



Published in final edited form as:

Fam Community Health. 2015 ; 38(1): 66–76. doi:10.1097/FCH.0000000000000050.

Partnering with Youth to Map Their Neighborhood Environments: A Multi-Layered GIS Approach

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Abstract

Mapping approaches offer great potential for community-based participatory researchers interested in displaying youth perceptions and advocating for change. We describe a multi-layered approach for gaining local knowledge of neighborhood environments that engages youth as co-researchers and active knowledge producers. By integrating geographic information systems (GIS) with environmental audits, an interactive focus group, and sketch mapping, the approach provides a place-based understanding of physical activity resources from the situated experience of youth. Youth report safety and a lack of recreational resources as inhibiting physical activity. Maps reflecting youth perceptions aid policy-makers in making place-based improvements for youth neighborhood environments.

Keywords

Community-based participatory research; Geographic information systems (GIS); Physical activity environments; Group Level Assessment (GLA)

Introduction

This paper introduces and describes the application of a participatory, multi-layered approach for gaining local knowledge of neighborhood factors that may influence adolescent physical activity along a newly developed urban trail system. The approach integrates geographic information systems (GIS) with several participatory strategies that engage youth as both co-researchers and as active knowledge producers. Research activities for

youth include conducting environmental audits (sidewalk assessments), developing themes via participation in an interactive focus group, and creating paper maps as part of a sketch mapping exercise. The data collected and analyzed by youth are depicted using GIS, which permits the display of multiple layers of information and can subsequently be used for place-based interventions and improvements in physical activity environments.

Background

Data show that many U.S. youth are not engaging in sufficient levels of physical activity, contributing to high levels of obesity and chronic health problems.¹ A key factor for increasing youth physical activity is the presence of recreational facilities such as parks.² However, living in close proximity to recreational resources does not ensure access, particularly in low-income and minority neighborhoods, as access depends on a number of social and built environment factors that make up neighborhood environments.³ Social environment factors that can decrease levels of physical activity include safety concerns associated with fear of crime, street traffic, and incivilities such as graffiti,⁴ while built environment features such as the presence and quality of sidewalks play a key role in supporting youth physical activity.²

While features of the social and built environment have been shown to affect youth physical activity, their measurement presents difficulties due to their complex nature. Safety concerns have been evaluated in a variety of ways, including subjective measures examining fear of crime and safety from traffic, and objective measures focusing on lighting and neighborhood incivilities (e.g., graffiti, broken glass).^{2, 4} Similarly, researchers have used a number of procedures for measuring the built environment, including perceived measures (e.g., questionnaires about neighborhood parks), GIS measures using secondary data (e.g., density of park acreage, street connectivity), and objective tools. Examples of objective tools are environmental audits. These audits can be used to systematically assess street-scale features of the built environment, such as the presence, width, and quality of sidewalks, along with a variety of other social and built environment factors that relate to physical activity, including recreational facilities (e.g., parks), traffic levels, land uses, and safety.⁵ Due to challenges associated with traditional audit tools that include a large number of items and the need for trained experts to conduct the assessments, shorter audit tools have been developed that are designed for use by community members with minimal training.⁶ Conducting environmental audits with local community members presents an opportunity to gather both objective and subjective information about neighborhood environments from local experts.⁷

Over the last decade, public health professionals and researchers have become increasingly interested in partnering with community members to ensure that interventions are relevant to local communities and can promote health and motivate social change.⁸ Community-based participatory research (CBPR) emphasizes collaborative endeavors between academic and community partners, with shared decision making throughout the research process.^{9, 10} By partnering with the people who are intended to benefit from health promotion and community development efforts, CBPR increases the likelihood that interventions are feasible and will have a long-term impact. Since participatory methodologies used in CBPR

give a voice to individuals not usually represented in the research process, youth are an ideal fit for CBPR efforts.¹¹

