the shortest network distance, one and two standard deviational ellipses, and the convex hull polygon measures were correlated with each other. Among those, the convex hull polygons and standard deviational ellipses had the greatest magnitude of positive correlations.

Of the 237 non-routine (i.e. rare) activity locations, most activity spaces and patterns found these locations outside those areas. Only the two standard deviation ellipses had more than 50% of these rare events occur within the activity space, with 57% of locations falling inside. This was followed by convex hull (43.5%), one standard deviational ellipse (35.4%), shortest network path (31.6%) and, finally, destination nodes (24.5%). Chi-square analyses revealed a statistically significant difference in alcohol use behaviors with or without a child present for rare or non-routine activities within the activity space, outside the activity space, and routine activity locations that made up the activity space for each activity space type we created. Rare locations had a higher proportion of alcohol use when children are present. Chi-square analyses cannot tell us which relationships drive statistical significance. However, alcohol use occurred more frequently (regardless of whether their children were present) inside activity spaces operationalized as convex hull polygons or two standard deviational ellipses. Similarly, destination notes, shortest network path, and one standard deviational ellipses had the highest percentage of alcohol use with their child(ren) present occurring in rare locations that fell outside the activity space measure.

Discussion

One goal of this paper was to assess how different measures of environmental context are related to the traditional use of residential Census tracts. We examined how total alcohol outlet density varied across each measure, finding that density for residential Census tract was not related to density of the activity space and activity pattern measures. These results are similar to Morrison and colleagues (2019) which found the highest correlations for outlet density among activity space measures (e.g, convex hull, ellipses), extending these findings to parenting contexts. This suggests that we need to be thoughtful when examining how the environment may affect social problems. Using residential address to understand social determinants of health or gene x environment interactions may limit our ability to design location-based interventions to reduce problems. Further, as discussed in the introduction, some types of activity spaces or patterns may be more relevant than others, depending on the behaviors being studied. For example, for studies of parents who rely primarily on public transportation, using a network-based activity pattern may be most relevant. Activity spaces created using the two standard deviational ellipse method will generally cover the most geographic area, which means it may be most likely to capture most of the environmental exposures experienced by parents.

Although alcohol outlet density in residential Census tract was not correlated with other activity space measures, it has been related to a host of social and health problems such as child abuse and neglect, assaults, and intimate partner violence (Cunradi et al., 2011;

Freisthler et al., 2007; Gruenewald & Remer, 2006). This suggests that where one lives is likely to exert some influence on these problems. Remaining questions include whether this measurement may undercount the total effect of outlet densities on problems or if activity spaces measure different types of risks for different types of problems. Developing strong theoretical frameworks to examine the social mechanisms by how residential neighborhoods or different types of activity spaces may affect different types of problems is essential in advancing our understanding of these problems and the development of interventions to reduce them.

The second goal of this paper was to assess alcohol use by activity space locations for parents. Here we found significant differences by alcohol use and having their child(ren) present for different types of locations, where a higher percentage of parents drank at non-routine locations where their children were not present. In other words, parent drinking may be more likely to occur at rare locations. We also found that convex hull polygon and two standard deviational ellipses capture a higher percentage of drinking events within the activity space, suggesting that more expansive measures may be better for assessing environments were risks occur. In our case, for parents, traveling longer distances without children might make parents more prone to the influence of cueing, which may increase drinking events. In this case, neither activity spaces nor residential Census tract would be the best measures to assess risk for harm due to alcohol use. Drinking location (e.g., bars, restaurants that serve alcohol, at parties) may be the key to understanding how environmental context may affect parenting risks. In contrast, rare events where no alcohol was used and children were present also occurred at a higher proportion in rare, non-routine locations, suggesting child-centered activities that were planned and purposeful may also be in parallel to adult-centered, drinking activities. One important consideration for future studies is how activity space or pattern data is collected. GPS monitoring, which often happens for short durations, may miss those rare locations. For a sub-set of parents, these locations may have the greatest alcohol-related risks. GPS monitoring may help capture routine locations and passive exposure to the alcohol environment; however, interview-based procedures may better highlight how to capture occasions where direct exposure and social interactions can increase alcohol-related risks.

Limitations.

