

Purpose of Study

The purpose of this study is to examine exposure to secondhand smoke in respect to people's pedestrian movement throughout the neighborhoods in Morningside Heights, Bloomingdale, and the Manhattan Valley. This study seeks to examine the exposure of individuals to secondhand smoke throughout the neighborhoods adjacent to Avery Hall and Columbia University. This corridor receives a large amount of pedestrian traffic every day as people are constantly walking in the Morningside Heights, Bloomingdale, and the Manhattan Valley neighborhoods both to walk toward Columbia University, away from Columbia University, and toward the mixed use corridors in the Bloomingdale and the Manhattan Valley neighborhoods. We expect to see high smoker concentrations.

Data Sensors and Collection

The study will utilize several different types of sensors including a smartphone as a physical push button and GPS sensor to record the location with the timestamp of where different smokers were observed. This will be the primary mode of data collection to collect the concentrations of smokers in the neighborhood at various times of the day depending on the walking route. The study will be conducted using body sensors attached to the students or volunteers, in this case as a pilot, the ones who are going to gather the data are the authors. The sensors wearer will walk through the Morningside Heights, Bloomingdale, and the Manhattan Valley neighborhoods both to walk toward Columbia University, away from Columbia University, and toward the mixed-use corridors in the Bloomingdale and the Manhattan Valley neighborhoods. Additional sensors, such as particulate matter monitors, nicotine detectors, and polymer film sensors, will also be utilized. The particulate matter monitor measures the concentration of particulate matter throughout the air released from cigarettes. The nicotine detectors measure the concentration of nicotine in the air. The detectors help to detect tobacco smoke because it contains high levels of nicotine, a major cigarette chemical. The last sensor that will likely be utilized are polymer film sensors, a type of air quality sensor. These sensors can measure nicotine vapor molecules from secondhand smoke utilizing polymer films.

Data Types

The information from these sensors will be recorded as several different data types. There will be point data that will reflect the time and location where smokers were observed. There will be lines reflecting the walking routes we took throughout the day at certain times. Then, continuous polygon data will be collected, reflecting the air quality by measuring the different levels of particulate matter, nicotine, and nicotine vapor molecules. We expect to observe tiny drops in air quality when walking by smokers in Morningside Heights, Bloomingdale, and the Manhattan Valley neighborhoods.

Data Visualization

As for data visualization, we intend to use a map that displays the point data of the smokers, along with the walking route that we took. Visualization will be made of the total amounts of point data where smokers were observed. There will also be a time series that reflects the walking route and the smokers that were observed

throughout the travel path to the different neighborhood destinations. The continuous polygon data of air quality (reflected in particulate matter, nicotine, and nicotine vapor levels), will also be integrated into the map. Based on the information about smokers found during the study, the amount of secondhand smoke that we breathed in will be estimated. The amount of chemicals that we were exposed to will also be estimated to roughly determine how much secondhand smoke I was exposed to over the course of the study.

Scales

The study's object scale involves using wearable sensors, and we are thinking of wearable devices that are more static, like embedded on a shirt or a belt. These devices have a subtle look, so the wearer does not feel like a walking clown in the neighborhood. On a larger scale, static sensors can be placed several feet from the smoking area to determine the air quality around the locus.

Technology & Prototype

The images below show the general process of the pedestrian secondhand smoke study in the Morningside Heights, Bloomingdale, and the Manhattan Valley neighborhoods and the Columbia campus. First, results will be recorded with the individual points of the smoker with a time and location stamp. The recording of results from several different times will result in the creation of a collective point map database. Next, different analyses can be performed including a cluster hot spot analysis to identify the areas in the neighborhood where there are higher concentrations of smokers overall. Next, the time series can be created in respect to the individual points that smokers were found, and the overall hotspots in the neighborhoods. The map can then be overlaid with different maps from data recorded from the air quality sensors, with respect to measured elements such as particulate matter and nicotine concentration in the air. In the end, a personalized map would be able to be created showing how much secondhand smoke an individual person was exposed to, as well as any other chemicals they might have been exposed to. This might also be able to be visualized in respect to the human body to how many toxins are consumed. We expect secondhand smoke in the neighborhood to be significant.

Sensor Technology and Data Analysis (Images Generated with DALLE)

