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Geography 186

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Gender Differences in Running

Introduction

It is known that spending time outdoors is beneficial for several reasons, from improved mental health to increased fitness, access to the outdoors is pivotal in improving overall health. College students are often stressed and can benefit exponentially from outdoor access. Running is a popular pastime between classes known to relieve stress and get a quick workout. Furthermore, running is accessible monetarily and does not require transportation. However, what are the boundaries that make running inaccessible, and what can be done to break down barriers? Examining a college town, Isla Vista, we aim to understand what affects home ranges and daylight quantity of runners, and if gender plays a significant role in which paths are taken.

Inaccessible greenspace means that not all can run safely, indicating inequitable access and disproportionate benefits for students. We are investigating what can be done to make Isla Vista's running community safer, and what are the drivers that restrict runners. Identifying what factors affecting running patterns allows for adaptation of current paths to make them safer.

We are attempting to solve what shapes where runners travel by looking at the differences in home ranges of women and men runners. Distinguishing by gender, we are picking two samples of each gender to visualize the difference. Identifying barriers will allow us to recommend changes in infrastructure or safety measures to aid in making running safer and equitable.

Background

The gender difference in running has been previously studied, from urban settings to recreational running. Similarly, these papers seek to answer if there are differences in running patterns, identify why these patterns exist, and promote solutions to diminish differences in home ranges. One study examined running in highly urbanized areas, such as Montreal, Canada, and Washington DC. The paper examines differences in location and time, with a focus on daylight and night-time patterns. Some drivers found a preference for proximity to parks and bike lanes. Lower medium-income neighborhoods and lower population density also heavily impacted paths. These findings empower a data-driven approach to urban planning as well as bring up important questions about societal expectations for how gender and public facilities interact.

Another approach has been investigating the perception of safety based on gender approaches. To select a reflective sample, the study selected random participants who utilize public parks. From their sample, the study extracted six variables that contribute to safety within a park, visibility, technical condition, cleanliness, external protection, other park users, and mobility facilities. Furthermore, the study explicates how differently men and women weigh each of these factors in their utilization of public facilities. The paper defines “non-obvious” factors which are variables that pose threats such as the amount of daylight, paths, and even how full trash cans are. They found that women place a much greater importance on these non-obvious factors over men. Polko ultimately emphasizes the importance of maintaining invisible aspects of parks to make them appear safer to particularly women, such as frequently maintaining garbage cans, park paths, and lighting.

Utilizing a qualitative approach can be enlightening, as seen in a study conducted by Schuurman et al. The study has runners keep a diary of their runs for three weeks. They found that runs were based on what was sought to be extracted, such as the characterization of routine or fun runs. They found that gender was of importance in selecting runs close to home, as well as the ability to check in with children for women. Another paper surveyed runners on which environments were most preferable, and found that the most “ideal” route had a well-paved, integrated greenspace, well-lit, quiet, and well-maintained- showcasing the importance of integrating plants in running habitats. Regarding gender, women were more involved in considering their safety in running than men, affirming the need for making spaces feel safer to increase utility. Furthermore, in a study by Sang (202), they found that men often were found to use parts of greenspace that were considered more “remote” or “inaccessible”, highlighting the dichotomy between what spaces are accessible based on gender.

Our study seeks to take a look into Isla Vista, which is uniquely affected by a nearby University, generally homogenizing the sample of people who reside there. Furthermore, Isla Vista is notably composed of highly dense residential areas beside open spaces. This study aims to investigate the activity spaces of residents with the same general starting points allowing for a comparison of home ranges.

Case Study and Methodology

Strava is a platform where users can log their outdoor activities, from runs to surfs, to even bike rides. The application collects duration, time, elevation, latitude, longitude, as well as heart rate depending on the device recording the activity. Using Strava can be insightful in finding local data. For our purpose of analyzing the movement of college students based on gender, we decided to use Strava data of Isla Vista residents. Due to timing constraints we collected data on four users, with two of each sex.

Isla Vista is located on the central coast of California adjacent to the University of California. Proximal to the Pacific Ocean, the primary population of residents is students. With a population of approximately 20,000, Isla Vista's population has marginally more female persons at 56%, indicating the emphasis on gender within urban planning (*U.S. Census Bureau QuickFacts*, n.d.). To examine how equitable Isla Vista's infrastructure for running is depending on gender, our team analyzed Strava data to derive home ranges. The temporal range began from January 1st, 2025 to March 8, 2025, stopping before daylight savings to simplify quantifying which activity paths were conducted during daytime.

