Impact of Urban Climate on Running and Jogging

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Background

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. 

Methodology & Materials

- Six 3k routes of varying environments were found via Google Maps and a Garmin Connect database.
- 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

Observations

East River Observations
- Temperature: 95.7 degrees Fahrenheit
- Humidity: 18%
- Wind: 8mph
- 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 either asphalt, concrete, or mulch.
- If you were to closely examine the heart rate graphs of this run, you can see that 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, 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.

Central Park Observations
- Temperature: 97.8 degrees Fahrenheit
- Humidity: 41.0%
- Wind: 8mph
- 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 of this run, you can see that 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, 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: 6mph
- 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, the rate constantly increases due to many turns and changes of pace due to roads and crossways.
- Conclusion: we performed at a lower level during this run due to the more typical urban setting surrounded by tall buildings.

Results

<table>
<thead>
<tr>
<th>Route</th>
<th>Total Time</th>
<th>Average Pace</th>
<th>Average Heart Rate</th>
<th>Average Cadence</th>
<th>Average Ground Contact Time</th>
<th>Average Temperature</th>
<th>Calories Burned</th>
</tr>
</thead>
<tbody>
<tr>
<td>East River</td>
<td>20:09</td>
<td>8.02 min/km</td>
<td>180 bpm</td>
<td>141 spm</td>
<td>237.5 ms</td>
<td>34.4 degrees Celsius</td>
<td>154 C</td>
</tr>
<tr>
<td>Central Park</td>
<td>23:56</td>
<td>6:40 min/km</td>
<td>178 bpm</td>
<td>148 spm</td>
<td>244.3 ms</td>
<td>33.5 degrees Celsius</td>
<td>192 C</td>
</tr>
<tr>
<td>Upper Manhattan</td>
<td>26:03</td>
<td>6:43 min/km</td>
<td>178 bpm</td>
<td>146 spm</td>
<td>242.2 ms</td>
<td>33.5 degrees Celsius</td>
<td>194 C</td>
</tr>
</tbody>
</table>

Conclusion

Through these three sets of runs, as well as our other three 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 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, along with 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 data gathered in the runs. For Central Park our average pace was 6:34 min/km, an average cadence of 131 spm, and an average ground contact time of 235.3 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 273.5 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 indicates that the environment is much harsher which results in a runner's performance decreasing.

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