Closely connected to CBPR are endeavors in the fields of public participation GIS¹² and qualitative GIS,¹³ where researchers have been developing strategies for collaborating with youth to map their perceptions of neighborhood environments and to then use those maps as tools for advocacy. For example, Wridt (2010) used a qualitative GIS approach involving sketch mapping exercises and travel diaries to document youth travel patterns, the use and perception of physical activity spaces, and the locations of areas with safety concerns.¹⁴ As part of approaches labeled qualitative GIS and participatory photo mapping, Dennis (2006) and Dennis et al. (2009) integrated participatory photography, focus groups, and interviews with GIS to create youth narratives about specific locations within their neighborhoods.^{15, 16} Maps created from these projects revealed a number of important findings concerning the importance of mapping youth perceptions, including that youth perceptions of crime and safety were not spatially aligned with existing crime data. These projects also provided youth participants with opportunities to present the results in public forums and provide guided neighborhood tours for local health officials.

Outcomes of these projects illustrate the potential impacts of youth collaborations using GIS, highlighting the complex influence of neighborhood social environments on youth physical activity. They also reveal the need for locally tailored approaches in health promotion that incorporate situated knowledge of local youth. This paper describes the pilot testing of a multi-layered approach that engages youth as co-researchers in their social and built environments. First, youth conduct environmental audits combined with digital photography to gather objective and subjective data about neighborhood sidewalks, safety, and physical activity resources. Second, youth take part in an interactive focus group strategy (Group Level Assessment, or GLA) where youth produce their own themes related to the most important features of their neighborhood environments. Third, youth create sketch maps that display additional place-based data related to youth concerns about safety. These three layers of data are then integrated into a GIS, producing maps that display how multiple layers of youth knowledge vary across their neighborhood environments.

Study Area, Community-University Partnership, & Youth Collaborators

The study focused on five neighborhoods that adjoin an urban trail system¹⁷ in Covington, Kentucky, which is part of the Greater Cincinnati, Ohio metropolitan area. Recent estimates place Covington's school district population at 4,707, with more than 40% of students living in families in poverty.¹⁸ The study area was selected to pilot test our participatory approach because: (1) the urban trail system is a newly introduced project still under development and (2) local schools buffering the trails lack physical activity opportunities¹⁹ and have high rates of overweight or obese students.²⁰

A key partner in this research is the Center for Great Neighborhoods (CGN), a Covington nonprofit organization that facilitates a number of youth programs including *Art by Covington's Future*, a three-week summer program where local youth earn money while learning digital photography and taking part in community projects. Fifteen youth were

enrolled in the 2012 summer program and CGN staff recruited 100% of participants. A multidisciplinary research team collaborated with CGN staff to design a program that would (1) engage youth in fun activities where they could learn about digital photography and their local environments, and (2) collect data that could be used to inform stakeholders about the corridors between trail system access points and other important public spaces for children, including parks and schools.

All of the children (ages 11-17, median age of 14) enrolled in the program consented to and participated in 100% of the planned activities. Of the 15 participants, nine lived within the five-neighborhood study area, while four lived in adjacent neighborhoods and attended the high school located within the study area. More than 50% of the participants were African-American (eight) and 33% were white (five), while the remaining two participants were Latino and multi-racial. Thirteen (87%) of the participants were female and 14 (93%) of the participants came from families below 200% of the Federal Poverty Line.

The Multi-Layered GIS Approach

Focusing on neighborhoods surrounding an urban trail system, this project was designed to collaborate with youth to gather first-hand knowledge of their neighborhood environments. An emphasis was placed on those neighborhood factors that could prevent youth from accessing and utilizing the trail system, including the presence and quality of sidewalks and perceptions of local parks and playgrounds along the trails. In addition, safety was a major focus as preliminary work done by the CGN identified safety as a concern among area youth. Together, the CGN and academic partners collaborated to create a multi-layered approach that incorporated three methods and one integration process, as depicted by Figure 1.

Method 1: Environmental Audits and Digital Photography

The environmental audit tool used in this research (the Neighborhood Walkability Assessment, or NWA) is a youth-report form adapted for this study from two existing tools: the Walking and Biking Suitability Assessment (WABSA)⁶ and the Pedestrian Environmental Data Scan (PEDS).²¹ The NWA instrument consists of a single page of 16 items to be assessed, including a subjective assessment for safety, where youth are asked to respond to the following statement: “I feel safe walking on this sidewalk”. The response choices range from 1 to 5 (Strongly Agree to Strongly Disagree), with higher scores equating less favorable walking conditions, and lower scores indicating more favorable walking conditions.

