Impact of Urban Climate on Running and Jogging

Brandon Ram[1], Kings Odigie[2], Muneeb Rana[3], Michael Sangobanwo[4], Prathap Ramamurthy[5]

[1]brandonram@scholarsnyc.com, The Scholars' Academy, [2]kingso@scholarsnyc.com, The Scholars' Academy, [3]muneeb.rana22@gmail.com, Curtis High School, [4]msangobanwo@gmail.com, The City College of New York, [5]rprathap@gmail.com, The City of New York

Abstract

A phenomenon which proves to be sweeping this nation for the last couple of years is the aspiration to get or maintain fitness. Though many take vastly different approaches to achieving such fitness, one widely popular method is running. Such is evident in one of the better known cities in the world, New York City. On any given day, it would be rare to not see individuals running through the streets of New York. Such individuals often times can be seen choosing routes based on what may be most convenient for them compared to what may be most efficient. **Will different environments provide different results? Does it matter if an individual runs in a very urban area or a park? Is it possible that the presence of trees impacts a person's overall performance during a run?**

For our research project, we aim to answer such questions by conducting tests to see how the environment affects our running performance. Throughout our series of trials, we have put running to the test in different environments such as those accompanied by a body of water, those that are highly populated with cars and buildings, and those surrounded by plants and trees. In these trials, we were attempting to prove our hypothesis regarding running in different areas right or wrong. Specifically, we hypothesized that running in more rural environments that do not include many cars or buildings would increase one's performance per minute.

Background

Many city dwellers utilize the urban spaces: concrete path ways, streets and urban parks for running and jogging. But the urban environment unlike a natural park is dominated by concrete, asphalt, bricks and steel as opposed to bare soil and grass. These materials have a high capacity to store and dissipate heat which makes urban areas much warmer than the natural environment. This heat will add considerable physiological strain which will adversely affect the runners' performance. In some cases this might even result in excessive fatigue.

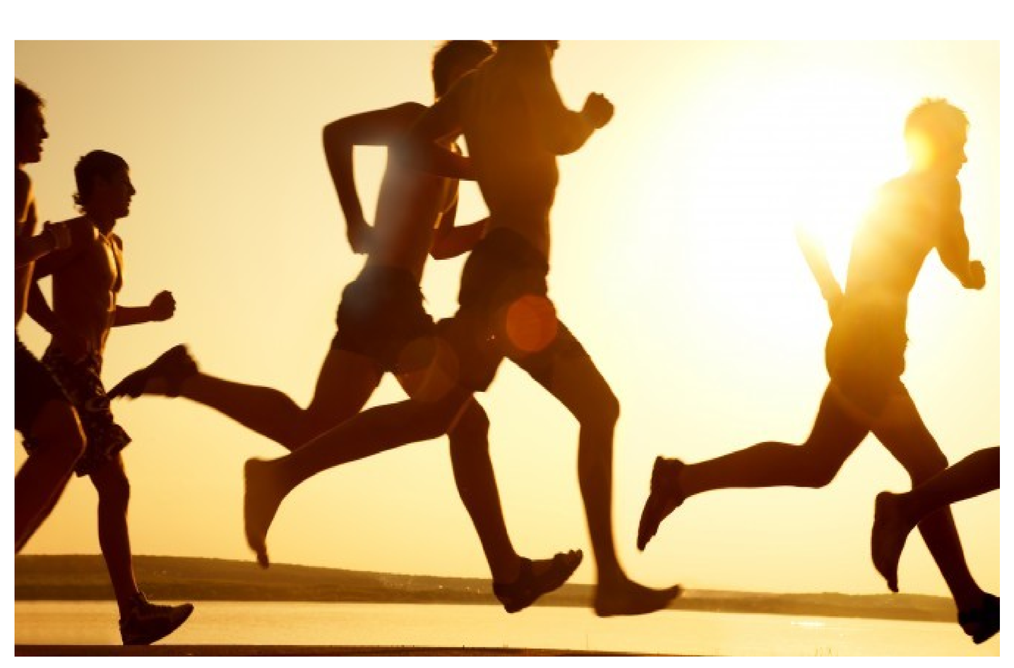


Methodology & Materials

- Six 3k routes of varying environments were found via Google Maps and completed by each of the group members.
- For each run, data was recorded using data tracking devices such as a Garmin watch (Fenix 3), temperature sensors, and heart rate monitors.
- This data was then extracted from the Garmin Connect database and converted to files capable of being processed and analyzed in Matlab.