We collected data from Strava, downloading GPX files for each activity that was characterized as a run and fell within the temporal range of January 1st to March 8th. Once collected, we compiled all files for visualization using an application called GPX Merge (*GPX Merge*, n.d.). This tool collected GPX files and compiled them into one larger file. After compiling each GPX activity for each user, we then visualized the data using ArcGIS Pro. The tool Gpx to Feature was used, and the polyline setting was selected to visualize pathways. Once the features were output, we then used the minimum bounding polygon tool. Convex Hull was selected as the polygon format due to its proficiency in procuring accurate home range estimates (Boyce & Ciuti, 2020). Once polylines and minimum bounding polygons of each user were created, each layer for each user was overlaid to create a map of home ranges. The purpose of this analysis was to view how each user either strayed or remained central to population density. The population density was characterized as the residential area of Isla Vista, and paths outside of Isla Vista are considered more "remote" and less "accessible". The proximity to population density is to understand if gender plays a role in how far runners will run from an area of general "safety". The population density was utilized to determine levels of safety for runners as closeness to other people can be perceived as an avenue to call for help in case of emergencies, whereas more remote areas can be perceived as more dangerous due to inaccessibility to call for help.

To factor in the time scale we used a program called Torben's Strava App (*Strava Äpp V2*, n.d.). As seen in figure **1** Torben's Strava app extracts the time of runs, as well as each activity based on type. We collected an XLSX file on the number of runs and times based on the type of Run. Once compiled, we then wrote a code that categorized each activity based on whether it fell after sunset or before sunset. Depending on the time, each activity populated the cell: before_after_sunset with either After_Sunset or Before Sunset. We then used Excel to generate charts to visualize how each Strava user either ran before or after sunset. The time scale was especially important in categorizing each run, as literature has unanimously agreed that the amount of lighting is key in how women consider levels of safety on their run. Daytime was considered to be a safer path, while running after sunset was considered to be more 'dangerous"- this is due to a lack of visibility, which results in a lack of awareness which may leave the runner feeling vulnerable to their environment. Depending on the runner, running during the daytime may be preferable, and if other behavior is visualized it could affect the runner's path, such as choosing to run a shorter distance or closer to population density.

x_date	name	type	start_date_local	end_date_local	sunset_time	before_after_sunset	x_min	x_nearest_city_start	distance	moving_time	elapsed_time	timezone	start_latlng	end_latlng	x_month	x_quarter	x_start_h	x_week	x_year
2025-03-06	Afternoon Run	Run	2025-03-06 17:50:30	2025-03-06 18:20:42	2025-03-06 17:59:00	After Sunset	30.2	NA-US-CA-Goleta	5004.8	1811	2056	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8583)	(34.4124, -119.8583)	3	1	17.84	10	2025
2025-03-04	Afternoon Run	Run	2025-03-04 17:30:53	2025-03-04 18:25:05	2025-03-04 17:57:00	After Sunset	54.2	NA-US-CA-Goleta	8205.7	3250	3941	(GMT-08:00) America/Los_Angeles	(34.4123, -119.8581)	(34.4124, -119.8583)	3	1	17.51	10	2025
2025-03-03	Lunch Run	Run	2025-03-03 12:41:01	2025-03-03 13:00:43	2025-03-03 17:56:00	Before Sunset	19.7	NA-US-CA-Goleta	3344.5	1181	1503	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8584)	(34.4121, -119.8586)	3	1	12.68	10	2025
2025-02-28	negative split rur	Run	2025-02-28 17:39:12	2025-02-28 18:09:48	2025-02-28 17:54:00	After Sunset	30.6	NA-US-CA-Goleta	5016.9	1838	1879	(GMT-08:00) America/Los_Angeles	(34.4124, -119.8583)	(34.4097, -119.8587)	2	1	17.65	9	2025
2025-02-26	Afternoon Run	Run	2025-02-26 17:47:44	2025-02-26 18:07:26	2025-02-26 17:52:00	After Sunset	19.7	NA-US-CA-Goleta	3213.2	1181	1271	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8584)	(34.4122, -119.8586)	2	1	17.8	9	2025
2025-02-24	trying zone 2	Run	2025-02-24 17:32:09	2025-02-24 17:55:45	2025-02-24 17:50:00	After Sunset	23.6	NA-US-CA-Goleta	3261.1	1414	1436	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8584)	(34.4117, -119.8586)	2	1	17.54	9	2025
2025-02-22	Morning Run	Run	2025-02-22 09:58:28	2025-02-22 10:29:10	2025-02-22 17:49:00	Before Sunset	30.7	NA-US-CA-Goleta	5065	1842	2000	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8582)	(34.4097, -119.8589)	2	1	9.97	8	2025
2025-02-20	Evening Run	Run	2025-02-20 18:04:27	2025-02-20 18:24:33	2025-02-20 17:47:00	After Sunset	20.1	NA-US-CA-Goleta	3255.3	1208	1231	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8584)	(34.4121, -119.8587)	2	1	18.07	8	2025
2025-02-19	Afternoon Run	Run	2025-02-19 17:44:00	2025-02-19 17:59:24	2025-02-19 17:46:00	After Sunset	15.4	NA-US-CA-Goleta	2597	925	929	(GMT-08:00) America/Los_Angeles	(34.4115, -119.8575)	(34.4121, -119.8587)	2	1	17.73	8	2025
2025-02-09	tipsy run!	Run	2025-02-09 00:23:48	2025-02-09 00:29:42	2025-02-09 17:36:00	Before Sunset	5.9	NA-US-CA-Goleta	1068.1	356	360	(GMT-08:00) America/Los_Angeles	(34.4118, -119.8657)	(34.4141, -119.8602)	2	1	0.4	6	2025
2025-02-05	quick rainy run	Run	2025-02-05 19:44:12	2025-02-05 19:55:00	2025-02-05 17:33:00	After Sunset	10.8	NA-US-CA-Goleta	1854.7	648	854	(GMT-08:00) America/Los_Angeles	(34.4124, -119.8583)	(34.4123, -119.8584)	2	1	19.74	6	2025
2025-01-30	Morning Run	Run	2025-01-30 09:12:59	2025-01-30 09:46:47	2025-01-30 17:27:00	Before Sunset	33.8	NA-US-CA-Goleta	5427.6	2026	2376	(GMT-08:00) America/Los_Angeles	(34.4124, -119.8584)	(34.4124, -119.8584)	1	1	9.22	5	2025
2025-01-27	Afternoon Run	Run	2025-01-27 17:09:52	2025-01-27 17:39:58	2025-01-27 17:24:00	After Sunset	30.1	NA-US-CA-Goleta	4993.8	1806	2173	(GMT-08:00) America/Los_Angeles	(34.4122, -119.8583)	(34.4122, -119.8582)	1	1	17.16	5	2025
2025-01-25	Afternoon Run	Run	2025-01-25 16:45:32	2025-01-25 17:18:50	2025-01-25 17:22:00	Before Sunset	33.3	NA-US-CA-Goleta	5045.4	1998	2738	(GMT-08:00) America/Los_Angeles	(34.4123, -119.8584)	(34.4124, -119.8583)	1	1	16.76	4	2025
2025-01-09	Afternoon Run	Run	2025-01-09 17:10:07	2025-01-09 17:43:01	2025-01-09 17:06:00	After Sunset	32.9	NA-US-CA-Goleta	5013.8	1975	2418	(GMT-08:00) America/Los_Angeles	(34.4123, -119.8583)	(34.4124, -119.8583)	1	1	17.17	2	2025
2025-01-07	knee test	Run	2025-01-07 16:50:01	2025-01-07 17:05:43	2025-01-07 17:04:00	After Sunset	15.7	NA-US-CA-Goleta	2674.1	944	2079	(GMT-08:00) America/Los_Angeles	(34.4124, -119.8585)	(34.4124, -119.8584)	1	1	16.83	2	2025

