Journal of Interdisciplinary Science Topics

A Model to Determine the Maximum Instantaneous Speed of the Flash

Danny Chandla & Skye Rosetti
The Centre for Interdisciplinary Science, University of Leicester
19/03/2015

Abstract
The Flash is the fastest man alive. But how fast can the CW's interpretation of the Flash actually travel? The limiting factor to his maximum speed is the energy available for movement, dictated by energy intake from his diet. The model proposed in this paper aims to evaluate this and incorporate his basal metabolic rate to determine a maximum instantaneous speed for the Flash of 4472.44 ± 57.64 ms^{-1}.

Introduction
Barry Allen, also known as the Flash (see figure 1), is the fastest man alive. For the CW interpretation of this well-known superhero he is shown to be able to run at speeds of 1633 ms^{-1} (Mach 4.8), which is approximately 2.5 times the speed of Concorde.

Figure 1 – Barry Allen, The Flash, approaching his greatest depicted speed in CW's The Flash [1].

In order to achieve these higher speeds, a large amount of energy is required. As Barry is still human, this energy would inevitably come from his diet. Consequently, the calorific content of his average meal would be much greater than that of an average human.

Some of the energy obtained from his diet would be used in maintenance of regular metabolic function, which is physiologically defined as the basal metabolic rate (BMR).

This paper considers the daily calorific intake consumed by the Flash, based on a single meal depicted on CW's *The Flash* and uses this to calculate his maximum speed.

Barry Allen's Daily Calorie Intake
In order to determine the quantity of food consumed in figure 2, the pile depicted was modelled as a hemisphere. It was assumed that the meal consisted of two types of item, burgers and fries, which were in a 1:1 ratio. Each item type had different packaging, and therefore different dimensions.

Figure 2 – A meal consumed by the Flash, consisting of burgers and fries [1].

In order to estimate these dimensions, they were modelled as cuboidal in shape and were considered in the same scale as the radius of the hemisphere. These measurements were obtained using a 15.00 ± 0.05 cm ruler on a screen with video in the

widescreen 16:9 aspect ratio as presented on the CW. The screen used for this purpose was a 13' laptop monitor. From the dimensions obtained in Table 1 the combined volume of a burger box and fry box were calculated to be 30.5 ± 0.78cm^3.

Item	Length / cm (± 0.05 cm)	Width / cm (± 0.05 cm)	Height / cm (± 0.05 cm)
Burger	2.50	2.50	2.00
Fries	3.00	2.00	3.00

Table 1 – The dimensions of the two objects considered in Figure 2. The total volume of packaging was considered in a 1:1 ratio and therefore calculated by obtaining the volume for each packing type and adding them together (30.5 cm^2).

The volume of this hemisphere was then calculated at 2424.52 ± 5.51 cm^3 from an initial radius of 10.5 ± 0.03cm. The relationship below was then used to calculate the number of object pairs (*N*) consumed:

$$N = \frac{V_{hemisphere}}{V_{boxes}} \qquad (1)$$

This gave a total of ~80 burgers and portions fries (79.49 ± 2.04).

As Big Belly Burger is a fictional fast food chain, the nutritional information for these items was equated to the equivalent items at McDonalds' (a Big Mac and Medium Fries).

The energy content of a single Big Mac and medium fries is 845 kcal [2]. Therefore, the total calorific content of a single meal consumed by the Flash was calculated as 67600 ± 1719.58 kcal. Assuming Barry Allen eats 3 meals a day, the total number of calories consumed in a day is 202800 ± 5158.73 kcal.

Barry Allen's BMR

In order to determine the amount of energy available for movement, the BMR needed to be quantified and removed from the total calories consumed. This was calculated by assuming that Barry's BMR remained the same as a normal human, using the revised Harris-Benedict equation for a male [3]:

$$E_{BMR}(kcal) = 88.62 + (13.397 \times mass\ in\ kg) + (4.799 \times height\ in\ cm) - (5.677 \times age\ in\ years) \qquad (2)$$

The height, mass and age used for the Flash were assumed to be the same as the actor who portrays him, Grant Gustin. These were taken to be 188 cm, 84 kg and 25 years respectively [4]. This calculation assumes that the Flash's BMR can be modelled as an average human, and provides a BMR of 2008 kcal day^{-1}.

The amount of energy available for movement was then calculated as:

$$E_{movement} = E_{total} - E_{BMR} \qquad (3)$$

Evaluating this gives the available energy for movement as 200792.32 ± 5158.73 kcal, which equates to 840115.10 ± 21584.11 kJ.

Maximum Instantaneous Speed

Assuming all of the energy available is used as kinetic energy, a maximum speed *v* for the Flash was obtained using the relationship:

$$E = \frac{1}{2}mv^2 \qquad (4)$$

$$\therefore v = \sqrt{\frac{2E}{m}} \qquad (5)$$

The gives the maximum instantaneous speed of the Flash to be 4472.44 ± 57.64 ms^{-1}.

Conclusion

The model used shows that based on the dietary intake shown in CW's *The Flash*, the maximum instantaneous speed that be achieved by Barry Allen is 4472.44 ± 57.64 ms^{-1}. This value is 2.74 times the value stated within the show and is roughly 13 times the speed of sound.

References

[1] Wu, K. & Johns, G. (2015) *Revenge Of The Rogues*, The Flash, Season 1, episode 10. The CW, first broadcast 20 January 2015.

[2] McDonalds (2015) *Nutrition Calculator*. Available: http://www.mcdonalds.co.uk/ukhome/meal_builder.html [Accessed 26/02/2015].
[3] Roza, A.M. & Shizgal, H.M. (1984) *The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass*, American Journal of Clinical Nutrition, 40, 168-182.
[4] IMDb (2015) Grant Gustin – IMDb. Available: http://www.imdb.com/name/nm2652716/ [Accessed 26/02/2015].