

Lab Report: Flight Characteristics of the Discraft Heat in Different Weights

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Objective: To investigate the flight characteristics (specifically distance) of the Discraft Heat disc golf disc in three different weights: 149 grams, 156 grams, and 172 grams.

Hypothesis: The Discraft Heat in 149 grams will have a faster release speed (and therefore travel faster and further) due to its lighter weight.

Experimental Setup:

- **Location:** Harrison, NY
- **Date:** February 20, 2025
- **Weather Conditions:** 24°F, Wind NW at 11 mph
- **Disc:** Discraft Heat (in 149g, 156g, and 172g weights)
- **Procedure:** Three trials were conducted. In each trial, the discs were thrown in a predetermined order to minimize bias:
 - Trial 1: 156g, 172g, 149g
 - Trial 2: 172g, 149g, 156g
 - Trial 3: 156g, 149g, 172g
 - Distance was measured using a laser rangefinder.

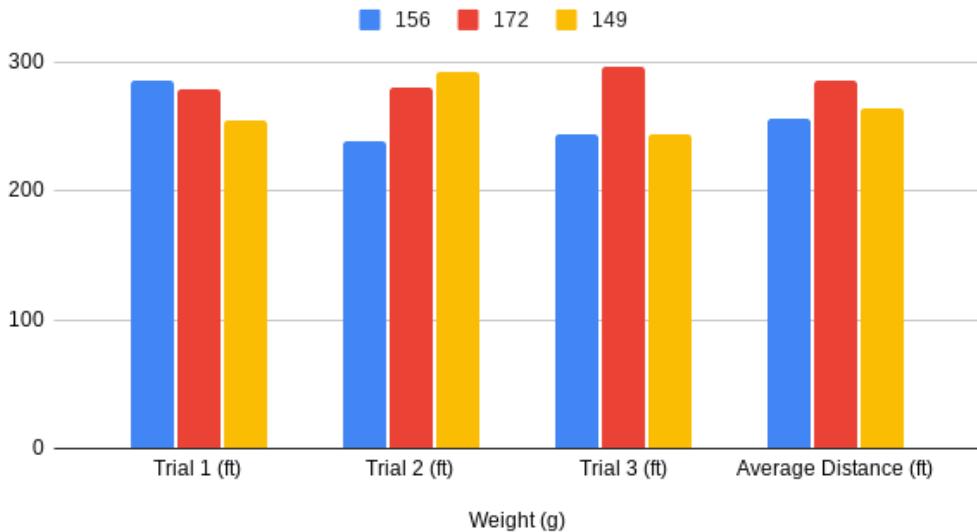
Results:

Weight (g)	Trial 1 (ft)	Trial 2 (ft)	Trial 3 (ft)	Average Distance (ft)
156	285	238.5	243.3	255.7
172	279.3	279.6	296.1	285.0
149	255.3	292.8	243.6	263.9

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156, 172 and 149



Findings:

The results of this experiment present a complex picture of the relationship between disc weight and distance. Contrary to the initial hypothesis, the 172-gram Discraft Heat achieved the greatest average distance (285 ft), exceeding the 149-gram version by 21.1 ft and the 156-gram version by 29.3 ft. The 149-gram disc, while not achieving the greatest overall distance, did demonstrate some variability in its individual throws, achieving the longest single throw of all the tested discs (292.8 ft). The 156-gram disc consistently demonstrated the shortest average distance.

