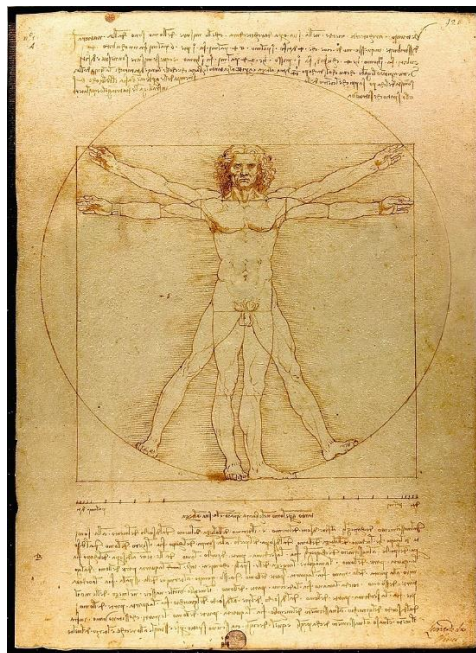


The Correlation between Ape Index and Climbing Ability

Problem: Does having a higher ape index help you climb better?

Climbers are always arguing whether taller climbers have an advantage when climbing. However, everyone seems to agree that having a higher “ape index” is helpful. Ape index is your wingspan (the length from fingertip to fingertip with your arms outstretched) minus your height. On average, people have an ape index of zero—something that was noticed millennia ago by Vitruvius, as depicted by Leonardo da Vinci in his famous “Vitruvian Man”.



So, having a higher ape index means that you have a longer reach than the average person of your height, which could give you an advantage.

Hypothesis: I think that on average people with a higher ape index will be better at climbing than people with a lower ape index. I think that this is true because in climbing you often have to make big reaches that a person with long arms (for their height) could do more easily.

Experiment

- **Materials:**
 - Climbers
 - Google Forms for an online survey
 - Computer and Excel for entering and analyzing data

- **Procedures:**

1. Make a Google Form survey, asking
 - Age
 - Length of time climbing
 - Gender
 - Climbing frequency
 - Height
 - Wingspan
 - Weight
 - Hardest boulder problem climbed in a typical session
 - Hardest boulder problem ever climbed
2. Post online in a bouldering forum, asking for help with a science fair project
3. Download data into Excel after receiving a sufficient number of responses
4. Clean data
 - Throw out outliers, joke answers, incomplete answers
 - Convert between units
 - centimeters to inches
 - kilograms or stones to pounds
 - Bouldering scale from “Font” scale to V-Scale
 - The V-Scale for bouldering ranges from V0 to V16
5. Sort into categories and analyze
 - Calculate Ape Index (Wingspan minus height)
 - Calculate BMI (Weight divided by height squared, in metric)
 - Determine Summary Statistics for the sample (the mean, standard deviation, and range for each variable)
 - Calculate correlation between each trait and climbing ability, using Excel
 - Calculate statistical significance of the correlation, using Excel
 - Graph as a scatterplot and find the trendline.

Results:

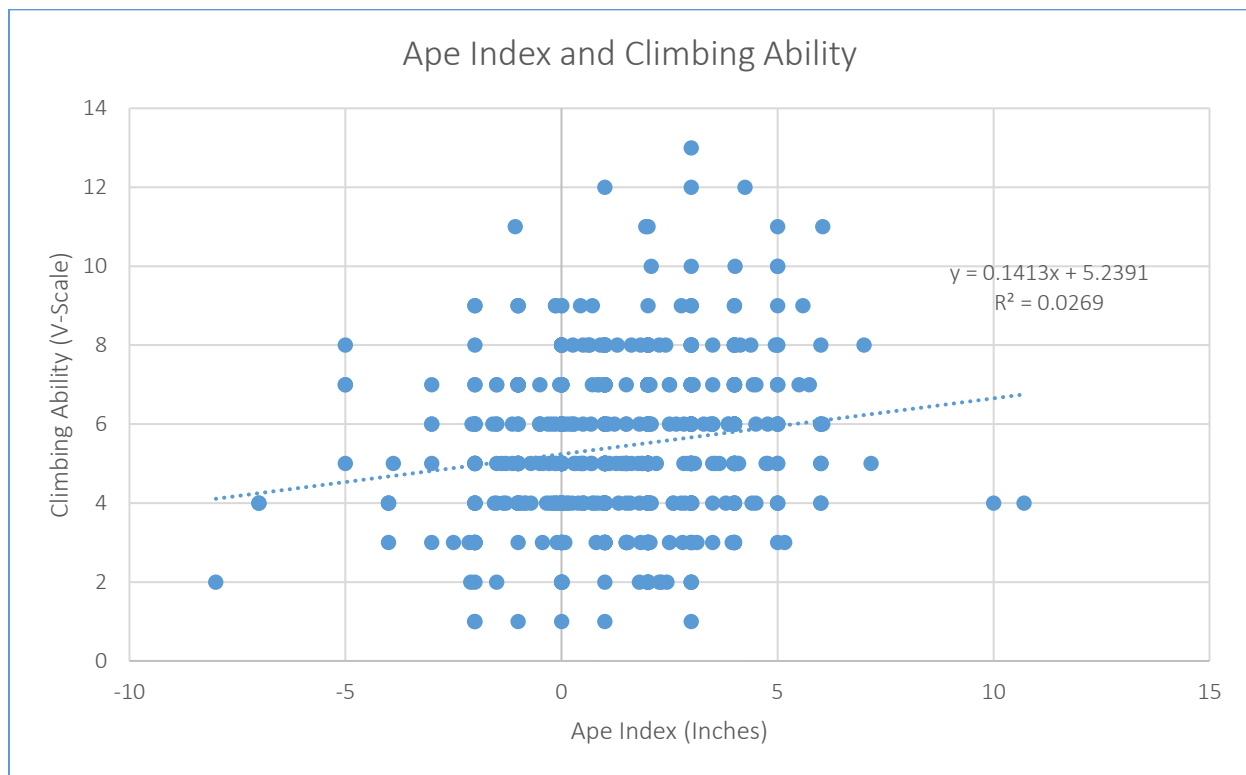
When I posted this online I got way more data than I expected—712 responses—and even after cleaning it I still had 669 responses. It is not close to being able to fit here, so I have all of it in an attached file. It can also be seen online here: <http://bit.ly/2okiosW>.

Here are the summary statistics for the entire sample:

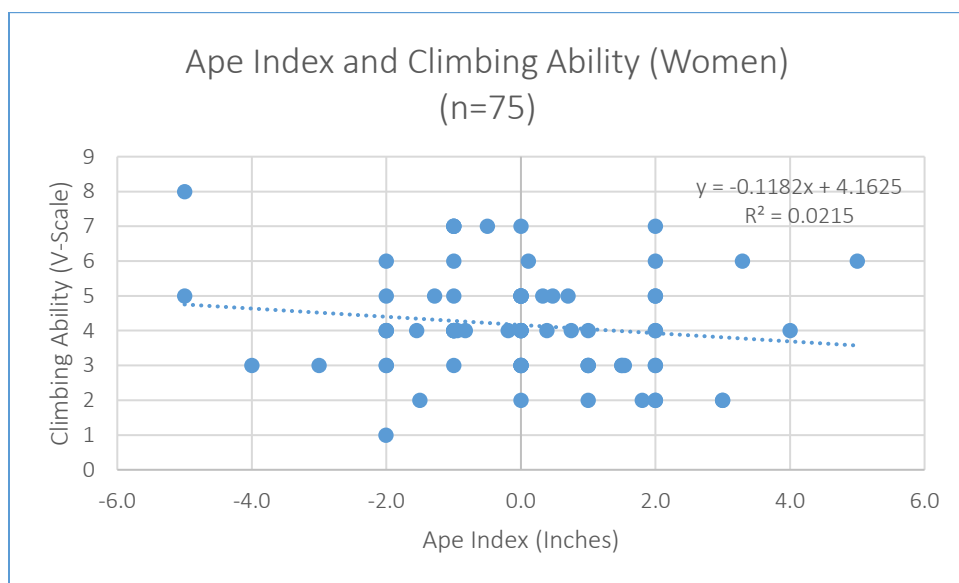
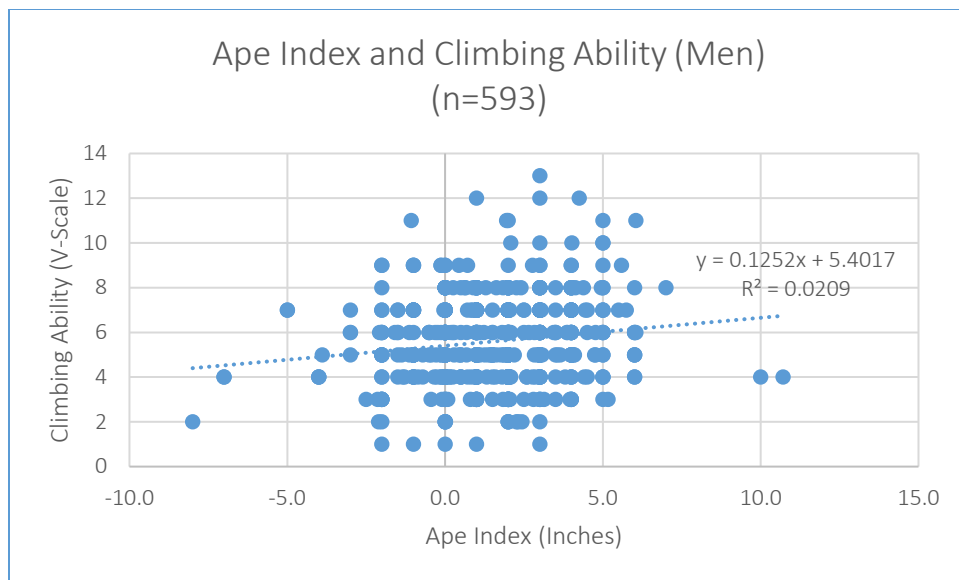
Summary Statistics (n=669)			
	Mean	Standard Deviation	Range
Age	25.24	5.09	13 to 49
Years climbing	3.96	3.62	0.1 to 30
Height (inches)	69.93	3.61	55.5 to 79
Arm Span (Inches)	3.96	3.62	54 to 84

