CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
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Project Number
36613

Project Title
Time to Score: The Physics of Penalty Kicks

Abstract

Objectives/Goals
I compared the speed of the fastest penalty kick with the time it takes the goalie to reach the goal post. I also tested how a player can kick it the fastest and how a goalie can get to the post the fastest.

Methods/Materials
I surveyed my soccer team for penalty kicks using an Adidas Smart Ball that measures speed. Each player kicked 3x for one, three, and five steps before kicking. I also measured the time it took for several goalies to reach the post during a penalty kick by counting the number of frames in a GoPro video. I compared the goalies' times with and without revealing the direction of the kick.

Results
Of the 12 kickers, the fastest one (61 mph) took five steps before kicking the ball. At this speed the ball would travel to the bottom corner of the goal in 424 milliseconds. All players that I tested kicked it the fastest when using their dominant foot. Of the four goalies that I tested, the fastest one could only reach the post in 767 milliseconds so it was significantly slower than the fastest kick. On average, the goalies are 2.3 mph faster if they know the direction of the kick. Two out of three goalies were faster going to the side of their dominant hand. Only the slowest kick (30 mph) will be saved by the fastest goalie.

Conclusions/Discussion
Out of all the kicks I tested, 78% would have scored against the fastest goalie. Any kick over 34 mph to the bottom corner of the goal will arrive before the fastest goalie. Based on these results, a goalie's only chance at saving a PK is to correctly predict the direction of the ball and begin moving before the ball is kicked. In the end, whether a PK scores is up to the kicker - the laws of physics favor the kicker. It is the kicker's "time to score".

Summary Statement
I measured the speed of players' penalty kicks and the speed of goalies to determine which is faster.

Help Received
None. I designed and performed the experiments myself.