Several key observations emerge from these findings:

- **Weight vs. Distance:** The most significant finding is the inverse relationship between weight and average distance. The heaviest disc, the 172-gram Heat, traveled the furthest, while the lightest disc, the 149-gram Heat, traveled a middle distance. The 156-gram disc performed the worst. This directly contradicts the hypothesis that lighter discs would achieve greater distances due to higher release velocities.
- **Throw-to-Throw Variability:** The 149-gram disc exhibited the greatest range of distances between its individual throws. While its average distance was less than the 172-gram disc, it also produced the single longest throw of the entire experiment. This suggests that the lighter disc might be more sensitive to variations in throwing technique or environmental factors. The 156-gram disc also showed some variability, while the 172-gram disc had the most consistent throw distances.
- **Potential Influence of External Factors:** The 11 mph northwest wind likely played a significant role in the observed results. The wind's influence could manifest in several ways: creating headwind, tailwind, or crosswind components that affect the disc's trajectory and distance. Given the northwest direction, it's plausible that some throws experienced a greater degree of crosswind or headwind than others, depending on the specific release point and trajectory. The heavier discs, with their greater momentum and potentially higher gyroscopic stability, may have been less susceptible to these wind effects.

Discussion:

The results of this experiment challenge the commonly held belief that lighter discs inherently travel further due to higher release velocities. While it's plausible that a lighter disc *could* be thrown at a higher initial velocity, this experiment suggests that other factors may outweigh the advantage of increased speed.

- **Aerodynamic Considerations:** The aerodynamic properties of a disc are complex and influenced by several factors, including weight, weight distribution, shape, and plastic type. While release velocity is important, other aerodynamic forces, such as lift, drag, and gyroscopic stability, play crucial roles in determining the disc's flight path and distance. The heavier disc, while potentially traveling at a lower initial velocity, might maintain its spin better and experience less drag, leading to a straighter and ultimately longer flight. The distribution of weight within the disc (rim weight vs. core weight) can also influence its flight characteristics. Subtle variations in weight distribution between the three discs, even within the same mold, could contribute to the observed differences in flight.
- **The Role of Wind:** The 11 mph northwest wind introduces a significant confounding variable. Lighter discs, with their lower momentum, are generally more susceptible to wind effects. The wind could have caused the lighter discs to deviate from their intended flight paths, reducing their overall distance. The heavier disc, with its greater momentum and potentially higher gyroscopic stability, may have been less affected by the wind, allowing it to maintain a straighter and longer flight path. It is also possible that the wind conditions favored the heavier disc, as they were the most consistent.
- **Throwing Technique and Consistency:** While the throwing order was randomized to mitigate potential biases, variations in throwing technique are inevitable, even with a single thrower. Subtle differences in release angle, hyzer/anhyzer angle, and follow-through can significantly impact the disc's flight. It's possible that the throws for the heavier disc were, on average, more consistent or better executed, contributing to its greater average distance. Even with randomization, it is difficult to completely eliminate the possibility that variations in throwing technique influenced the results.
- **The Complex Interplay of Factors:** It's important to recognize that disc flight is a complex phenomenon influenced by the interplay of multiple factors. Release velocity, spin rate, aerodynamic properties, wind conditions, and throwing technique all contribute to the disc's flight path and distance. This experiment highlights the difficulty of isolating the effect of a single variable, such as weight, without carefully controlling for all other factors.

Possible Sources of Error:

- **Wind:** The wind presents a significant source of potential error. While relatively consistent, micro-variations in wind speed and direction could have influenced the flight paths of the discs. Recording wind speed and direction at the precise moment of each throw, using a handheld anemometer, would provide more granular data and help to better account for wind's influence.
- **Throwing Consistency:** Even with a single thrower, minor variations in release angle, speed, and spin could have contributed to inconsistencies in distance. Using a mechanical throwing device would eliminate this source of error and provide more consistent throws.

- **Sample Size:** Three trials per weight may not be sufficient to draw definitive conclusions. A larger sample size (e.g., 10-15 trials per weight) would improve the statistical significance of the results and reduce the impact of outliers.
- **Measurement Accuracy:** While a laser rangefinder was used, slight inaccuracies in targeting and reading the device are possible. Multiple measurements for each throw, taken from slightly different angles, could improve the accuracy of the distance data.
- **Temperature:** While the temperature was recorded, it's possible that subtle temperature fluctuations during the experiment could have affected the plastic properties of the discs. Conducting the experiment in a temperature-controlled environment would eliminate this potential source of error.
- **Disc Variability:** Even within the same model and weight class, subtle variations in the plastic or molding process can exist between individual discs. These variations, undetectable by visual inspection, could influence the disc's flight characteristics.