Ape Index (Inches)	1.31	2.18	-8 to 10.5
Weight (lbs)	155.93	22.76	89 to 243
Bouldering typical (V-scale)	5.42	1.88	1 to 13
Bouldering best ever (V-scale)	6.71	2.15	1 to 15
BMI	22.38	2.61	15 to 38

The scatterplot below shows the correlation between ape index and climbing ability. I used “hardest boulder problem you can typically climb in a session”, although I also found the correlation with the hardest boulder problem ever climbed, and it made very little difference. The trendline slopes up slightly, showing a positive correlation, with a slope of 0.14. (Excel calculates the trendline automatically, and has a simple function to find correlation.) This means that each extra inch of ape index should give an extra 0.14 points of climbing ability (on the V-Scale). The correlation coefficient (Pearson’s r) is 0.164. (A correlation coefficient ranges from -1 to 1, with zero being totally uncorrelated.)

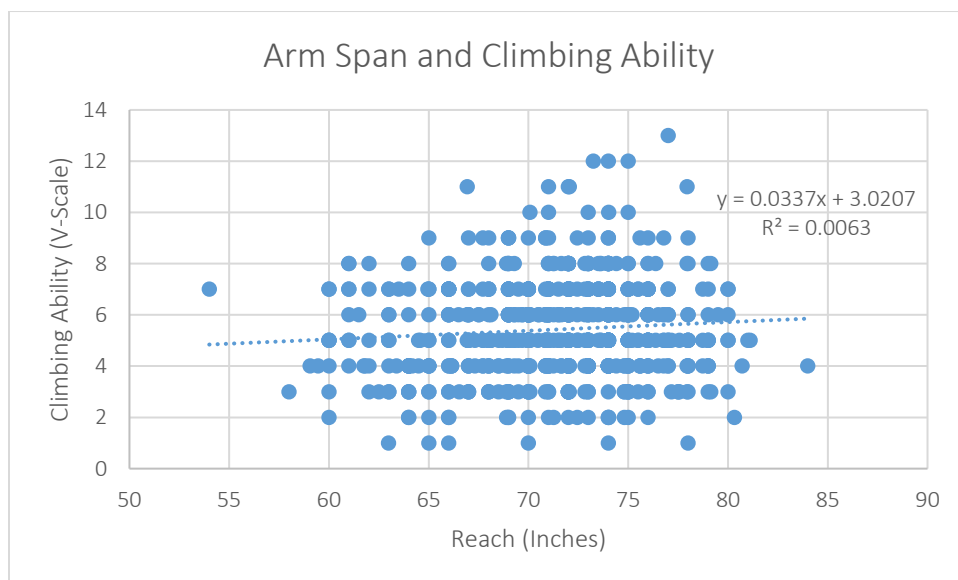


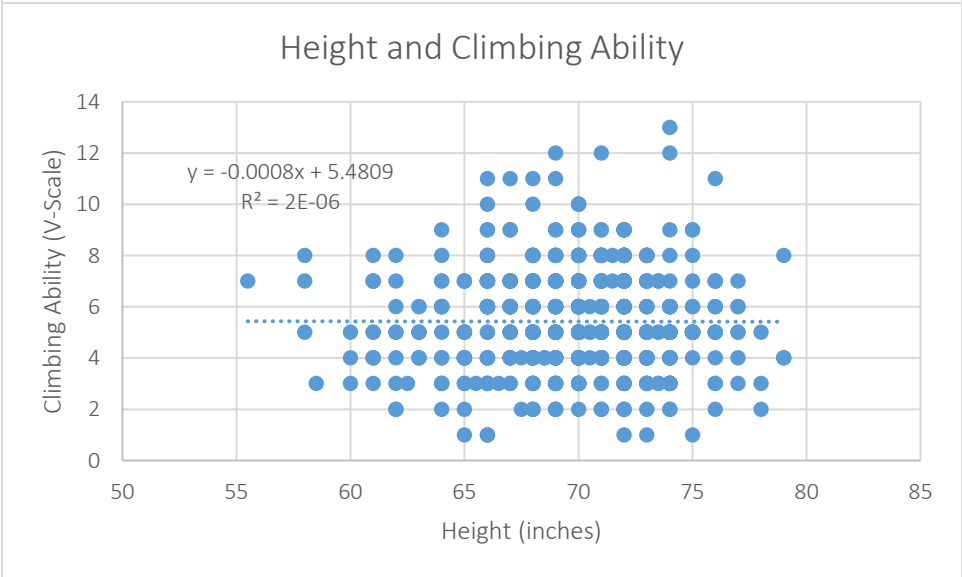
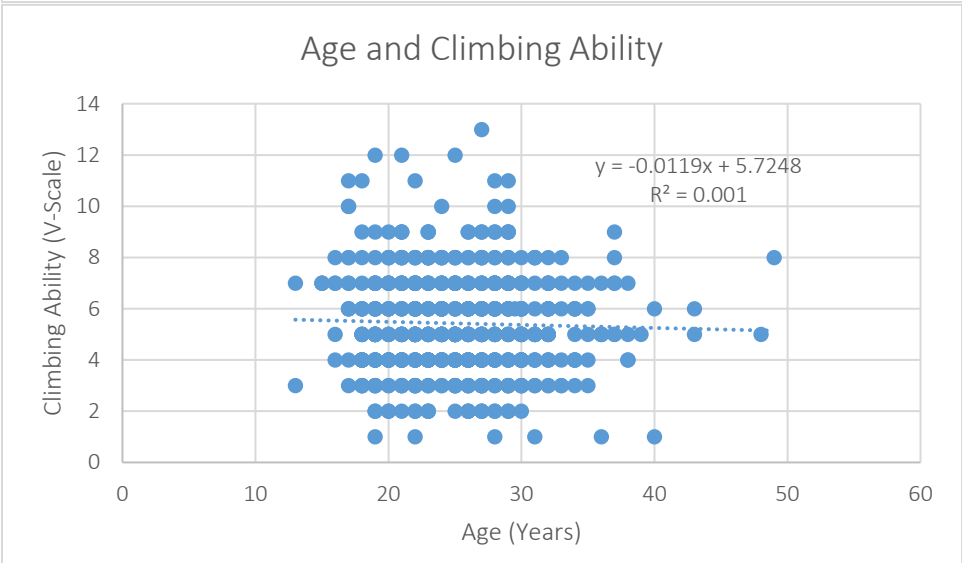
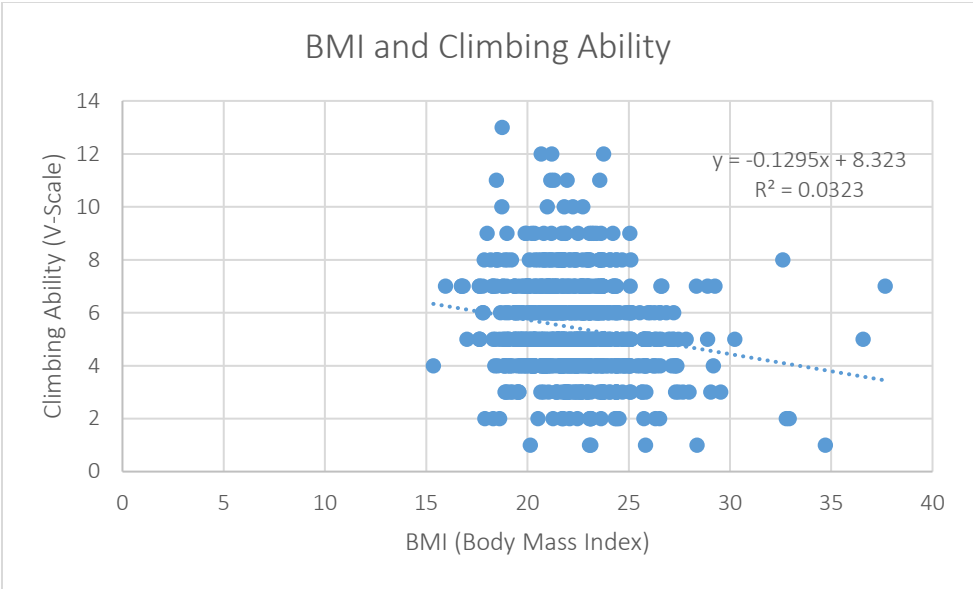
I also divided the data into two groups, men and women. Note that only 11% of the climbers are female. The men fit what I expected, with a positive trendline and a correlation coefficient of 0.145. The women, oddly, had a downward sloping trendline and a correlation coefficient of *negative* 0.147.



