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Research Methods 8-10%

AP OBJECTIVE-Apply basic descriptive statistical concepts, including interpreting and constructing graphs and calculating simple descriptive statistics.

A .Create a data set from 2012-1980 for the league leaders in stolen bases and use them to calculate mode, mean, median. Complete for both leagues (LEAVE OUT (1994 and 1981, strike shortened seasons…although Tim “Rock” Raines somehow managed to steal 71 bases in 88 games in 81!!)

National League

44, 66, 61, 52, 61, 68, 78, 64, 60, 70, 65, 48, 46, 62, 72, 58, 60, 53, 56, 58, 78, 76, 77, 65, 81, 109, 107, 110, 75, 90, 78, 97

American League ………

B. Distribution of Scores

* Arrange the stolen bases in order from lowest to highest for your league
1. National
2. American

Create a frequency histogram for one league.

* Measures of Central Tendency
	+ What is the Mode in both leagues?
	+ What is the median?
	+ What is the median in both distributions?
* What is the mean?
* How is a mean calculated?
* What is the mean in both of your distributions?
1. Skewed Distribution
* Which measure of central tendency would be the best “average to describe a skewed distribution? Why?
1. Measures of Variability
* How is range calculated
* What is your range of your distributions?
* What is a standard deviation?
* How is standard deviation calculated? (THIS IS THE ONLY TIME IN YOUR LIFE SOMEONE WILL ASK YOU THIS!)

Part II: “There are three types of lies: lies, damned lies, and statistics” Benjamin Disareli, 19th century British Statesman

1. Calculate the mode, median, mean, and standard deviation for stolen bases for the years

2007, 1999, 1987 for the National League and replace 87 with 82 for the American League. Only calculate players who had over 400 plate appearances.

1. What can we infer from these statistics?

Other Research Ideas

Homerun Trots-

1. What is the average time for a homerun trot? Mode? Median?
2. Standard Deviation?
3. Who was the slowest and fastest?
4. Create any correlation, such as, track one players home runs and weight or homerun trot time and age?
5. Examples of other Correlations
	1. Free Throws and Height

Here is where you can find the daily trot times

<http://www.wezen-ball.com/tater-trot-tracker/tater-trot-tracker/trot-times-for-june-9-2013.html>

Homerun Distance- http://hittrackeronline.com/

1. What is the average distance of a major league homerun?
2. Standard deviation?
3. What z score did the top five guys in each league have?

AP OBJECTIVE: Explain how psychologists design tests, including standardization strategies and

other techniques to establish reliability and validity.

Wonderlic Exam

1. What is the difference between an aptitude test and an achievement test
2. Identify each of the following as either an aptitude or an achievement test
	1. SAT
	2. ACT
	3. AP PSYCHOLOGY EXAM
	4. Wonderlic Exam
3. What is meant by a reliability? Is the Wonderlic Exam a reliable test?
4. Can you provide evidence for the reliability of the AP psychology test?
5. What does it mean to say a test is valid? In the context we are discussing class (NFL combines) does the Wonderlic Exam have validity?
6. Does the exam have Content Validity? Does the AP test have content validity? How do we know?
7. Does the exam have Predictive Validity?
8. Create a histogram of the 2013 NFL Combine Wonderlic Scores

Performance Enhancing Drugs and Sports Research

List of products

1. Anabolic Steroids
2. Creatine
3. Force Factor
4. MusclePharm-This review evaluates the health benefits of the functional food, conjugated linoleic acids (CLA) - a heterogeneous group of positional and geometric isomers of linoleic acid predominantly found in milk, milk products, meat and meat products of ruminants. During the past couple of decades, hundreds of reports - principally based on in vitro, microbial, animal, and of late clinical trials on humans - have been accumulating with varying biological activities of CLA isomers. These studies highlight that CLA, apart form the classical nuclear transcription factors-mediated mechanism of action, appear to exhibit a number of inter-dependent molecular signalling pathways accounting for their reported health benefits. Such benefits relate to anti-obesitic, anti-carcinogenic, anti-atherogenic, anti-diabetagenic, immunomodulatory, apoptotic and osteosynthetic effects***. On the other hand, negative effects of CLA have been reported such as fatty liver and spleen, induction of colon carcinogenesis and hyperproinsulinaemia. As far as human consumption is concerned, a definite conclusion for CLA safety has not been reached yet.*** Parameters such as administration of the type of CLA isomer and/or their combination with other polyunsaturated fatty acids, mode of administration (eg., as free fatty acid or its triglyceride form, liquid or solid), daily dose and duration of consumption, gender, age, or ethnic and geographical backgrounds remain to be determined. Yet, it appears from trials so far conducted that CLA are functional food having prevailing beneficial health effects for humans.
5. Any prework mix with NO3 claims
6. ZMA
7. DHEA
8. Glutamine
9. Any product that claims muscle building effects

