

Engineer: Head-first slide is quicker

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Base running and base stealing would seem to be arts driven solely by a runner's speed, but there's more than mere gristle, bone and lung power to this facet of baseball -- there are lots of mathematics and physics at play.

With baseball playoffs heating up and the World Series right around the corner, it's guaranteed that fans will see daring slides, both feet-first and head -first, and even slides on bang-bang plays at first.

Who gets there faster, the head-first slider or the feet-first?

The heads first player, says David A. Peters, Ph.D., the McDonnell Douglas Professor of Engineering at Washington University in St. Louis, and big-time baseball fan. He says it's a matter of the player's center of gravity.

Peters is a mechanical engineer who specializes in aircraft and helicopter engineering, and he sees our "fields of dreams" a bit differently than most – he sees them as playgrounds of math and physics.

Peters says that dynamics equations can determine which slide gets you there more quickly. But there are three important mathematical issues at play.

"There's momentum – mass of the body times how fast the player is moving," he says. "There's angular momentum. If it's feet-first and you're starting to slide, your feet are going out from you and you're

rotating clockwise; if it's head-first, as your hands go down, you're rotating counterclockwise."

Angular momentum is mass movement of inertia times the rotational rate.

"On top of this is Newton's Law," Peters explains. "The force is your mass times acceleration. The moments are moments of inertia times your angular acceleration."

So, who gets there faster?

"It turns out your center of gravity is where the momentum is," Peters says. "This is found half way from the tips of your fingers to the tips of your toes. In the headfirst slide, the center of gravity is lower than halfway between your feet and hands, so your feet don't get there as fast. It's faster head-first."

For a long time – until roughly the Pete Rose era of the '60s and '70s – players shunned the headfirst slide to protect their hands and faces. Spikes, evoking the Ty Cobb days, were weapons on the diamond. In the past few decades, players who prefer the head-first slide have taken to running holding onto their batter's gloves to prevent their hands from opening up and being exposed to injury. And, while the percentage of players who slide one way or the other is not actually known, Peters estimates it's about 50-50.

Peters notes a growing number of players who will slide into first base, despite conventional wisdom that running through first is the faster way.

"Mathematically, you might think there's an advantage, but leaving your feet is actually a detriment because you're no longer pulsing and you start to decelerate," he says. "When you're running, you get your feet out in

front of the center of gravity, so you're getting maybe three or four steps of an advantage."

Peters says the only advantage of any slide into first base is to avoid the first baseman's tag when he has to come off the base to spear an errant throw.

"In general, most agree to run through first, but you'll find people who will swear it's better to do it the other way."

Video: Dave Peters discusses the physics of sliding and compares sliding head first versus feet first. --

mms://mediaserver.wustl.edu/mpa/sliding/large.wmv

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