We recognize that our study has important limitations. Our sample size is small. Although that allowed us to probe about each location mentioned, it also limits the generalizability of our findings. Future work should seek to examine these relationships in larger studies. Given our small sample size, we were only able to conduct basic bivariate analyses. Studies with larger sample sizes are needed to assess any possible social mechanism (e.g., cueing, social interactions) that may increase our understanding of how environmental exposures may result in problems. We also did not collect nuanced data on alcohol use behaviors, on drinking-related risks or harms (e.g., abusive and neglectful parenting), or on how they traveled to their drinking locations. Thus, we were unable to assess whether frequency of drinking behaviors differed by location type. Parents who drink more frequently may be more likely to use alcohol within their activity spaces than those who drink less frequently, and their choice of drinking places may greatly influence their daily activities. We only

examined a few measures that denote activity spaces or activity patterns. As the field continues to advance, the analysis of different measures of activity spaces and patterns, along with a strong theoretical framework, will help us better identify how environment affects parenting practices. These different characterizations may be also be prone to misclassification bias if parents do not spend time in those larger areas, except to drive between them. Thus, determining if differences found are due to exposure or misclassification will be an important next step of the field.

Future Directions and Conclusions.

As we move forward to understand and incorporate the physical and social environment in studies of health and social problems, we need to determine which context of measurement is best for the problem under study. Another consideration is how drinking locations may interact with activity spaces for different types of drinking behaviors. Are there ways that people move throughout their environment that distinguish them from others to heighten or reduce risk? A person who bundles their activities within destination nodes may have different risks than a person who stays along the network path. Although this study has limitations, it is one of the first to examine activity spaces and patterns for parents to understand how the alcohol environment and alcohol use behaviors may shape vulnerabilities for specific risks. By continuing to use activity spaces to explore these relationships, we can start to unpack the nuanced and complicated relationships that exist.

Acknowledgements.

This project was supported by grant number P60-AA-006282 from the National Institute on Alcohol Abuse and Alcoholism. The content is solely the responsibility of the authors and does not necessarily represent the National Institute on Alcohol Abuse and Alcoholism or the National Institutes of Health.

The authors have no potential conflicts of interests. The study received Human Subjects approval from the Pacific Institute for Research and Evaluation and the University of California, Los Angeles. All study participants were required to provide verbal informed consent.

References

Berger LM (2005). Income, family characteristics, & physical violence toward children. Child Abuse & Neglect, 29, 107–133. [PubMed: 15734178]

Brockmole JR, Castelhano MS & Henderson JM (2006). Contextual cueing in naturalistic scenes: Global and local contexts. Journal of Experimental Psychology: Learning, Memory, and Cognition, 32(4), 699–706.

Burton LM, & Jarrett RL (2000). In the mix, yet on the margins: The place of families in urban neighborhood and child development research. Journal of Marriage and the Family, 62, 1114–1135.

Chambers T, Pearson AL, Kawachi I, Rzotkiewicz Z, Stanley J, Smith M, Bar M Ni Mhurchu C, & Signal L(2017). Social Science & Medicine, 193,41–50. [PubMed: 28992540]

Child Welfare League of America. (1990). Crack & Other Addictions: Old Realities & New Challenges. Washington, DC: CWLA.

Chun MM & Jiang Y (1998). Contextual cueing: Implicit learning and memory of visual context guides spatial attention. Cognitive Psychology, 36, 28–71. [PubMed: 9679076]

Coulton C, Crampton D, Irwin M, Spilbury J, & Korbin J (2007). How neighborhoods influence child maltreatment: A review of the literature and alternative pathways. Child Abuse & Neglect, 31, 1117–1142. [PubMed: 18023868]

Cunradi CB, Mair C, Ponicki W, & Remer L (2011). Alcohol outlets, neighborhood characteristics and intimate partner violence: Ecological analysis of a California city. Journal of Urban Health, 88(2), 191–200. [PubMed: 21347557]

Famularo R, Stone K, Barnum R, & Wharton R (1986). Alcoholism & severe child maltreatment. American Journal of Orthopsychiatry, 56, 481–485. doi: 10.1111/j.1939-0025.1986.tb03480.x [PubMed: 3740231]

Freisthler B (2004). A spatial analysis of social disorganization, alcohol access, and rates of child maltreatment in neighborhoods. Children and Youth Services Review, 26(9), 803–819.

Freisthler B (2011). Alcohol use, drinking venue utilization, and child physical abuse: Results from a pilot study. Journal of Family Violence, 26(3), 185 – 193. [PubMed: 21475714]

Freisthler B & Gruenewald PJ (2013). Where the individual meets the ecological: A study of parent drinking patterns, alcohol outlets and child physical abuse. Alcoholism: Clinical and Experimental Research, 27(6), 993–1000.

Freisthler B, Gruenewald PJ, Remer LG, Lery B & Needell B (2007). Exploring the spatial dynamics of alcohol outlets and Child Protective Services referrals, substantiations, and foster care entries. Child Maltreatment, 12, 114–124. [PubMed: 17446565]

Freisthler B, Gruenewald PJ Ring L & LaScala EA (2008). An ecological assessment of the population and environmental correlates of childhood accident, assault and child abuse injuries. Alcoholism: Clinical and Experimental Research, 32(11), 1969–1975.