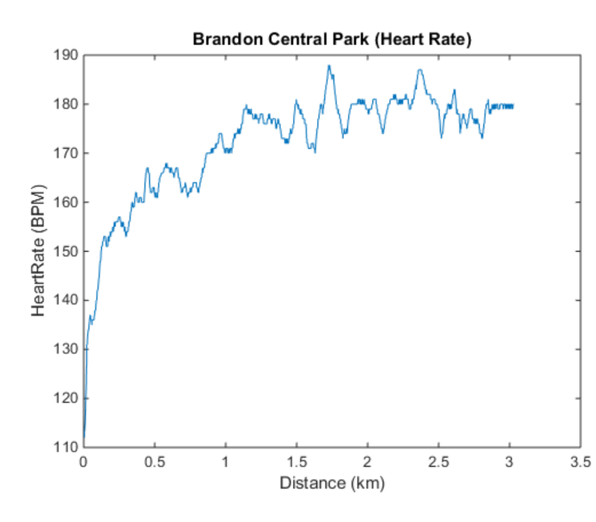
The following materials were utilized in completion of this project:

- Garmin Fenix 3
- Air Temperature and Humidity Monitor
- Garmin Heart Rate and Temperature Monitor
- Matlab Software

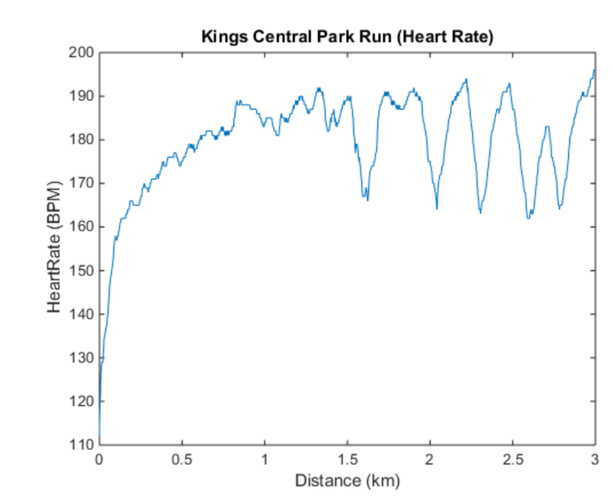



Results

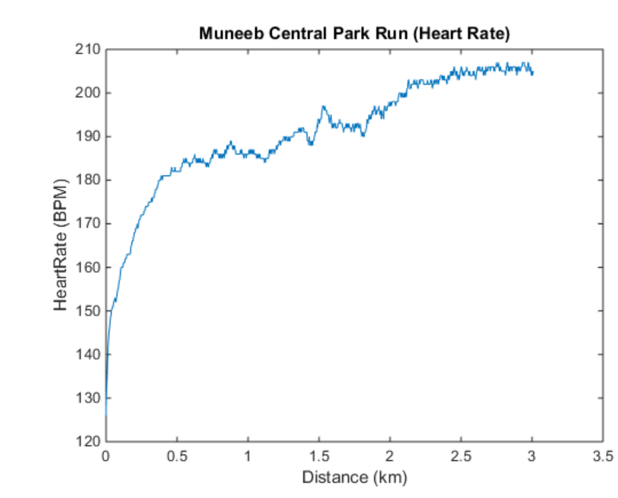
Central Park



Total Time: 18:59
Average Pace: 7:43 min/km
Average Heart Rate: 173 bpm
Average Cadence: 149 spm
Ground Contact Time: 188.6 ms
Average Temperature: 33.8 degrees Celsius
Calories Burned: 192C