Figure 1 : Time Data extracted from Torben's Strava App

Ultimately our analysis was performed in order to visualize how each person ran dependent on variables of closeness to safety: density of population and amount of light available, with an emphasis on how paths deviated from routine if the runner chose to run at night or on a more remote path.

Results and Discussion

When looking at the home range data we can see that the activity space varies widely. Drew's activity space is the largest, with Emma coming in second, Hsinpin coming in third and Justin came in last with the smallest activity space. While the home ranges vary, they do not follow a specific pattern according to gender. We predicted men to have activity in remote areas, and women to stay in areas with high density. The variation in home ranges with respect to gender can be due to a number of variables.

User	Time Scale	Number of Recorded Runs	Number of Runs Recorded After Sunset	Percentage of Runs Recorded during Day	Polygon Area (meters)	Average Runs Per Week
Hsinpin	1/07/25-3/06/25	16	11	31.25%	.000482	1.7
Emma	1/06/25-3/07/25	25	3	88%	.001922	2.7
Drew	1/02/25-3/	24	6	75%	.004888	2.6

	08/25					
Justin	1/06/25-2/ 20/25	20	0	100%	.000179	2.2

Figure 2: Attribute Table of Runner's Data

The first hypothesis is the difference in experience level. When looking at figure **2** and **3,** we can see that the top two runners are Emma and Drew. Emma's total runs are 25, while Drew's total number of runs is 24. These runners average 2.7 and 2.6 run events a week, whereas Justin and Hsinpin had an average of 2.2 and 1.7 run events a week respectively. Similarly, the runners with the highest frequencies in activity events also had the greatest area in activity space, indicating that activities space is also heavily correlated with how comfortable, or frequent, a runner visits the path. Furthermore, the more comfortable an user is with their environment, it appears the more frequently they record night time activity events. It is important to note that Hsinpin's data has an outlier in terms of number of runs after sunset despite her lower frequency of run events and smaller activity space. This could be attributed to the user feeling more comfortable or "safe" running after sunset due to the proximity to high density populations. However this user also often started their run temporally proximal to the sunset and would complete the run shortly after the sun set, which could be attributed to the runner wanting to watch the sunset. There is only one time event where the runner began more than an hour after sunset began. In order to avoid skewing data, in the future we can account for remaining light in the sky. It can even typically take 70-100 minutes before the sky turns full dark (Kirk, n.d.). Continuations of this study can characterize runs by amount of light in the sky rather than sunset, and categorize events by local timing of when the sky turns fully dark.

