

Journal of Physics Special Topics

An undergraduate physics journal

A1 9 Unrelenting Force

R. Wass, S. Bourne, A. Poole, E. Stedall

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH

December 12, 2025

Abstract

In this paper, we investigate a fictional shout from the video game, *The Elder Scrolls V: Skyrim*, focusing on the exit pressure to propel a modelled target 20 metres under projectile motion with no drag, and how a model considering drag would differ in shape and distance travelled. We found the exit pressure to be a value of ≈ 45 kPa and under drag the target would travel 18.22 metres.

Introduction

This paper investigates the fictional ‘*Unrelenting Force*’ shout from the video game, *The Elder Scrolls V: Skyrim* [1]. This shout is known for its ability to propel objects and creatures great distances. We are looking at the force that would be required to propel the average male a horizontal distance of 20 metres, and the corresponding air pressure at the user’s mouth.

To investigate the shout, we are assuming a scenario where the shout user is standing 45° downslope from their target, directly facing them, and concentrating all of the shout power into the target. The target is assumed to be standing on flat ground. We are also assuming the force occurs locally at the target, preventing shout strength loss. For the best accuracy, we model the force acting through the centre of gravity (CoG) of the body being affected by the shouting force. This is done to remove any impacts of rotational kinematics, which could result in a lift force, simplifying the aerodynamic model applied to the assumed cylindrical shape of a human. The air the target travels through is assumed to have no wind effects, be at sea level and 15°C. In the game, the target becomes sub-

ject to ‘rag-doll physics’ [1] [2]; here, the target is treated as rigid with constant shape.

We are assuming our target to be an average male, with a mass of 85 kg [3] and a chest measurement of 101.6 cm [4], giving a chest half-width, which accounts for the area of the chest that will be contacted by the force, as 50 cm [5]. This chest half-width is found using the average chest measurement and height of the assumed individual. As we are using a assumptive cylindrical model, we are taking the diameter of this model to be equal to the chest half-width measurement, and length equal to the average height of 176.2 cm [3].

To analyse the effects of the shout, we are first going to calculate the force required to propel our target a distance of 20 metres, ignoring drag, and the subsequent pressure of the shout to do so, later incorporating aerodynamic drag and comparing the flight paths.

Theory

When ignoring drag, the range, R , of a projectile fired with initial velocity, u , at an angle θ , under gravitational force, g is given by,

$$R = \frac{u^2 \sin(2\theta)}{g}, \quad (1)$$

which can be arranged in terms of u to give,

$$u = \sqrt{Rg} \quad (2)$$

when using the previously assumed angle. Thus, the required initial velocity of the target at launch is $\approx 14 \text{ ms}^{-1}$.

To find the pressure, Δp , of the air hitting the target, we consider impulse force, J , and its relationship to pressure,

$$J = mu \quad (3a)$$

$$J = F\Delta t = \Delta p A_{chest} \Delta t \quad (3b)$$

where A_{chest} is the frontal facing area of the cylinder and Δt is the pulse (shout) duration, assumed as 0.3 seconds.

When we aim to calculate the pressure, we combine the calculations for impulse, finding,

$$\Delta p = \frac{mu}{A_{chest} \Delta t} \quad (4)$$

for a pressure value at the target of $\approx 45 \text{ kPa}$. If we maintain the assumption that this force of pressure is acting through the CoG of the target, we can investigate the effects of drag as the target flies through the air. Here, we must consider the drag force, F_d , that acts upon the target during its motion, which can be calculated using:

$$F_d = \frac{1}{2} C_d A v^2 \quad (5)$$

which takes into the drag coefficient, C_d , of the target and its velocity, v at a given moment in time. Therefore, the drag force is not consistent throughout the target's flight. Additionally, the coefficient of drag for a smooth cylinder is dependent on whether the air flow surrounding it is turbulent or laminar [6]. We can find C_d using the Reynolds number, Re , which is given by,

$$Re = \frac{\rho u L_c}{\eta} \quad (6)$$

where ρ is the density of air and η the viscosity of air, both at sea level and 15°C [7]. L_c is the characteristic length of the assumed cylinder, which is its height due to its vertical orientation.

This results in a Reynolds number on launch of $\approx 1.6 \times 10^6$, indicating a turbulent air flow around the target. Due to the Reynolds number being to the magnitude of 10^6 , we are taking the drag coefficient, C_d , to be 1 and keeping this throughout the target's projectile motion [6], as it does not fluctuate significantly from this value until the target reaches speeds of $\approx 0.001 \text{ ms}^{-1}$.

Using this value for the coefficient of drag, we can find the variable drag force during the target's flight, and plot the flight path against one that does not consider drag forces.

Results & Discussion

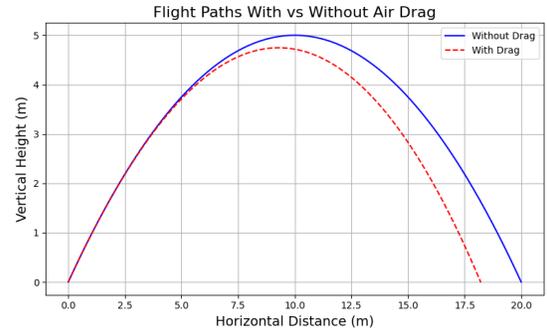


Figure 1:
The target's flight path with and without drag considerations.

Figure 1 displays the flight path considering drag lands before that ignoring drag, with a final range of 18.22 metres.

The method used throughout this paper has a number of limitations arising from its assumptions. The model ignores any distance between the shout user and target, which would cause the pressure at the target to be lesser than when leaving the mouth due to the inverse square law [8]. The simplified model shows a clear impact of drag upon the target during flight, however this is not fully representative of a realistic scenario.

References

- [1] The UESPWiki. Skyrim: Unrelenting force. https://en.uesp.net/wiki/Skyrim:Unrelenting_Force, 2025. Accessed 3 Nov 2025.
- [2] Diana Ipacs. Ragdoll physics in video games: What is it, exactly? <https://bluebirdinternational.com/ragdoll-physics/>, 2025. Accessed: 11 November 2025.
- [3] NHS England. Adult overweight and obesity. *Health Survey for England, 2022 Part 2*, 2024.
- [4] Free Rx Editors. How to measure chest: Simple guide for accuracy. <https://tinyurl.com/yebv9vt9>, 2024.
- [5] Dmitry Pavlov. Table of typical men's measurements according to gost 17522-72. <http://dmitriy-prog.ru/mensizestable.html>, 2017 - 2020.
- [6] Wolf Dynamics. Flow past a cylinder – from laminar to turbulent flow. https://www.wolfdynamics.com/wiki/tut_2D_cylinder.pdf. Accessed: 2025-11-09.
- [7] Engineers Edge. Viscosity of air, dynamic and kinematic. https://www.engineersedge.com/physics/viscosity_of_air_dynamic_and_kinematic_14483.htm. Accessed: 2025-11-09.
- [8] Kyle Mathias. Inverse square law of sound: Simple explanation. <https://audiouniversityonline.com/inverse-square-law-of-sound/>, 2025. Accessed: 10 November 2025.