All students must research #1 and #9

Instructions

1. Go to a GNC.COM. Go to Sports Nutrition and choose one product form each of the following categories, pre-workout, workout, post-workout
2. Click on product information and look at the label.
3. You do not need to research each ingredient. Pick three ingredients that have the most and pick two that have an insignificant amount
4. Read the warning label? Is there anything concerning to you?
5. Journal any positive
6. Journal negatives
7. Try to find the results on the National Institute of Health website-Type in the ingredient on the search bar and read a few abstracts.
8. Did the information alter your attitude about the product?

Part II.

1. Student research the following drugs and their relation to performance enhancing
	1. Nicotine
	2. Caffeine
	3. Beet Juice
	4. Adderall, Ritalin
	5. Cocaine
	6. LSD
2. Do you think laser eye surgery should be considered performance enhancing? Why/Why not?
3. Do you think “Mind Enhancers” like Ritalin and Adderall are the same as PED’s?
4. Take the Performance Enhancing Drug Attitude Survey.

AP OBJECTIVE:

• Distinguish general differences between principles of classical conditioning,

operant conditioning, and observational learning (e.g., contingencies).

• Describe basic classical conditioning phenomena, such as acquisition, extinction,

spontaneous recovery, generalization, discrimination, and higher-order learning.

The Coach, The Player, The Fan Interview

Interview the Coach (these are just suggestions, but your questions have to relate to superstition and learning). Use the coaching questions as a guide to interviewing the player as well.

1. Background questions:
	1. How long have you been a coach?
	2. Did you play the sport you coach? What level?
	3. How many career wins do you have as a coach?
2. Do you have any superstitions as a coach? Can you explain why? Have you altered superstitions mid-stream?
3. Do you believe as a coach you are in control of your preparation and performance or outside factors, such as the referees, the location of the game, weather, ect?
4. Do you believe outside factors such as pre-game meals, hygienic practices such as shaving a certain way, or what you are wearing have anything to do with the outcome?
5. Do you have any rituals before a game? Any “lucky charms?”
6. If I told you that every coach I interviewed lost his next game after the interview what you think about that?

Interview the Fan

1. Are you from the greater Philadelphia area?
2. Are your parents from the greater Philadelphia area?
3. Who is your favorite sports team if you could only pick one? Why?
4. Do you own anything with their emblem, posters, mugs, jerseys, ect how many approximately?
5. On a scale of 1-10 what would you say is your dedication to this team?
6. Do you go to home games? Do you go to away games? What are your thoughts of the away fans?
7. Is there a team you dislike the most? Why? Geographical distance? Success of the other team? Perceived egotism?
8. How do you feel when your team wins? Loses?
9. Have you ever felt depressed for more than a few days after your team lost a big game?
10. Do you believe as a coach you are in control of your teams preparation and performance or outside factors, such as the referees, the location of the game, weather, ect?
11. Do you believe outside factors such as pre-game meals, hygienic practices such as shaving a certain way, or what you are wearing have anything to do with the outcome?
12. Do you have any rituals before a game? Any “lucky charms?”
13. If I told you that every fan I interviewed lost his next game after the interview how would that make you feel?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age | Positives of Playing Sports | Negatives of Playing Sports | Piaget Stage of Development(think how the stage could play a role) | Erikson Stage of Development(How could the stage play a role?) |
| 5 (or below)-7 |  |  |  |  |
| 7-12 |  |  |  |  |
| 12-17 |  |  |  |  |

Developmental Psychology and Athletics

Perception Worksheet

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Football Toss

10 Trials with goggles

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting? \_\_\_\_\_\_\_\_\_\_\_\_\_

10 Trials without goggles

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting?\_\_\_\_\_\_\_\_\_\_\_\_

Free Throws

10 Trials with goggles

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting? \_\_\_\_\_\_\_\_\_\_\_\_\_

10 Trials without goggles

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting?\_\_\_\_\_\_\_\_\_\_\_\_

Baseball Catch

*Describe two binocular cues for perceiving depth, and explain how they help the brain to compute distance.*

***Binocular cues*** require information from both eyes. In the ***retinal disparity*** cue, the brain computes the relative distance of an object by comparing the slightly different images an object castson our two retinas. The greater the difference, the greater the distance. In the ***convergence*** cue, the brain calculates the degree of neuromuscular strain when our two eyes turn inward to look at a nearby object. The greater the strain, the closer the object.