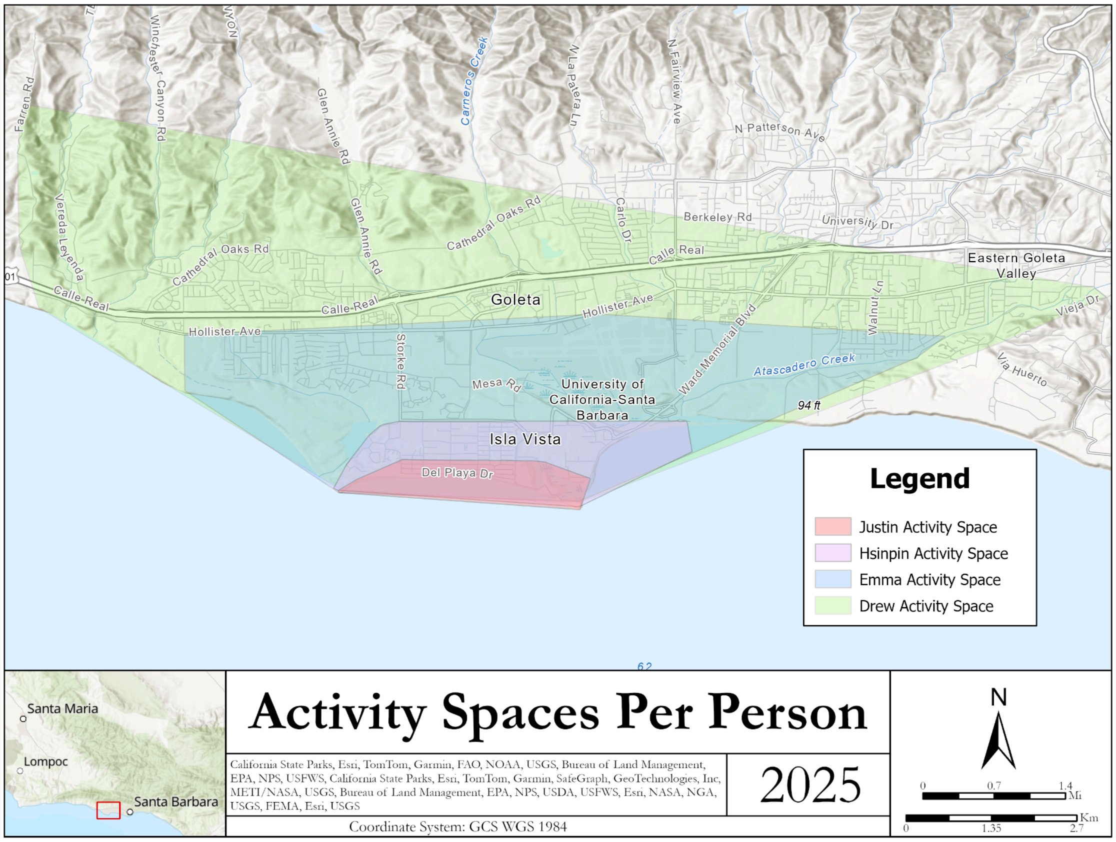


Figure 3: Activity Spaces Per Person

As seen in the attribute chart of the users in the study, there was large variability in terms of number of runs, number of runs recorded after sunset, the size of activity space, and average runs per week. As seen in figure **4** the number of runs did not necessarily follow a pattern, with Justin recording twenty events, but retaining the smallest activity space and recording zero runs after sunset. This variation could be as a result of a phenomenon recorded by Schuurman's qualitative approach to gender variation of running. Schuurman accounted variation with the intention of the run, it could be that Jusin did not visit open spaces, and remained in "urban" areas due to his runs being "routine" runs over recreational runs (Schuurman, n.d.). Rather than explore, Justin's goals could have simply been to train, rather than explore and visit open spaces. This could possibly account for Justin's routine visits to the same paths as well as running at similar times in the morning.