On the first day of the project, youth participated in an audit training session, which consisted of a brief presentation to explain each of the items and included pictures that showed examples and instructions on how to score the items. Youth were then instructed how to assess the subjective safety item by using both observation and their own experiences. Next, the youth practiced on sidewalks surrounding the Center for Great Neighborhoods (CGN), conducting several audits on their own, with assistance from the project staff. On the next two days of the project, participants convened at the CGN and were placed into groups of two or three. Each group was provided with a clipboard

containing audit sheets, directions, and a map of the area. Also, groups were given a camera, with all team members helping to complete the audit tool and providing input on what pictures to take. Participants were encouraged to photograph features promoting social and physical activities outside, emphasizing parks and playgrounds, and “bad things,” or features that may inhibit physical activity, such as places that are not safe due to fear of crime and incivilities (e.g., broken glass). CGN staff members were trained to assist participants, but not to dictate audit scoring or what features youth chose to photograph. The research team selected more than 300 sidewalk segments to be audited by youth based on their proximity to local schools and trail access points, and the corridors connecting these locations. Also, the CGN conducted preliminary research to help place participants in the areas that were most familiar to youth.

Method 2: Group Level Assessment (GLA)

After completing the audits, youth convened at the CGN to participate in a Group Level Assessment (GLA). GLA is an interactive focus group strategy that allows individuals to not only share opinions, but also to analyze data across participants and to move toward action planning.²² The GLA was a three-step process. First, youth participants walked around a large room and provided written responses to 16 prompts written on poster-sized papers hanging throughout the room. The posters contained pictures (taken by youth during audits) and sentence prompts related to physical activity and/or their neighborhood environments. Examples of prompts include the following: “I would like to walk to school but don't because...” and “What is good/bad about these places (arrows pointing to pictures of three parks in the study area)?” Second, the 16 posters were divided into four groups and given to youth (who had been placed in groups of three or four). Youth were then instructed to search for common themes contained on the posters, and to create a list of the most important ideas from their posters. In the final step, each small group presented their main ideas to the larger group, after which a trained facilitator led a large group discussion to identify overall themes from across all the groups.

Method 3: Neighborhood Sketch Mapping

After the GLA, participants took part in a sketch mapping exercise. Each youth was first given colored markers and a paper map of the study area. The youth were then asked to mark the locations of their house, friends' houses, and places where they play and hang out. Also, an emphasis was placed on having the participants identify “bad places,” which were described as areas where youth did not feel safe for potential reasons such as concerns over strangers, illicit activities (gangs, drugs), or traffic. One result of this process was a series of paper maps that displayed the locations of safety concerns from the perspective of the youth.

Integration Process of Data into GIS maps

Data collected from the environmental audits, the GLA, and sketch mapping were then integrated into GIS. First, the scores for each of the items of the audit were entered into an Excel spreadsheet and joined to a GIS (ESRI's ArcGIS 10.0) Covington sidewalk shapefile. This allowed neighborhood sidewalks to be displayed on maps and color-coded based on audit scores. After analyzing the youth sketch maps, the final layer of data added to the GIS was a composite youth map that displayed the specific locations of areas perceived as

unsafe. The final product is a GIS database that contains all of the layers in the participatory process, thereby allowing the creation of maps that contain the audit, GLA, and sketch mapping data.

