



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

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Project Title
Can the Forces of Firearm Recoil Cause Brain Injury?

Abstract

Objectives/Goals
The objective of my project was to determine if the recoil forces of different firearms could generate enough acceleration of the head to cause subconcussive brain injury.

Methods/Materials
A head accelerometer, ten firearms, eight different ammunitions, safety glasses, ear plugs, laptop computer and a weight scale were used. Recoil energy was calculated for each of the firearm combinations using the equation:
$$\text{Recoil Energy} = [\text{mgun}/64.348] \times [(\text{mshot} \times \text{vshot} + \text{powder} \times \text{vshot} \times \text{xf})/7000 * \text{mgun}]^2$$
. Peak head acceleration was measured using the head accelerometer for each of the firearm combinations tested. One hundred and ninety data points were collected. Calculated recoil energy and head acceleration were compared.

Results
Average recoil acceleration of the head increased as the calculated recoil energy increased. The recoil forces generated to the head were dependent on the velocity of the bullet, weight of the bullet, weight of the firearm, weight of the powder charge, type of firearm and the mass of the shooter. Firearms with recoil energies above 35 ft-lbs created enough head acceleration to potentially cause subconcussive brain injury. Firearms with lower recoil energies, as high as 24.5ft-lbs do not create enough head acceleration to cause subconcussive brain injury. Mismounting the firearms created forces to the head that could cause subconcussive brain injury. Recoil reducers in the stock of the firearm lessened the recoil forces to the head.

Conclusions/Discussion
Firearms with high recoil energies created enough head acceleration to potentially cause subconcussive brain injury. This should be a wake up call for people who shoot large recoil energy firearms frequently like peace officers, marksmen and soldiers. They should be aware that frequent use of large caliber firearms could cause excessive forces to the head.

Summary Statement
Firearms with high recoil energies created enough head acceleration to cause brain injury.

Help Received
Mr. Hobbs helped with development. Father helped with testing. Mother pasted together board.