Impact of Urban Climate on Running and Jogging

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ABSTRACT

This project studied over the summer mainly focuses on the effects that different environments have on city runners. The study involves logging 3-Kilometer runs all around New York City including urban and rural settings through a span of two weeks. Throughout that time the runners were exposed to different conditions to see the effect of climate and environment on the recorded stats. The data was recorded using a Garmin sports band (Fenix 3) that monitored the heart rate, pace, route, and temperature of the surroundings with different sensors strapped to the runner's body. The data was compiled and analyzed using the programming and GIS software R. Conclusions were drawn from the analyzed and graphed data to observe any correlations in the data collected.

INTRODUCTION

Running is a popular activity in NYC. You can see people jogging in parks and on sidewalks daily. It is a very good form of exercise because it improves endurance /stamina and raises heartbeat speed, allowing the passage of oxygen to better flow throughout the body. Climate and environment are two factors that determine the performance levels of running. A runner's performance has an inverse relationship with the temperature of his/her running location. The higher the temperature, the lower the performance levels. Running in urban areas tends to reduce the overall performance of runners because tall buildings absorb heat, which causes an increase in temperature of the area (by as much as 10 degrees) in comparison to the average temperature observed in other parts of the city. Likewise, vegetation absorbs CO_2 emissions generated by fossil fuels which generates heat. [Basically, the different areas' conditions account for the changes in temperature that affect the runner.]

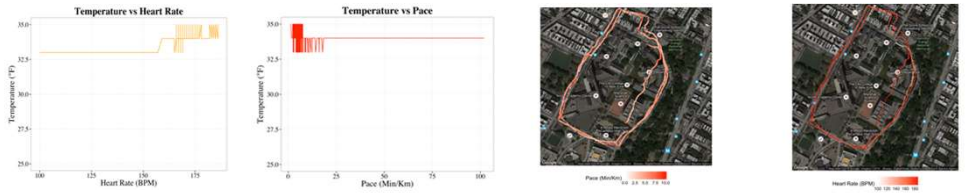
METHODS

To collect data, we ran in multiple places in different parts of New York with varying environments. The locations included: Central Park, St. Nicholas Park, FDR Drive, Harlem River Park, Riverside Park, CCNY, and Williamsburg. The selected areas vary in the surroundings, especially in terms of the surfaces, which allows us to make comparisons between urban and rural-like settings.

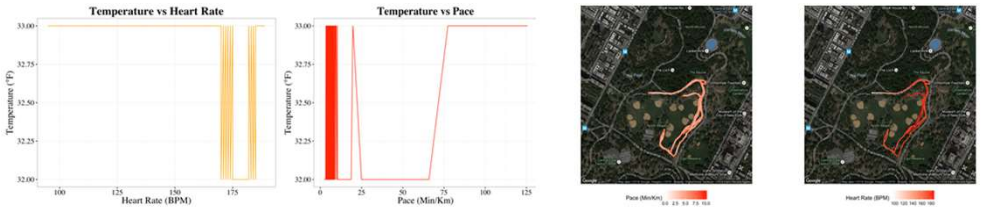
Garmin: The technology used to collect data during runs. The Fenix 3 watch recorded our pace, elevation, cadence, ground contact time, etc. A heart rate monitor was strapped around the chest to record the heart rate. A small pocket sized thermometer recorded the surrounding temperature. All this data was compiled into Microsoft Excel spreadsheets, which were used to analyze the data.

R: This programming language was used to compile (and organize) the data, importing the ggmap package which takes in coordinates for longitude and latitude to map out movement using Google Earth. The data was then compiled into graphs to better visualize the results-- scatter plots for comparisons and routes each runner ran for tracking. The scatter plots compared heart rate to temperature to pace in order to analyze the relationship between them, while the maps compared each of these to time.

OBSERVATION / RESULTS



The standard urban location used for this analysis was CCNY because its running path is surrounded by tall buildings and consequently it had the highest temperature per heart-rate and temperature per pace data. The standard rural location used was Central Park because its running path consisted of mainly trees and grasses, did not have buildings around it, and as a result had the lowest temperature per heart-rate and temperature per pace data. It was observed that temperature had a proportional relationship with the runner's heart-rate and an inverse relationship with pace. In correlation with our observations, we recorded the highest heart-rate and the lowest pace data at CCNY; and at Central Park, we recorded the lowest heart-rate and highest pace data of all the locations used during the experiment. For this experiment, the runners mostly ran on concrete, which is a good absorber of heat and has a high emissivity. Due to this, concrete contributes to a higher than normal temperature in urban locations like CCNY. Another observation made from this experiment was that the FDR Drive, Riverside Park, and Harlem River Park running sites were located close to water and highways. Water has a high specific heat capacity allowing it to absorb a lot of heat from the sun, but it has a low emissivity. The environment of these locations contributed to a temperature reading that was cooler than the recorded temperature of the city at the time of the run because of the nearby water. This caused deviations in the data in that places such as Harlem River Park and FDR Drive, which could be considered urban since they contain minimal vegetation and are surrounded by structures, had lower temperatures than other urban areas and even rural areas. For all the locations, the heart-rate vs time and pace vs time showed a similar trend as shown in the plots. As people run, their heart-rate increases so that their body can keep up with the demand for oxygen and so that they can maintain a constant pace. Once the temperature has reached the highest possible value, the heart-rate hovers around the same values at that temperature until the end of the run, as shown by the maps and plots.



CONCLUSIONS

In conclusion, urban areas hinder the performance of runners more than rural areas. This is because urban areas are full of buildings and have more exhaust fumes, which store and release heat into the environment. This heat causes more stress on runners in the form of higher temperature and heart rate. Not only that, but also urban places contain more asphalt and concrete than rural areas. These two types of surfaces absorb and emit more heat than surfaces in rural areas, such as vegetation. Overall, the effects of running in urban areas are a hotter temperature and a faster heartbeat, which means a person has to work harder when running in places such as cities.

FUTURE WORK

- **Run on different materials like grass, sand, asphalt e.t.c to see how the thermal conductivity of these materials affect a runner's performance.**
- **Run in areas with differing amounts of vegetation and buildings, using a control of a vacant plot.**
- **Run near bodies of water with differing sizes to see the pattern of its effect on the temperature/runners stats**
- **Run while monitoring the times in the shade or sun and its effects on the material under the runner's feet**

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