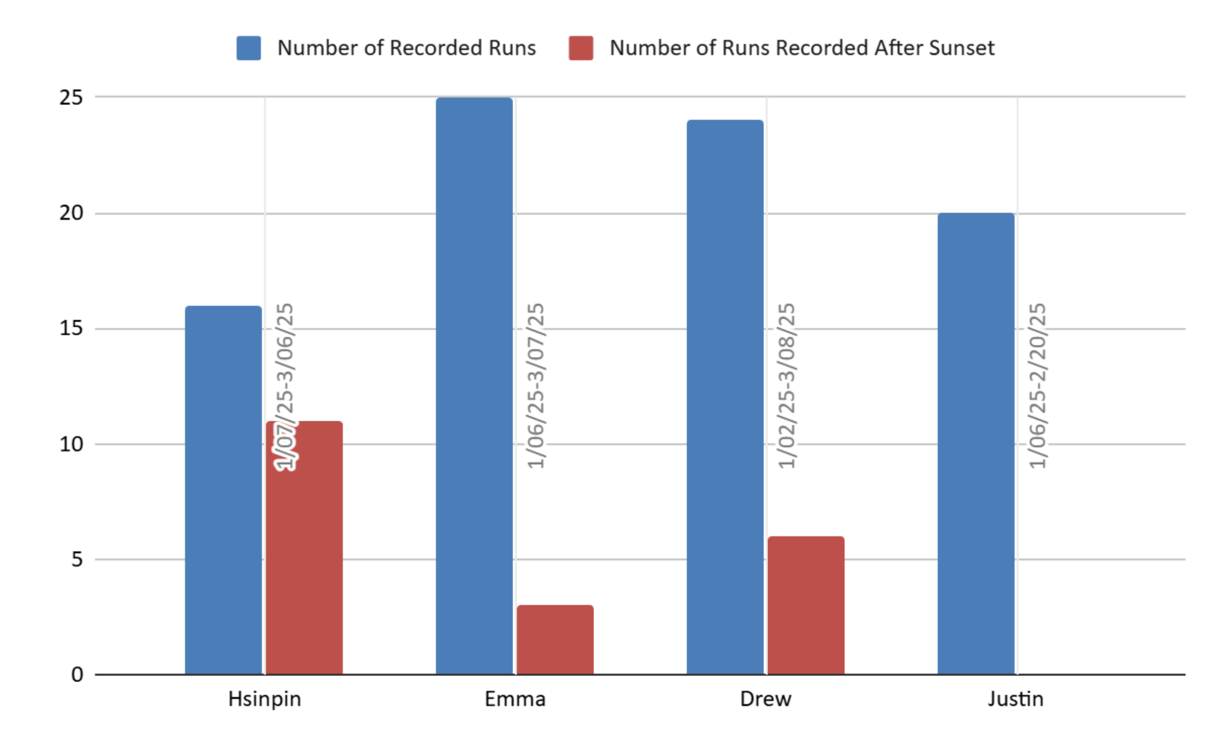
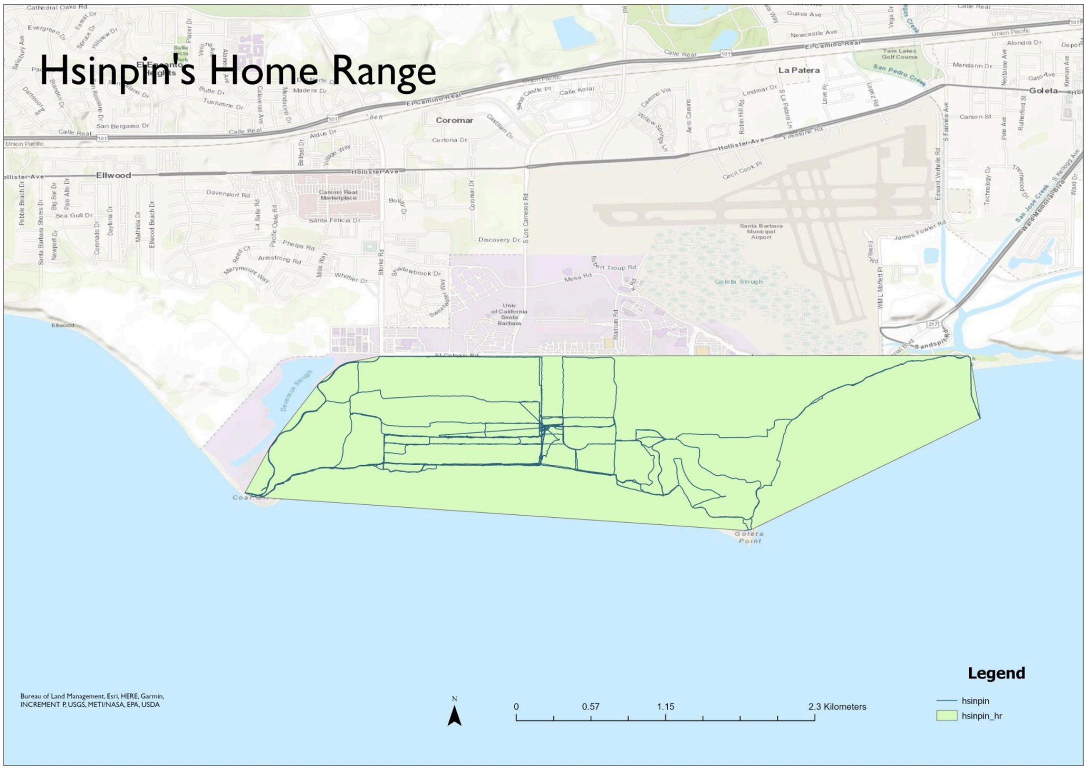