Freisthler B, Lipperman-Kreda S, Bersamin M, & Gruenewald PJ (2014). Tracking the when, where, and with whom of alcohol use: Integrating ecological momentary assessment and geospatial data to examine risk for alcohol-related problems. Alcohol Research: Current Reviews, 36, 29–38.

Freisthler B, Merritt DH & LaScala EA (2006). Understanding the ecology of child maltreatment: A review of the literature and directions for future research. Child Maltreatment, 11(3), 263–280. [PubMed: 16816324]

Freisthler B, Wolf JP, Johnson-Motoyama M (2015). Understanding the role of context-specific drinking in neglectful parenting behaviors. Alcohol and Alcoholism, 50, 542–550. doi: 10.1093/alcalc/agv031 [PubMed: 25810450]

Freisthler B, Thomas CA, Curry SR, Wolf JP (2016). An alternative to residential neighborhoods: An exploratory study of how activity spaces and perception of neighborhood social processes relate to maladaptive parenting. Child and Youth Care Forum, 45(2), 259–277. doi: 10.1007/s10566-015-9329-7 [PubMed: 27057130]

Gruenewald PJ and Mair C (2015) Heterogeneous dose-response and college student drinking: Examining problem risks related to low drinking levels. Addiction, 110, 945–954. [PubMed: 25689153]

Gruenewald PJ & Remer L (2006). Changes in outlet densities affect violence rates. Alcoholism: Clinical and Experimental Research 30(7): 1184–1193.

Jones M & Pebly A (2014). Redefining neighborhoos using common destinations: Social characteristics of activity spaces and home Census tracts compared. Demography, 51, 727–752. [PubMed: 24719273]

Kelleher K, Chaffin M, Holleberg J, & Fischer E (1994). Alcohol and drug disorders among physically abusive & neglectful parents in a community-based sample. American Journal of Public Health, 84, 1586–1590. [PubMed: 7943475]

Kwan M-P (2012a). The uncertain geographic context problem. Annals of the Association of American Geographers, 102(5): 958–968.

Kwan M-P (2012b). How GIS can help address the uncertain geographic context problem in social science research. Annals of GIS, 18(4): 245–255.

Leventhal T & Brooks-Gunn J (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. Psychological Bulletin, 126, 309–337. [PubMed: 10748645]

Lipton R, Gaidus A, Ponicki WR, and Gruenewald PJ (2018) Space-Time analyses of alcohol outlets and related motor vehicle crashes. Alcoholism: Clinical and Experimental Research, 42, 1113–1121.

Mair C, Cunradi C, Gruenewald PJ, Todd M and Remer L (2013) Drinking context-specific associations between intimate partner violence and frequency and volume of alcohol consumption. Addiction, 108, 2102–2111. [PubMed: 24112796]

Mason MJ, Mennis J, Coatsworth JD, Valente T, Lawrence F, & Pate P (2009). The relationship of place to substance use and perceptions of risk and safety in urban adolescents. Journal of Environmental Psychology, 29, 485–492. doi:10.1016/j.jenvp.2009.08.004 [PubMed: 20161426]

Mennis J & Mason MJ (2010). People, places, and adolescent substance use: Integrating activity space and social network data for analyzing health behavior. Annals of the Association of American Geographers, 101, 272–291. doi: 10.1080/00045608.2010.534712

Morrison CN, Byrnes HF, Miller BA, Kaner E, Wiehe SE, Ponicki WR, & Wiebe DJ (2019). Assessing individuals' exposure to environmental conditions using residence-based measures, activity location-based measures, and activity path-based measures. Epidemiology, 30, 166–176. [PubMed: 30721163]

Murphy JM, Jellinek M, Quinn D, Smith G, Poitrast FG, & Goshko M (1991). Substance abuse & serious child mistreatment: Prevalence, risk, & outcome in a court sample. Child Abuse & Neglect, 15, 197–211. doi:10.1016/0145-2134(91)90065-L

Noah AJ (2015). Putting families into place: Using neighborhood-effects research and activity spaces to understand families. Journal of Family Theory and Review, 7, 452–467. [PubMed: 26681979]

Patterson Z & Farber S (2015). Potential path areas and activity spaces in application: A review. Transport Reviews, 34, 679–700.

Sacks JJ, Brewer RD, Holt JB, Zhang X, Kanny D, Elder R, Gruenewald PJ (2019). Measuring alcohol outlet density: An overview of strategies for public health practitioners. Journal of Public Health Management and Practice online early. Accessed July 1, 2019 at https://europepmc.org/abstract/med/31136416.