Next Steps:

1. **Controlled Environment:** Conducting the experiment in a controlled indoor environment would eliminate the influence of wind and other weather conditions, allowing for a more accurate assessment of the weight's impact on flight. This would involve access to a large indoor space, such as a sports dome or warehouse, with sufficient ceiling height to accommodate disc flight.
2. **Increased Trials:** Increasing the number of trials per weight (e.g., ten or more) would provide a more robust dataset and reduce the impact of individual throw variations. This would require more time and potentially more discs to ensure consistency.
3. **Velocity Measurement:** Measuring the release velocity of each throw using specialized equipment (e.g., radar gun, speed sensor) would provide valuable data to test the initial assumption about release speed and its correlation with distance. This would require access to specialized equipment and training on its use.
4. **Spin Rate Measurement:** Measuring the spin rate of each throw using specialized equipment (e.g., high-speed camera, spin rate sensor) would also provide further insight into the relationship between spin and flight characteristics. This would also require specialized equipment and expertise.
5. **Detailed Flight Path Analysis:** Recording the complete flight path of each disc (e.g., using high-speed video analysis) would provide a more detailed understanding of the disc's trajectory and how it is affected by weight. This would require sophisticated video equipment and software for analysis.
6. **Material Testing:** Conducting material testing on the discs (e.g., tensile strength, flexibility, density) could provide insights into how the different weights affect the physical properties of the plastic and how those properties relate to flight characteristics. This would require access to material testing equipment and expertise in material science.
7. **Varying Wind Conditions:** Future experiments could be designed to specifically investigate the interaction between disc weight and wind conditions. This could involve testing in a wind tunnel or conducting outdoor tests under a range of wind speeds and directions.

Insights into Weight and Throwing Recommendations:

- **149g:** This lighter weight might be more suitable for players with less throwing power or those who prioritize a quicker release. However, it may be more susceptible to wind. Consider this weight for calm conditions or shorter throws. It could also be a good choice for beginners who are still developing their throwing technique. The greater variability observed in the throws with this weight suggests that consistency in throwing technique is particularly important when using lighter discs.
- **156g:** This weight fell in the middle in terms of distance in this particular test. It could be a good compromise between the 149g and 172g, potentially offering a balance of speed and stability. However, its performance in this experiment was the least consistent. Further testing is needed to better understand the flight characteristics of this weight.
- **172g:** This heavier weight achieved the greatest distance in this experiment. It might be a good choice for players with more power or in windy conditions, as it appears to be less affected by wind drift. This weight may be preferable for maximizing distance on open fairways. The greater consistency observed in the throws with this weight suggests that heavier discs may be more forgiving of minor variations in throwing technique.

Conclusion:

This experiment yielded unexpected results, with the heavier 172-gram Discraft Heat outperforming the lighter weights in terms of average distance. The wind likely played a significant role in these results, and further research in a controlled environment is needed to isolate the true effect of weight on disc flight. The complex interplay of factors influencing disc flight, including aerodynamics, wind conditions, throwing technique, and disc variability, highlights the challenges of isolating the impact of a single variable like weight. While the preliminary findings suggest that heavier discs may be advantageous in windy conditions or for players with greater throwing power, and lighter discs might be more suitable for calmer conditions or players prioritizing a quicker release, more rigorous testing is required to draw definitive conclusions. The insights gained from this experiment emphasize the importance of considering the complex interactions between disc properties, environmental factors, and throwing technique when selecting discs for different playing conditions and personal preferences. Future research, incorporating the suggested next steps, will provide a more comprehensive understanding of the relationship between disc weight and flight characteristics, ultimately helping disc golfers make more informed decisions about their equipment and improve their performance on the course.