Results: Demonstrating the Utility of the Multi-Layered GIS Approach

By partnering with youth using multiple research strategies, this project produced data identifying how youth perceive their neighborhood environments: Youth assessed 250 sidewalks, took over 500 pictures, commented on 16 poster prompts, identified four major themes (from the GLA), and produced 15 paper maps (from the sketch mapping exercise). We demonstrate the utility of our approach by focusing our results on how the environmental audit and sketch mapping data supplement the two youth-identified themes related to physical activity resources (1) *“There are not enough activities or recreational space,”* and perceptions of safety; and (2) *“There are some places where we feel safe, others where we do not.”*

The first theme - *“There are not enough activities or recreational space”* - was identified by youth participants who expressed general dissatisfaction with parks in the area, largely that they did not offer much for adolescents and were more appropriate for younger children. Participants described neighborhood parks as “boring” or “kiddish,” and of the major physical activity resources discussed during the GLA, only one (Austinburg Park; see Figure 2) had multiple youth participants describe it in a positive way. This theme was also apparent through examining the sketch mapping data: Participants were asked to mark places on their map where they played or hung out; nearly all destinations were noted as the locations of their friends' houses, and only one map had a park and school marked on it. Despite having several parks within proximity to schools and trail access points (see Figure 2), participants tended to identify places outside Covington as offering their preferred activities.

For the second theme - *“There are some places where we feel safe, others where we do not”* - youth expressed fears about individual “strangers” and car traffic that could be situated by geographic location and further contextualized. Closely related to the first theme, many participants expressed concerns about safety as reasons for not visiting neighborhood parks; comments about parks included “creepy people,” “bad people,” and “unsafe.” Figure 2 shows “bad places” that participants marked on their paper maps (represented as ovals) and unsafe sidewalks identified during the environmental audit process (represented as bold lines). The sketch mapping and audit data helped evaluate the spatial distribution of the youth-identified safety theme, making it clear that concerns related to safety were concentrated in the northern half of the study area and near particular trail access points. It was also revealed during the GLA (and supported by the mapping data) that the safety concerns in the area stemmed largely from a mobile home community located between two access points along the trail system. This area was further qualified by local stakeholders and CGN staff as a center for criminal activities such as drug trafficking and prostitution.

Safety from traffic was also included in the youth-identified safety theme. Participants described the dangers posed from cars as a barrier to getting around their neighborhoods,

particularly when traveling by bicycle. During the GLA, more than half of the participants noted that they like to ride their bikes around their neighborhood, while a third of participants responded that they ride their bikes to school. Group consensus among bike-riding participants was that it was far too dangerous to ride in the street, so they always ride their bikes on the sidewalk. Figure 3 displays the data from the neighborhood audits and shows the location of particular streets identified as having heavy traffic (in bold). While many of the streets have very little traffic (according to official traffic counts), the map reveals that youth perceive high levels of traffic on several of the streets surrounding the schools, parks, and trail system access points.

Summary of Multi-Layered Approach and Community Outcomes

This paper described a multi-layered GIS approach, which combines three methods and one integration process, for engaging youth and gathering knowledge of their neighborhood environments. First, environmental audits were combined with digital photography to provide objective and subjective data about youth neighborhood environments. Second, Group Level Assessment (GLA) produced youth-generated themes describing group consensus about neighborhood environments. Third, sketch mapping provided an additional layer of data related to the safety concerns of youth, as participants marked on paper maps the specific location of areas perceived as unsafe. Finally, we used GIS to integrate the multiple layers of place-based data on youth perceptions of safety, sidewalks, and physical activity resources such as parks. We also reported a subset of our results to demonstrate the utility of the multi-layered GIS approach. Two youth-identified themes were discussed: one related to a lack of recreational activities and spaces, and the second related to how safety concerns were not uniform across the study area. Themes were supplemented with additional layers of data collected from the neighborhood audits and sketch mapping.

In addition to gaining an understanding of how youth perceive their neighborhood environments, important goals of this pilot project were to engage local youth in the research process and to use the results to inform interventions for neighborhood improvements, particularly in the under-resourced areas surrounding the new urban trail system. Throughout the project, youth proved capable and enthusiastic about using the audit tools; several participants discussed how they have used the knowledge learned in the project to educate parents about the importance of the built environment, pointing out areas in their neighborhood with poor sidewalks or missing crosswalks. Participants also had a role in presenting the results to the community. The first author presented the research, along with one of the youth participants, at the CGN in a public forum that was attended by neighborhood residents, the coordinator of the urban trail system, and several of the youth participants. The presentation was part of a photography exhibit where the youth proudly displayed a collection of photos taken during their summer research project.