10 Trials with eye patch

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting? \_\_\_\_\_\_\_\_\_\_\_\_\_

10 Trials without eyepatch

\_\_\_\_\_\_\_\_\_ x incomplete

\_\_\_\_\_\_\_\_\_ x complete

At what toss did you feel as if your perception was adjusting?\_\_\_\_\_\_\_\_\_\_\_\_

**Why Babe Ruth is Greatest Home-Run Hitter**

**Hugh S. Fullerton (1921)**

Published in *Popular Science Monthly*, *99* (4), 19-21, 110.

[*Classics Editor's note: This is not a well-known article now, but it is a prime example of the popularization of experimental psychology in the USA at the beginning of the 20th century. The story of its origin can be found in Alfred H. Fuchs' (1998) "*[*Psychology and 'The Babe'*](http://www3.interscience.wiley.com/cgi-bin/fulltext?ID=32034&PLACEBO=IE.pdf)*,"* Journal of the History of the Behavioral Sciences*,* 34*, 153-165. (N.B. Access to* Interscience *and* Adobe Acrobat Reader *capability required to browse article.) -cdg-*]

**Popular Science Monthly tests in the laboratory his brain, eye, ear, and muscle -- and gets his secret**

The game was over. Babe, who had made one of his famous drives that day, was tired and wanted to go home. "Not tonight, Babe," I said. "Tonight you go to college with me. You're going to take scientific tests which will reveal your secret."

"Who wants to know it?" asked Babe.

"I want to know it," I replied, "and so do several hundred thousand fans. We want to know why it is that one man has achieved a unique batting skill like yours -- just why *you* can slam the ball as nobody else in the world can."

So away we went. Babe in his baseball uniform, not home to his armchair, but out to Columbia University to take his first college examination.

Babe went at the test with the zeal of a schoolboy, and the tests revealed why his rise to fame followed suddenly after years of playing during which he was known as an erratic although a powerful hitter. How he abruptly gained his unparalleled skill has been one of baseball's mysteries.

Albert Johanson, M.A., and Joseph Holmes, M.A., of the research laboratory of Columbia University's psychological department, who, in all probability, never saw Ruth hit a baseball, and who neither know or care if his batting average is .007 or .450, are .500 hitters in the psychology game. They led Babe Ruth into the great laboratory of the university, figuratively took him apart, watched the wheels go round; analyzed his brain, his eye, his ear, his muscles; studied how these worked together; reassembled him, and announced the exact reasons for his supremacy as a batter and a ball-player.

Baseball employs scores of scouts to explore the country and discover baseball talent. These scouts are known as "Ivory hunters," and if baseball-club owners take the hint from the Ruth experiments, they can organize a clinic, submit candidates to the comprehensive tests undergone by Ruth, and discover whether or not other Ruths exist. By these tests it would be possible for the club owners to discover -- during the winter, perhaps -- whether the ball-players are liable to be good, bad, or mediocre; and, to carry the [p. 20] practical results of the experiments to the limit, then may be able to eliminate the possibility, or probability, of some player "pulling a boner" in mid-season by discovering, before the season starts, how liable he is to do so.

The scientific ivory hunters of Columbia University discovered that the secret of Babe Ruth's batting, reduced to non-scientific terms, is that his eyes and ears function more rapidly than those of other players; that his brain records sensations more quickly and transmits its orders to the muscles much faster than does that of the average man. The tests proved that the coordination of eye, brain, nerve system, and muscle is practically perfect, and that the reason he did not acquire his great batting power before the sudden burst at the beginning of the baseball season of 1920, was because, prior to that time, pitching and studying batters disturbed his almost perfect coordination.

*Ruth the Superman*

The tests revealed the fact that Ruth is 90 per cent efficient compared with a human average of 60 per cent.

That his eyes are about 12 per cent faster than those of the average human being.