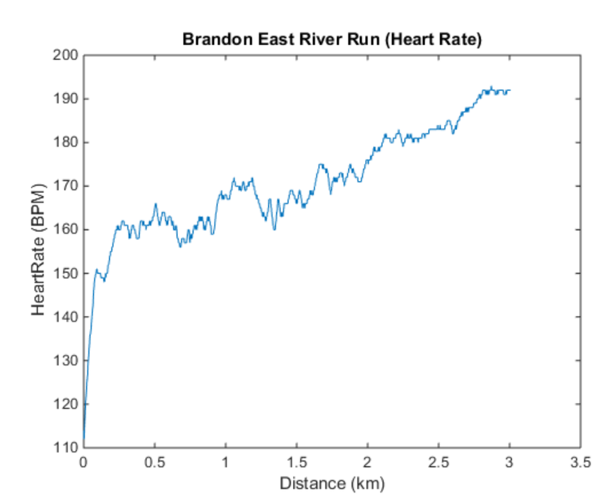


Total Time: 22:35
Average pace: 6:39 min/km
Average heart rate: 178 bpm
Average cadence: 148 spm
Ground contact time: 277.4 ms
Average temperature: 34.4 degrees Celsius
Calories burned: 187C

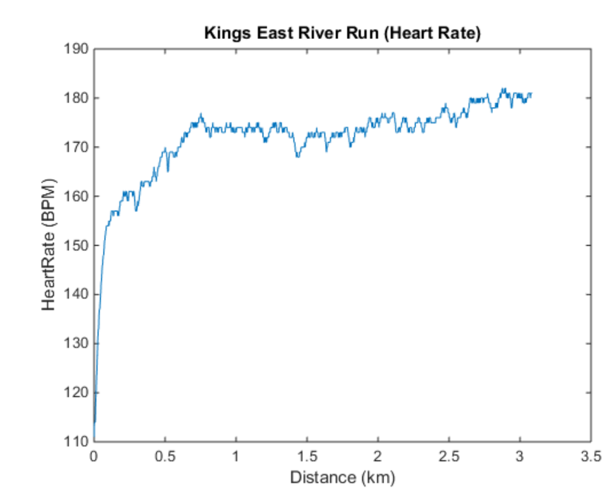


Total Time: 16:06
Average Pace: 5:21 min/km
Average Heart Rate: 191 bpm
Average Cadence: 160 spm
Ground Contact Time: 237.5 ms
Average Temperature: 34.4 degrees Celsius
Calories Burned: 154 C

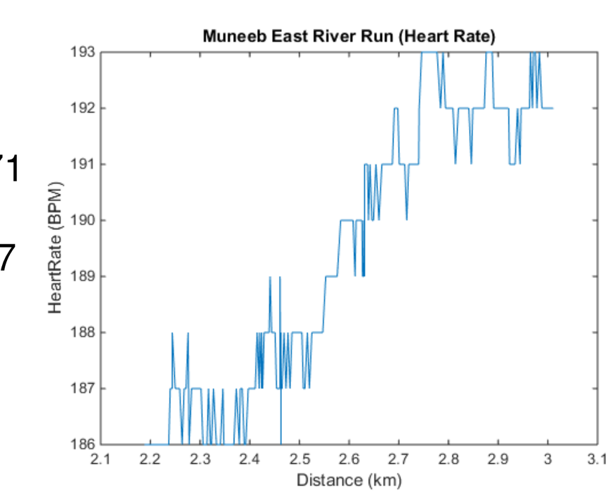
East River



Total Time: 20:46
Average pace: 6:54 min/km
Average heart rate: 169 bpm
Average cadence: 148 spm
Ground contact time: 291.1 ms
Average temperature: 32.1 degrees Celsius
Calories burned: 166 C

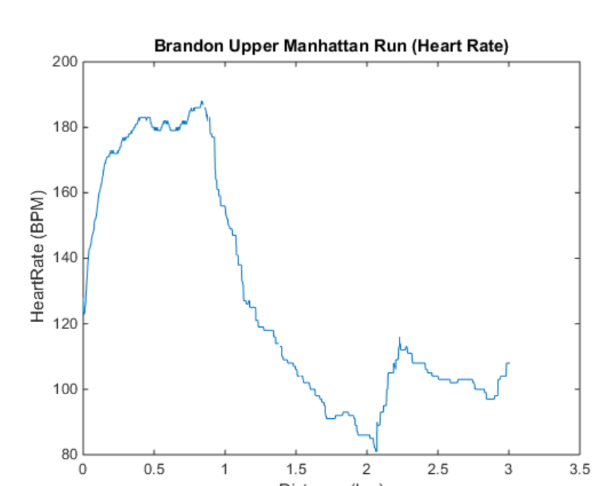


Total Time: 23:56
Average pace: 7:46 min/km
Average heart rate: 171 bpm
Average cadence: 157 spm
Ground contact time: 221.1 ms
Average temperature: 32.1 degrees Celsius
Calories burned: 213 C