Figure 4: Number of Total Recorded runs and Number of runs Recorded After Sunset

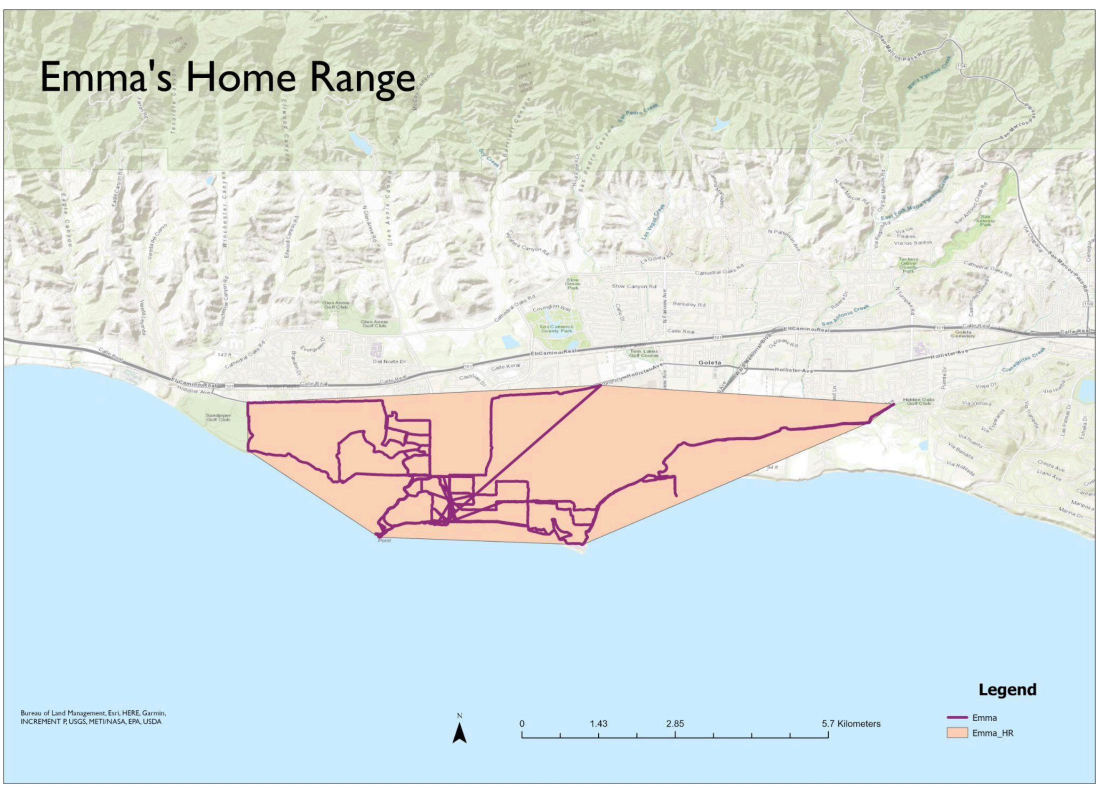
Female

1



Female

2



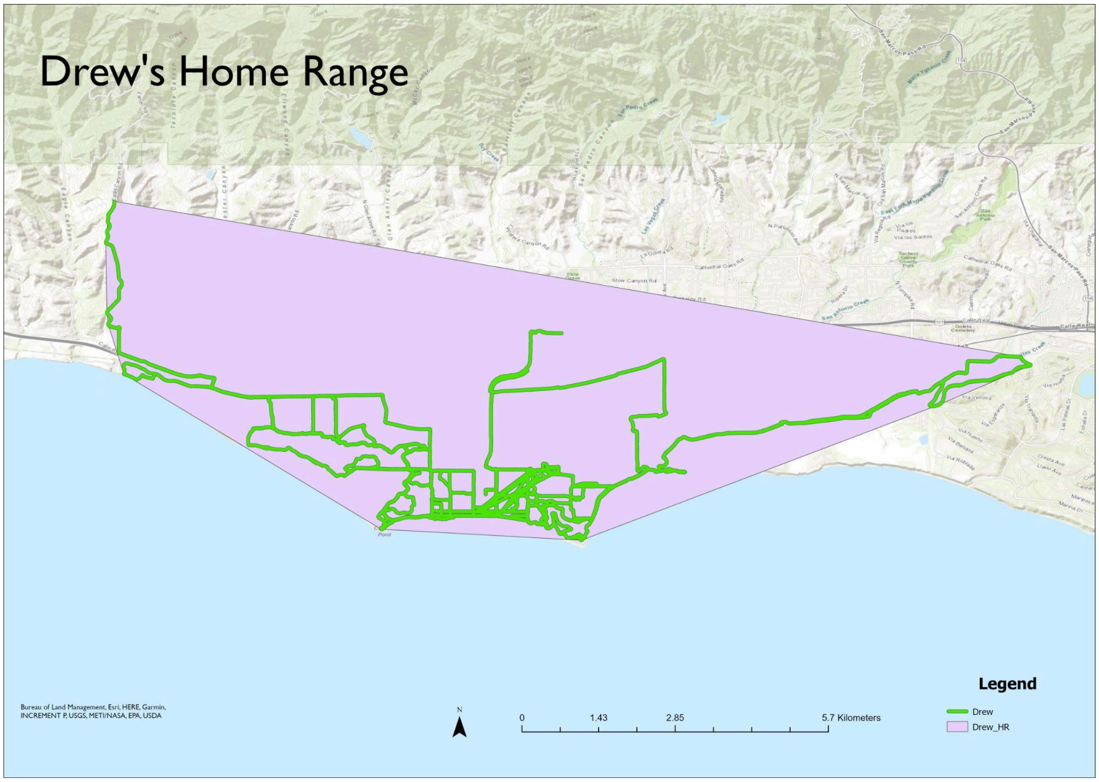
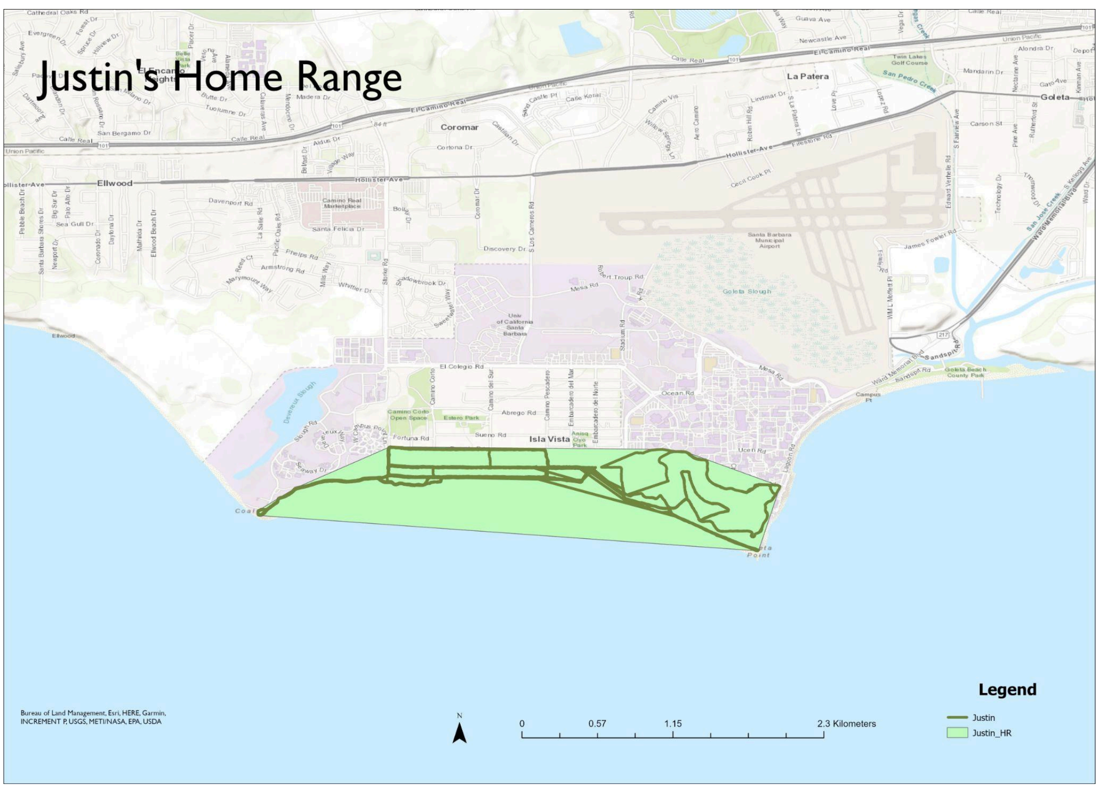
Male 1	Drew's Home Range Legend Drew Drew_HR 0 1.43 2.85 5.7 Kilometers N Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA
Male 2	Justin's Home Range Legend Justin Justin_HR 0 0.57 1.15 2.3 Kilometers N Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

Figure 5: Separate Home Ranges of Each Runner

Examining data displayed in figure **5,** we can see that women exhibited higher rates of running after sunset in comparison to men. This can be attributed to experience, as well as the nature of the runner. Runners with higher experience typically feel more comfortable to run after sunset. However, runners can run after sunset due to recreation, or simply maximize the utility of a run by running during the evening to watch the sunset.