I also measured people's age, BMI, height, wingspan, and how long they had been climbing. Height, wingspan, and age were not that important compared to ape index. BMI was about as negatively correlated with climbing ability as ape index was positive, and was quite important. However, nothing was anywhere near as important as time climbing, for we found that it had a correlation of positive 0.403, and an r squared value of 0.162. (R-squared is the "coefficient of determination", or how much of the variation it explains.) Here's a table of the r and r squared values of each variable:

	r	r squared	Slope	Ratio
Height	-0.0015	0.00000225	-0.0008	On average, every inch taller you are, you climb 0.0008 V-points worse.
Arm Span	0.0794	0.00630436	0.0337	On average, every inch longer your arms are, you climb 0.03337 V-points better.
BMI	-0.1796	0.03225616	-0.1295	On average, every point higher your BMI is, you climb 0.1295 V-points worse.
Time Climbing	0.4034	0.16273156	0.2087	On average, every year you've been climbing makes you climb 0.2087 V-points better.
Age	-0.0321	0.00103041	-0.0119	On average, every year older you are, you climb 0.0119 V-points worse.





Conclusion:

My hypothesis was correct. People with a higher ape index tend to climb better; on average each inch higher your ape index is you climb 0.1413 V-points better. So someone with a plus seven ape index would climb about 1 level higher on the V-scale. This is not a large effect—the r squared value indicates it only accounts for 2.69 percent of the total variation in climbing ability. This is still more important than either height or reach themselves.

Generally, people with a leaner body type are more athletic overall. In climbing this is true, but having longer arms is also important because of the long reaches that many climbs have. (Just being tall doesn't help, I found.) If people have shorter arms for their height then they might not be able to make those moves, and might have to resort to dynos (jumps) and other more difficult moves.

One problem I had was the failure of some people to measure properly, or joke answers. Some people wrote questionable answers, ones that are not likely to be true but are not completely impossible and cannot immediately be thrown out. For example, someone said that they were 70 inches tall and had an arm span of 81 inches. A plus eleven ape index is unlikely, but definitely not impossible. Or the 55.5 inch tall 13 year old who weighs 165 pounds? Ones that we could throw out were the people saying they have a wingspan of “about 3 meters” or “23 centimeters.” Another problem was that we didn't restrict what units they measured themselves in, so we had to convert from centimeters to inches, and kilograms and stones to pounds. This was just a real pain when trying to analyze and sort the data. The one thing we definitely had was enough data. We got 712 responses, and even after taking out all joke or incomplete answers still had 669.

However, my sample isn't representative of the whole climbing community. The people who took this survey are all members of the online forum on which we posted it. The kind of people who go on to sites like this tend to take climbing seriously, and so our data showed a lot of good climbers. The average climbing ability for my data was V5-6, which is quite good, and definitely not the average for all climbers. Also, most of the responses were from young males, and so our data for women was not as accurate. There was one woman with a negative five ape index who was a V8 climber, extremely good. This single person decreased the correlation from -0.14 to -0.05, a giant difference. This wouldn't have made such a difference if we had gotten more samples of women. This doesn't look at all like the population I've seen at the gym, which is maybe half women, of all ages, and averages maybe V3 for climbing ability.

Previous studies have disagreed on the impact of ape index on climbing ability, though none of them have had as high of a sample size as mine. Mermier et al (2000) for example, only tested 44 climbers. AW Sheel (2004) summarizes:

“Using a multiple regression analysis, it was shown that training variables explained 58.9% of the total variance in climbing, whereas the anthropometric and flexibility components explained only 0.3% and 1.8% of the total variance.”

My study agrees that training variables (like time spent climbing) are much more important than body type, although I found a much higher correlation with ape index and other anthropomorphic traits.

Citations:

Mermier et al. "Physiological and anthropometric determinants of sport climbing performance". *British Journal of Sports Medicine* 2000; 24, 359-366.

Sheel, AW. "Physiology of sport rock climbing", *British Journal of Sports Medicine* 2004;38:355–359.