Journal of Interdisciplinary Science Topics

Calculating the punching force of “one-punch” Mickey

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09/04/2014

Abstract
This paper will examine the film *Snatch*, to understand concepts related to the physics of a knockout in boxing. The punching force exerted by the character named Mickey is calculated by using the equations for momentum and impulse (under reasonable assumptions) to find that Mickey exerts a punching force of 1780N.

Introduction
The movie *Snatch* is a British film directed by filmmaker Guy Ritchie, which takes place in London, England. One of the characters in the film is depicted to have supreme fighting skills as he can knockout any individual with just one punch. This character is named Mickey O’Neil, also known as “one-punch” Mickey, portrayed by American actor Brad Pitt. The movie shows several scenes where Mickey finishes his opponent via knockout in a boxing match with just one punch.

As such, the premise for this article is to analyse the effects of a concussion on the brain and what creates the “knockout” effect on an individual. The article will also investigate the punching force exerted by Mickey by applying the laws of physics to determine the force behind his knockout power.

Mechanism of a Concussion
The term concussion is defined as a sharp blow to the head in the form of a collision [1]. More specifically, in boxing this refers to the impact of the glove of one person to the head of the other creating a relative motion of the head and brain, adhering to Newton’s laws of motion. Within the skull, the brain is suspended between cerebrospinal fluid and attached by blood vessels and nerve fibres [1]. During the impact, the head is accelerated due to inertia that causes the skull to accelerate as well. As the skull comes to rest, the brain is still moving within and it will hit the wall of the skull, creating a contusion. If punched hard enough, the reticular activating centre (important in maintaining proper posture) in the brain will be affected leading to an irregular reflex which will cause the person to fall and hit the floor unintentionally [1].

Applying Physics to Boxing
To calculate the punching force exerted by Mickey to knockout his opponent, concepts from physics can be used. When a boxer is in their “ready” position, their fists are up and contain potential energy that will come from their muscles and body motions. During the punching process, the potential energy is being converted to kinetic energy.

In order to calculate the punching force, we need to calculate the change in momentum for the head being punched. We know that before the punch, the momentum of the head will be zero; therefore the change in momentum will equal the final momentum (head being punched). A few reasonable assumptions have to be made however in order to accommodate the calculations:

- The weight of the head of the person being punched by Mickey in the movie is 8kg [3]
- The time of contact between the hand and head is 0.03s [4]
- The head moves a distance of 0.20m during contact as estimated by watching the film

The first step is to calculate momentum given by the following equation [2];

$$\rho = mv$$

In the equation above, velocity can be calculated by [2];

$$v = \frac{d}{t} = \frac{0.20m}{0.03s} = 6.67\ ms^{-1}$$

Substituting this value into the momentum equation will give us;

$$\rho = mv = 8kg \times 6.67ms^{-1} = 53.4\ kg\ ms^{-1}$$

Since we now know the change in momentum, we can use the equation for impulse to find the force since the change in momentum is equal to the impulse. The equation for impulse is the following [2];

$$Impulse = F \times \Delta t$$

Rearrange for '*F*' to get;

$$F = \frac{Impulse}{\Delta t}$$

The final step is to substitute the values into the rearranged equation for '*F*' and find the force. The change in time is 0.03s as stated in the assumptions.

$$F = \frac{53.4\ kg\ ms^{-1}}{0.03\ s} = 1780\ N$$

Conclusion

By conducting calculations using the assumed values, it is seen that the force exerted by Mickey's punch is 1780N, which is about 400lbs of force. Experimentally obtained values from professional boxers in the middleweight class (165lb) have been observed to be around 2625N of force which is fairly close to "one-punch" Mickey's (given that he can be comparable to a middleweight due to his size in the movie) [4]. The calculations however, cannot take into account the way an individual places a punch on the opponent's head, which is an important aspect of achieving a knockout. Delivering a punch in a way that creates a "snapping" motion (e.g. landing a hook punch onto the jaw) in the opponents head will have a higher chance of knocking the opponent out because it will cause the brain to move faster and hit the wall of the skull, causing a concussion. The 1780N of force calculated here is a reasonable calculation of Mickey's punch, but it is important to mention that a great deal of his destructive power is related to the placement and style of his punch.

References

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