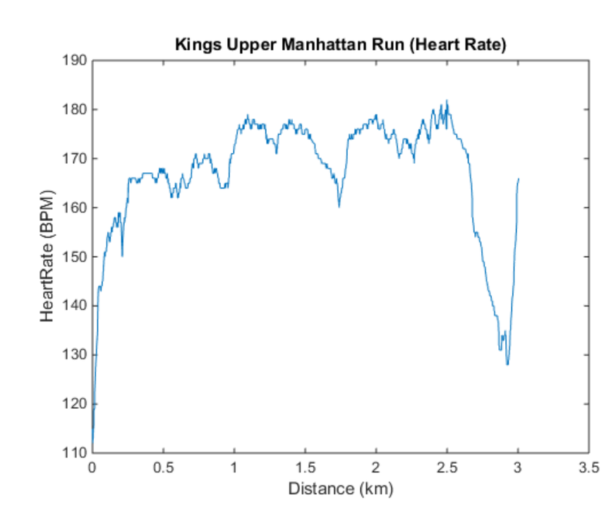


Total Time: 16:02
Average pace: 5:20 min/km
Average heart rate: 172 bpm
Average cadence: 163 spm
Ground contact time: 232.3 ms
Average temperature: 32.1 degrees Celsius
Calories burned: 134 C

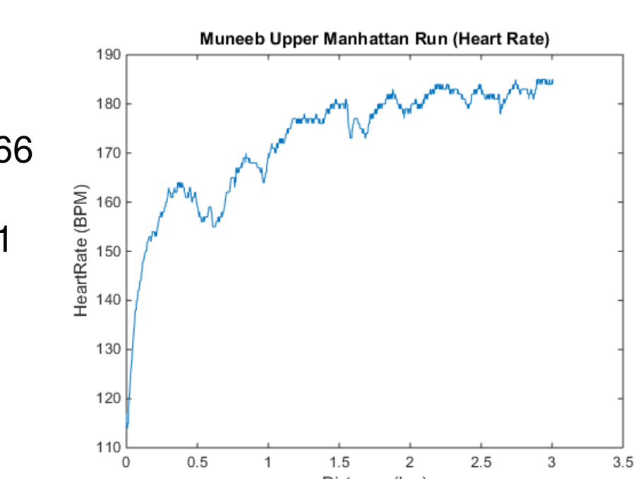
Upper Manhattan



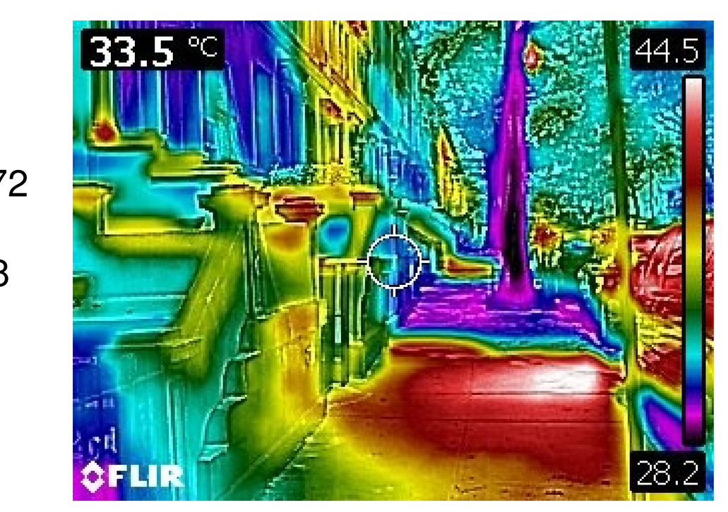
Total Time: 26:03
Average pace: 8:40 min/km
Average heart rate: 126 bpm
Average cadence: 141 spm
Ground contact time: 330.6 ms
Average temperature: 33.5 degrees Celsius
Calories burned: 194 C