While the total impact of this project is yet to be determined, we can report a few outcomes that have resulted from this research. First, a mobile home community located along the trail system, which every participant viewed as the potential source for many of the safety concerns, was removed. While its removal is not a known direct result of this project, we believe that the maps produced by this project helped raise awareness about the mobile

home park as a potential barrier to accessing and using the urban trail system. A second outcome is related to efforts of the City of Covington to improve its sidewalk infrastructure. City officials learned of our project and asked us to share the youth maps, which are now being used to help prioritize areas along the urban trail system in need of sidewalk improvements.

Discussion

CBPR has emerged as an effective strategy for engaging local residents as active participants in the research process and developing interventions based on their needs. However, communicating the results of community-based projects in a manner that reaches policy-makers and spurs real change remains a challenge. To overcome this challenge, “the knowledge and expertise of local people needs to be made concrete and tangible.”²⁴ The multi-layered GIS approach outlined in this paper serves as a possible model for CBPR researchers as it integrates multiple levels of data into maps and allows the complexity of youth perspectives to become concrete and tangible to policymakers. For this approach to be effective, the most important ingredient is to have a partner that is known and respected in the community and that understands the key issues. CGN staff had well-established relationships with many of the youth as they had previously participated in any number of their youth programs. This helped to not only ensure that youth participants were placed in neighborhoods in which they had familiarity, but also allowed us to prioritize neighborhood audits in potential “problem areas” so that we could maximize our limited resources. Further, the knowledge of CGN staff helped to contextualize and validate some of the youth judgments about safety, with the mobile home community cited above as an example. Finally, CGN's subsequent work offers a few examples of how this project may continue to impact the community. The CGN mapped data from a separate project focused on bullying and found spatial correlations with “bad places” identified in this project. The CGN is also using this experience and has partnered with a local health initiative that has adopted our Neighborhood Walkability Assessment (NWA) to identify ways to improve routes for a community walking campaign.

Limitations

Despite having a committed community partner in the CGN, engaging youth in a multidisciplinary project that integrates several methods with GIS presented a number of challenges. A first set of challenges involved the NWA audit tool. The NWA was created by adapting items from existing tools that have been tested for validity and reliability; however, no such testing was completed for the NWA. Time constraints also prevented a more comprehensive training session on conducting neighborhood audits that have been described in previous research.⁶⁻⁷ In addition, planning the routes of each participant was unexpectedly challenging and time-consuming, as was data recording into a spreadsheet and joining it the GIS. A second set of challenges involved the utilization and integration of the photos and sketch mapping data. Youth took hundreds of pictures during the neighborhood audits, some of which were used as prompts for the GLA. However, the majority of the photos were not used and we found it difficult to find ways to integrate the photos into maps. Incorporating the sketch mapping data also presented difficulties. The youth produced

15 paper maps that displayed the locations of different features in their community. Youth were encouraged to have fun with the project using a variety of symbols (e.g., “frown faces” for unsafe places, “stars” for places they play), but some of the resultant maps were then messy and difficult to interpret. Another challenge with the sketch mapping was a lack of time, which prevented explanation about what the youth were marking on their maps. For example, in some cases youth marked the location of unsafe places and did not have the opportunity to describe why they perceived these places as unsafe.

Directions for Future Research

We conclude the paper by offering suggestions for future research that could help overcome some of the challenges discussed above and build and improve upon the multi-layered approach. While the process we have presented is meant to serve as a model, researchers wanting to replicate it should view it as flexible, dependent on the purpose of project, the needs of the community, and the available resources. This is particularly true for the neighborhood audits, which require a lot of resources and can vary considerably based on location. If audits are important, researchers may want to review other available tools (beyond the NWA) to find the best fit for their community.²⁴