That his ears function at least 10 per cent faster than those of the ordinary man. That his nerves are steadier than those of 499 out of 500 persons.

That in attention and quickness of perception he rated one and a half times above the human average.

That in intelligence, as demonstrated by the quickness and accuracy of understanding, he is approximately 10 per cent above normal.

It must not be forgotten that the night on which the tests were made was an extremely warm one, and that in the afternoon he had played a hard, exhausting game of baseball before a large crowd, in the course of which he had made one of those home-run hits which we at Columbia were so eager to understand and account for. Under such circumstances, one would think that some signs of nerve exhaustion would be revealed. The instigation lasted more than three hours, during which Ruth stood for most of the time, walked up and down stairs five times, and underwent the tests in a close warm room. At the end of that time I was tired and nervous, and, although Ruth showed no symptoms of weariness, it is probable that under more favorable conditions his showing would have been even better.

The tests used were ones that primarily test motor functions and give a measure of the integrity of the psychophysical organism. Babe Ruth was posed first in an apparatus created to determine the strength, quickness, and approximate power of the swing of his bat against his ball. A plane covered with electrically charges wires, strung horizontally, was placed behind him and a ball was hung over the theoretical plate, so that it could be suspended at any desired height.

I learned something then which, perhaps, will interest the American League pitchers more than it will the scientists. This was that the ball Ruth likes best to hit, and can hit hardest, is a low ball pitched just above his knees on the outside corner of the plate. The scientists did not consider this of extreme importance in their calculations, but the pitchers will probably find it of great scientific interest.

*Science Discovers the Secret*

The ball was adjusted at the right height, and, taking up a bat that was electrically wired, Ruth was told to get into position and to swing his bat exactly as if striking the ball for a home run, to make the end of it touch one of the transverse wires on the plate behind him, then swing it through its natural arc and hit the ball lightly. The bat, weighing fifty-four ounces (exactly the weight of the bats Ruth uses on the diamond), was swung as directed, touched the ball, and the secret of his power -- or, rather, the amount of force with which the strikes the ball -- was calculated. At least, the basis of the problem was secured: The bat, weighing fifty-four ounces, swinging at a rate of 110 feet a second, hits a ball travelling at the rate of, say, sixty feet a second, the ball weighing four and a quarter ounces, and striking the bat at a point four inches from the end. How far will it travel? There are other elements [p. 21] entering into the problem, such as the resilience of the ball, the "English" placed on it by the pitcher's hand, and a few minor details. But the answer, as proved by the measurements, is somewhere between 450 and 500 feet. This problem cannot be worked down to exact figures because of the unknown quantities.

The experimenters, however, were not so much interested in the problem in physics as they were in the problems in psychology. The thing they wanted to know was what made Ruth superior to all other ball-players in hitting power, rather than to measure that power.

*Babe Could Beat His own Record!*

**Before proceeding to the psychological tests, however, we tried another in physics to satisfy my curiosity. A harness composed of rubber tubing was strapped around Ruth's chest and shoulders and attached by hollow tubes to a recording cylinder. By this means his breathing was recorded on a revolving disk. He was then placed in position to bat, an imaginary pitcher pitched an imaginary ball, and he went through the motions of hitting a home run. The test proved that, as a ball is pitched to him, Babe draws in his breath sharply as he makes the back-swing with his bat, and really "holds his breath" or suspends the operation of his breathing until after the ball is hit. But for that fact, he would hit the ball much harder and more effectively than he now does. It has been discovered that the act of drawing in the breath and holding it results in a sharp tension of the muscles and a consequent loss of striking power. If Ruth expelled his breath before striking the ball, the muscles would not become tense and his swing would have greater strength and rhythm.

The first test to discover the efficiency of his psychophysical organism was one designed to try his coordination; a simple little test. The scientists set up a triangular board, looking some thing like a ouija-board, with a small round hole at each angle. At the bottom of each hole was an electrified plate that registered every time it was touched. Ruth was presented with a little instrument that looked like a doll-sized curling iron, the end of which just fitted into the holes. Then he was told to take the instrument in his right hand and jab it into the holes successively, as often as he could in one minute, going around the board from left to right.