Sedlak AJ, Mettenburg J, Basena M, Petta I, McPherson K, Greene A, and Li S (2010). Fourth National Incidence Study of Child Abuse and Neglect (NIS–4): Report to Congress. Washington, DC: U.S. Department of Health and Human Services, Administration for Children and Families.

Sun A, Shillington AM Hohman M, Jones L (2001). Caregiver AOD use, case substantiation, & AOD treatment: Studies based on two southwestern counties. Child Welfare, 80, 151–177. [PubMed: 11291899]

Thompson RA (2015). Social support and child protection: Lessons learned and learning. Child Abuse & Neglect, 41, 19–29. [PubMed: 25043921]

Wolf JP, Freisthler B, Kepple NJ, & Chavez R (2017).The places parents go: Understanding the breadth, scope, and experiences of activity spaces for parents. Geojournal, 82, 355–368. doi: 10.1007/s10708-015-9690-y [PubMed: 28392621]

Wolf JP, Ponicki W, Kepple NJ, & Gaidus A (2016). Are community-level prescription opioid overdoses associated with child harm? A spatial analysis of California zip codes, 2001–2011. Drug and Alcohol Dependence,166, 202–208. doi:10.1016/j.drugalcdep.2016.07.014 [PubMed: 27496625]

Table 1:

Correlation of Different Operationalized Definitions of Activity Spaces

	Residential Tract	Nodes	Shortest Network	One SD Ellipse	Two SD Ellipse	Polygon
Residential Census Tract	1	---	---	---	---	---
Census Tract Nodes	.135	1	---	---	---	---
Shortest Network Path	.192	.679*	1	---	---	---
One SD Ellipse	.009	.542*	.510*	1	---	---
Two SD Ellipse	−.065	.452*	.638*	.677*	1	---
Convex Hull Polygon	.037	.539*	.770*	.822*	.824*	1

* $p < .001$

Table 2:

Results of Chi-square Test and Descriptive Statistics for Alcohol Use and Location of Event (n = 1,420)

Destination Nodes	Location			
	Rare, Not Inside Activity Space	Rare, Inside Activity Space	Routine	F-statistic
Alcohol use	(n=147)	(n = 53)	(n=1220)	
No alcohol use, child not present	7.2%	3.8%	89.0%	19.35*
No alcohol use, child present	10.8%	3.7%	85.6%	
Alcohol use, child not present	19.3%	8.0%	72.7%	
Alcohol use, child present	8.8%	0.9%	90.3%	
Shortest Network Path	Location			
	Rare, Not Inside Activity Space	Rare, Inside Activity Space	Routine	
Alcohol use	(n=133)	(n = 67)	(n = 1220)	
No alcohol use, child not present	6.9%	4.1%	89.0%	30.20**
No alcohol use, child present	9.9%	4.6%	85.6%	
Alcohol use, child not present	12.5%	14.8%	72.7%	
Alcohol use, child present	9.7%	0.0%	90.3%	
One Standard Deviation Ellipse	Location			
	Rare, Not Inside Activity Space	Rare, Inside Activity Space	Routine	
Alcohol use	(n = 120)	(n = 80)	(n = 1220)	
No alcohol use, child not present	5.6%	5.3%	89.0%	18.60*
No alcohol use, child present	8.9%	5.6%	85.6%	
Alcohol use, child not present	15.9%	11.4%	72.7.%	
Alcohol use, child present	7.1%	2.7%	90.3%	
Two Standard Deviation Ellipse	Location			
	Rare, Not Inside Activity Space	Rare, Inside Activity Space	Routine	
Alcohol use	(n = 81)	(n=119)	(n = 1220)	
No alcohol use, child not present	3.8%	7.7%	89.0%	17.94*
No alcohol use, child present	6.1%	8.3%	85.6%	
Alcohol use, child not present	10.2%	17.0%	72.7.%	
Alcohol use, child present	4.4%	5.3%	90.3%	
Convex Hull Polygon	Location			
	Rare, Not Inside Activity Space	Rare, Inside Activity Space	Routine	
Alcohol use	(n=102)	(n = 98)	(n = 1220)	
No alcohol use, child not present	4.7%	6.3%	89.0%	22.24**
No alcohol use, child present	8.0%	6.4%	85.6%	
Alcohol use, child not present	10.2%	17.0%	72.7.%	
Alcohol use, child present	5.3%	4.4%	90.3%	

Note. Numbers in parentheses indicate row percentages.

* $p < .01$,

** $p < .001$