A second direction would be to have the youth take fewer photos and to incorporate narratives or other aspects of participatory photo mapping to provide an additional source of youth data.¹⁷ A third direction would be to integrate the GLA process with sketch mapping. Here researchers could supplement the individual youth sketch maps with an overall community map that is marked on by all participants, where the pictures taken from the audits are used in the GLA and appended to their specific location on the map. This would allow discussion among the youth as a group about their perceptions of neighborhood features, culminating in a final product of one map produced directly by youth. If available, this map could also incorporate data related to community risks, such as actual crime statistics, land uses (e.g., vacant buildings, liquor stores), and incivilities (graffiti, broken glass).¹⁴ An additional strategy could be to have youth talk or write narratives about their individual maps; this would allow them to describe in their own words what they put on their individual maps and the reasons for doing so. Also, depending on availability, researchers could also incorporate data related to actual crime statistics, land uses (e.g., vacant buildings, liquor stores), and incivilities (graffiti, broken glass).

A fourth direction would be to involve the parents of youth participants, as parents often play a key role in shaping how youth perceive safety issues in their neighborhoods.² Comparing youth and parental perceptions could justify the need for including youth in CBPR approaches, as preliminary evidence shows that significant differences exist between youth and adult perspectives, particularly related to safety concerns.²⁵ While it would involve numerous challenges, a final direction of research involves engaging youth directly with the GIS. In this project youth were not involved with inputting the data into GIS or creating the final maps. Providing youth access to GIS and having them create their own maps would add an additional level of engagement while teaching them new skills.

Acknowledgments

Supported in part by USPHS Grant #UL1 RR026314 from the National Center for Research Resources, NIH.

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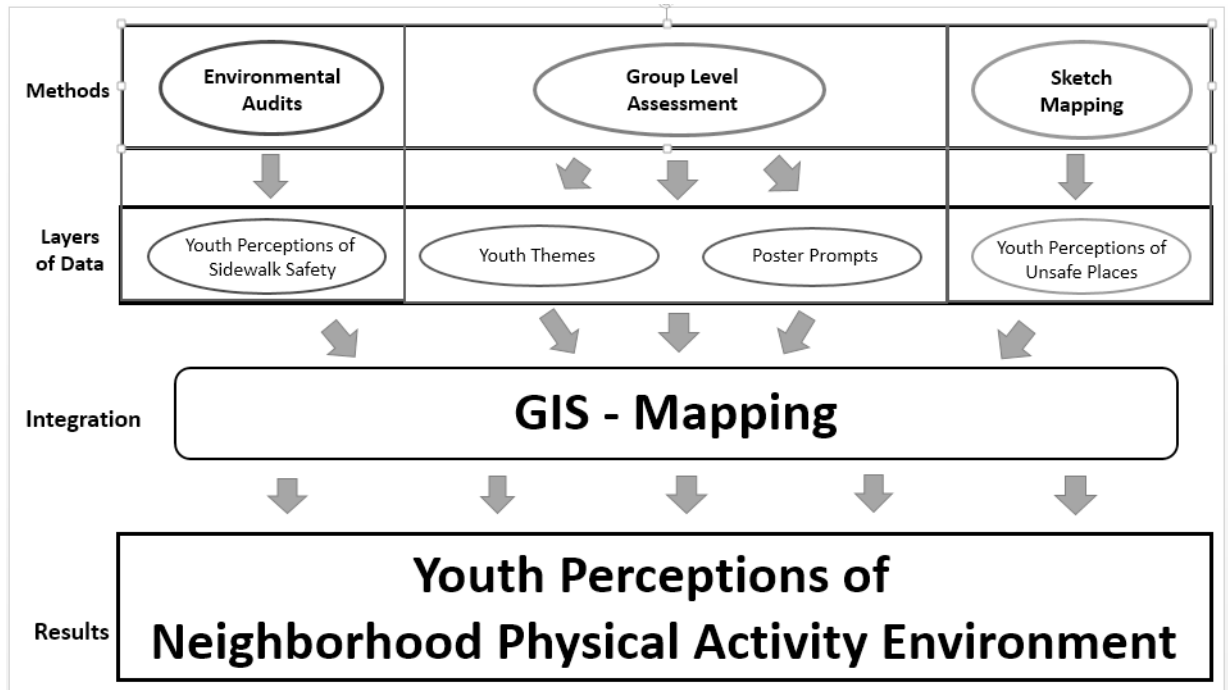