He grew interested at once. Here was something at which he could play. The professor "shushed" me, fearing that I would disturb Ruth or distract his attention as he started around the board, jabbing the curling-iron into the holes with great rapidity. He would put it into the holes twelve to sixteen times so perfectly that the instrument barely touched the sides. Then he would lose control and touch the sides, slowing down. Only twice did he pass the hole without getting the end of the iron into it. With his right hand he made a score of 122. Not unnaturally, his wrist was tired and Babe shook it and grinned ruefully.

Then he tried it with his left hand, scored 132 with it, proving himself a bit more left- than right-handed -- at least in some activities. The significance of the experiment, however, lies in the fact that the average of hundreds of persons who have taken that test is 82 to the minute, which shows how much swifter in the coordination of hand, brain, and eye Ruth is than the average.

*Every Test but Another Triumph*

In a sequel to this test that followed, Babe tapped an electrified plate with an electrically charged stylus with the speed of a drum-roll, scoring 193 taps per minute with his right hand and 176 with his left hand. The average score for right-handed persons undergoing this wrist-wracking experiment is 180, and, while there is no data covering right-handed persons using the left hand, it is certain that Ruth's record is much above the average, as he is highly efficient with the left hand.

But steadiness must accompany speed and so they tested the home-run king for his steadiness of nerve and muscle by having [p. 110] him thrust the useful little curling-iron stylus in different-sized holes pierced through an electrified plate which registered contacts between the stylus and the side of the hole. These measured respectively sixteen, eleven, nine, eight, and seven sixty-fourths of an inch; small enough, but not too small for Babe, for he made a score that showed him better than 499 persons out of 500.

The tests that interested me most were those to determine how quickly Ruth's eye acts and how quickly its signals are flashed through the brain to the muscles. Showing an amazingly quick reaction time, they interpreted what happens on the ball-field when the stands rock under the cheering that greets another of Ruth's smashes to the fence, proved an eye so quick that it sees the ball make an erratic curve and guides the bat to follow.

The scientists discovered exactly how quickly Ruth's eye functions by placing him in a dark cabinet, setting into operation a series of rapidly flashing bulbs and listening to the tick of an electric key by which he acknowledged the flashes.

The average man responds to the stimulus of the light in 180 one thousandths of a second. Babe Ruth needs only 160 one thousandths of a second. There is the same significance in the fact that Babe's response to the stimulus of sound comes 140 one thousandths of a second as against the averages man's 150 thousandths.

Human beings differ very slightly in these sight and sound tests, or rather the fractions are so small that they seem inexpressive; yet a difference of 20 or 10 one thousandths of a second indicates a superiority of the highest importance.

Translate the findings of the sight test into baseball if you want to see what they mean in Babe Ruth's case. They mean that a pitcher must throw a ball 20 one thousandths of a second faster to "fool" Babe than to "fool" the average person.

If the results of these tests at Columbia are a revelation to us, who know Ruth as a fast thinking player, they must be infinitely more amazing to the person who only comes into contact with the big fellow off the diamond and finds him unresponsive and even slow when some non-professional topic in under discussion.

The scientific "ivory hunters" up at Columbia demonstrated that Babe Ruth would have been the "home-run king" in almost any line of activity he chose to follow; that his brain would have won equal success for him had he drilled it for as long a time on some line entirely foreign to the national game. They did it, just as they proved his speed and his steadiness -- by simple laboratory tests.

For instance, they had an apparatus with a sort of a camera shutter arrangement that opened, winked, and closed at any desired speed. Cards with letters of the alphabet on them were placed behind this shutter and exposed to view for one fifty-thousandth of a second. Ruth read them as they flashed into view, calling almost instantly the units of groups of three, four, five, and six letters. With eight shown he got the first six, and was uncertain of the others. The average person can see four and one half letters on the same test.

When cards marked with black dots were used, Ruth was even faster. He called up the number of dots on every card up to twelve without one mistake, The average person can see eight.

To test him for quickness of perception and understanding, he was given a card showing five different symbols -- a star, a cross, and three other shapes -- many times repeated, and was told to select a number -- one, two, three, four, or five -- for each symbol, then to mark the selected number under each one as rapidly as he could go over the card. He scored 103 hits on that test, which his the average of all who have tried it. But when given a card covered with printed matter and told to cross out all the a's, he made a score of sixty, which is one and a half times the average.

The secret of Babe Ruth's ability to hit is clearly revealed in these tests, His eye, his ear, his brain, his nerves all function more rapidly than do those of the average person. Further the coordination between eye, ear, brain, and muscle is much nearer perfection than that of the normal healthy man.