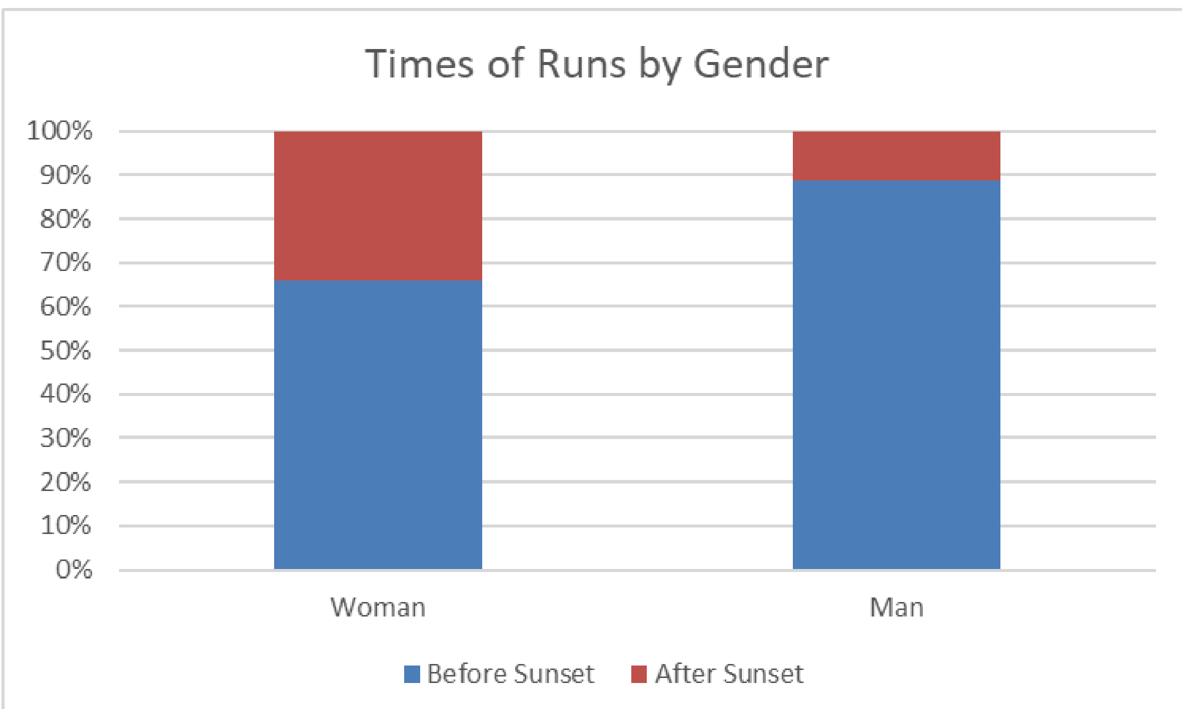


Figure 5: Times of Runs by Gender before and after Sunset in Percentage

Conclusion

After investigating movement data of four different runners based on gender through utilizing Strava Data, we have come to conclusions that running is heavily influenced by the intention of the run, runners' experience level, and how comfortable a runner is in their environment. Some factors that can make a runner comfortable are the frequency of previous run events in the area, proximity to population density, and experience level of the runner. We experienced variation in data due to different intentions of runners, with one running recreationally during sunset, and one running routinely, resulting in a smaller but more frequently visited activity space. Furthermore we saw that runners with higher experience levels had larger activity spaces, as seen in figure **5,** displaying each activity space separately. To conclude, the study found enlightening results from the data. However research was restricted by the sample size, and future iterations of research should expand the sample size as well as include qualitative data. This additional data could include separating data based on experience level, such as average number of runs a week, as seen in figure **2,** or asking participants if their intention behind running can be characterized as “fun” or “routine”

Despite the restriction, the study yielded results that can aid in recommendations. Making runners feel more comfortable in their environment can create higher frequencies in running, such as facilitating group runs, or run clubs. They can also be improved by setting up points at lower density population areas where runners can possibly contact authorities in case of emergency. In sum, this study found that running is extremely variable and can be influenced by different factors, which can be manipulated in order to facilitate higher comfortability of runners.

Boyce, M. S., & Ciuti, S. (2020). *Data from: Human selection of elk behavioural traits in a landscape of fear* [Dataset]. Movebank Data Repository. https://doi.org/10.5441/001/1.J484VK24

GPX merge. (n.d.). Retrieved March 21, 2025, from https://joewein.net/bike/gpxmerge/

Isla Vista | Santa Barbara County, CA - Official Website. (n.d.). Retrieved March 21, 2025, from https://www.countyofsb.org/927/Isla-Vista

Kirk, A. (n.d.). *How Long Does it Take to Get Dark After Sunset?* Retrieved March 21, 2025, from https://lovethenightsky.com/how-long-after-sunset-is-it-dark/

Schuurman, N. (n.d.). *Environmental Preferences and Concerns of Recreational Road Runners*. Retrieved March 21, 2025, from https://www.mdpi.com/1660-4601/18/12/6268

Strava Äpp V2. (n.d.). Retrieved March 21, 2025, from https://entorb.net/strava-streamlit/

U.S. Census Bureau QuickFacts: Isla Vista CDP, California. (n.d.). Retrieved March 21, 2025, from https://www.census.gov/quickfacts/fact/table/islavistacdpcalifornia#