Total Time: 24:09
Average pace: 8:02 min/km
Average heart rate: 166 bpm
Average cadence: 151 spm
Ground contact time: 244.3 ms
Average temperature: 33.5 degrees Celsius
Calories burned: 221 C



Total Time: 20:09
Average pace: 6:42 min/km
Average heart rate: 172 bpm
Average cadence: 158 spm
Ground contact time: 245.0 ms
Average temperature: 33.5 degrees Celsius
Calories burned: 181 C



Observations

East River Observations

Temperature: 95.7 degrees Fahrenheit
Humidity: 18%
Wind: 8kph

- Mostly sunny with a few clouds here and there
- This run included an area mostly accompanied by a large body of water, with a decent amount of trees and an overall path composed of stone and concrete.
- As shown by our heart rate graphs, running in an area more highly noted for a body of water had an influence on our running performance.
- As shown by the graphs, our heart rates are clearly increasing more steadily and more constantly at a relatively slower rate.

Central Park Observations

Temperature: 97.8 degrees Fahrenheit
Humidity: 41.0%
Wind: 6kph

- Bright and mostly sunny
- This run had an overall environment consisting of trees and other plants. The routes presented in this area consists of either asphalt, concrete, or mulch.
- If you were to closely examine the heart rate graphs for this run, you can see than the overall heart rate increased at a rate which is a little better than average, but not as steady compared to East River run and not as inconsistent as the run around buildings in Upper Manhattan.
- In general, our heart rates were relative to our environment and the trees made for better consistency, but a little harder running path due to the rough textures.

Upper Manhattan Observations

Temperature: 87.9 degrees Fahrenheit
Humidity: 42.4%
Wind: 6kph

- Running in a shaded area, surrounded by tall buildings
- The surroundings for this run are exactly what you expected it to be; heavily populated with people and many cars and buildings. There were very little trees and many sloped pathways.
- According to our heart rate graphs, our overall performance for this run was poor in comparison to our runs around water and trees. There were clearly more breaks in the data and the rate constantly increases due to many turns and changes of pace due to roads and crossways.
- Conclusively, we performed at a lower level during this run due to the more

Conclusion

Through these three sets of runs, as well as our three other trials, it is clearly evident that the environment or location of the run has an impact on a runner's performance. Runs in more urban areas contain significant numbers of concrete paths, cars, as well as various buildings, all of which store and emit heat. As a result of such, an individual typically would find runs under such conditions to be more challenging. However, runs in areas which lack the significant presence of such urban structures would provide for a reverse effect. Rather than the presence of buildings and cars which store significant amounts of heat, the presence of water and vegetation lack the vast capacity to store heat thus allowing the environment to provide for more comfortability and less strain. This can be seen when comparing three of our runs, the Central Park, the East River, and the Upper Manhattan runs. Though one would expect heart rate to increase with a harsher running environment, this is true only to a certain extent. Such results would solely be evident if all other factors of a run such as pace and cadence remained consistent throughout all of the runs. The varying of these factors can be used to further display the impact in which running environments had on an individual. Harsher runs would provide for a slower pace, a longer time, as well as a lower cadence and a higher ground contact time. We expected both the Central Park run and the East River run to be relatively easy. This held true when we looked at the other factors and data gathered in the runs. For Central Park our average pace was 6:34 min/km and we showed an average cadence of 152.3 spm (steps per minute) and an average ground contact time of 235.5 ms. The East River showed similar numbers as our average pace of 6:40 min/km, an average cadence of 156 spm and an average ground contact time of 248.17 ms. The Upper Manhattan run on the other hand had an average pace of 8:01 min/km, an average cadence of 150 spm, and an average ground contact time of 273.3 ms. By looking at this data it is clear that the Upper Manhattan environment provided for a harsher environment. The lower cadence and the greater ground contact time for the Upper Manhattan run compared to the others display that this run not only took us longer but was overall more challenging as well as resulting in more strain, evident by the worst average performances. Therefore, the environment of a run has significant impacts on a runner's performance.

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