Figure 1. The Multi-Layered GIS Approach

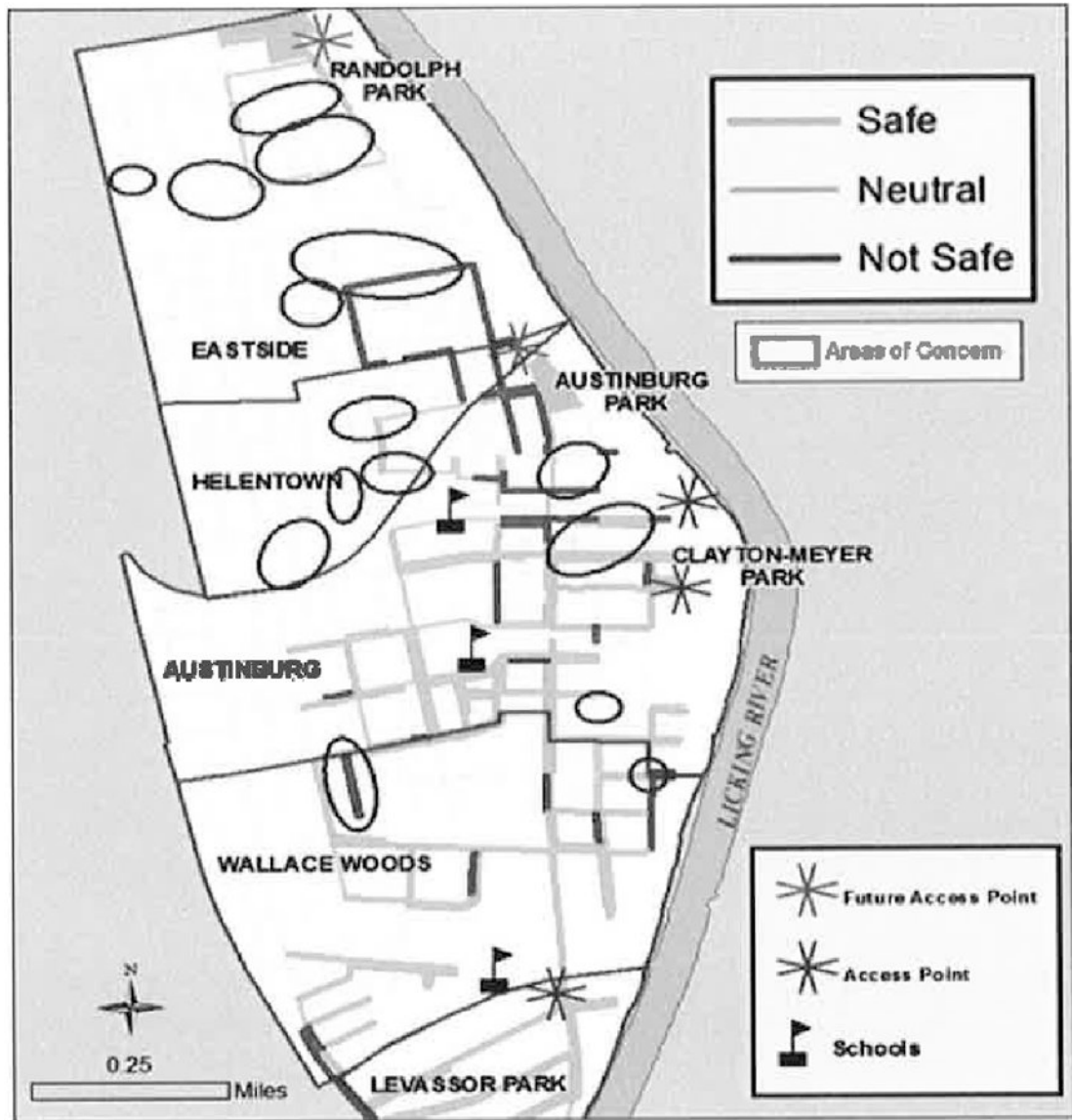


Figure 2. Youth Audit Safety and Sketch Map



Figure 3. Youth Perceptions of Traffic