The scientific "ivory hunters" dissecting the "home-run king" discovered brain instead of bone, and showed how little mere luck, or even mere hitting strength, has to do with Ruth's phenomenal record.

# St. Louis Cardinals slugger Pujols gets Babe Ruth test at Washington University

August 22, 2006

By Gerry Everding

Article Body 2010

Baseball purists, especially those of Yankee allegiance, might argue that St. Louis Cardinals homerun-hitting superstar Albert Pujols is simply not in the same league as legendary New York Yankees slugger Babe Ruth.

It’s an argument that science may never fully resolve, but researchers at Washington University in St. Louis can now offer at least some hard numbers on how Pujols compares to the Babe in terms of the perceptual and motor skills necessary to consistently hit balls out of the park.

Pujols visited Washington University in April to take part in a series of laboratory tests similar to those conducted on Babe Ruth on a summer afternoon in 1921 by a couple of graduate students at Columbia University. Results of the Pujols testing, conducted at the request of a reporter from GQ magazine, are detailed in a story that appears in the magazine’s September issue.

“This spring, GQ persuaded Albert Pujols, reigning National League MVP and the game’s most dominant slugger, to take time off from an epic home-run tear and reenact, at Washington University in St. Louis, the 1921 Babe Ruth tests,” writes Nate Penn, author of the GQ article, which is titled “Performance: How To Build The Perfect Batter.”



Daniel Stier / GQ, September 2006

El Hombre vs. The Babe: Pujols swings a bat in the lab of Catherine Lang, assistant professor in physical therapy.

The Pujols tests were conducted by faculty in the University’s Department of Psychology in Arts & Sciences and in the School of Medicine, including Richard Abrams, Ph.D., professor of psychology; Desiree White, Ph.D., associate professor of psychology; David Balota, Ph.D., professor of psychology; and Catherine Lang, Ph.D., assistant professor of physical therapy, neurology and occupational therapy.

Pujols, like Ruth, was asked to demonstrate his hitting form while hooked up to various machines that monitored the strength and speed of his swing. Pujols, complaining of a strained back, may have “held himself back a bit” on some of the tests, but his results compared favorably with those of Ruth.

In terms of sheer batting speed, Pujols swung his preferred 31.5-ounce bat at a speed of 86.99 miles per hour. Ruth, on the other hand, using a 54-ounce bat, swung at an estimated speed of 75 miles an hour.

“Making exact comparisons between the Pujols and Ruth test results is difficult because the tests given to Ruth were not very well normed,” suggests White. “But it’s clear that both Ruth and Pujols performed well above average on a number of tests that are very similar in nature.”

The New York Times covered the Ruth testing on Sept. 11, 1921, with a front-page headline: “RUTH SUPERNORMAL, SO HE HITS HOMERUNS.” The test results were described in a 1921 issue of “Popular Science” magazine as a “revelation” that showed Ruth’s “coordination of eye, brain, nerve system, and muscle [to be] practically perfect.”

Looking back on the 1921 Popular Science article, which is available, online, WUSTL’s Richard Abrams suggests that the author of the magazine article was clearly a big fan of Ruth’s and that this may have colored his description of the test results.

“Re-reading the 1921 article today I found that Babe Ruth really was not ‘off the charts’ on most of the tasks studied - instead it was reported merely that he was some amount faster or better than average,” Abrams said.

“In only one case in the 1921 article were percentiles reported. As a result, we really don’t know how great Babe was at these tasks. It is clear, though, that the author of the 1921 article was strongly biased to suggest that Babe achieved extreme scores on most of the tasks.”

While the media may have exaggerated Ruth’s results, few modern psychologists would find fault with the array of tests Columbia used to probe Ruth’s talents with a bat, many of which are still used today. The science behind Ruth’s 1921 tests is examined in great detail in an article titled “Psychology and ‘The Babe’” published in a 1998 issue of the Journal of the History of the Behavioral Sciences, also available online.

Both Ruth and Pujols participated in a number of standard psychological lab tests, such as pegboard and finger tapping exercises, designed to gauge motor skills and cognitive performance.

White, who administers these tests frequently as part of her research and clinical work, was especially surprised by Pujols’ performance on two tests in particular, a finger-tapping exercise that measures gross motor performance and a letter cancellation task that measures ability to conduct rapid searches of the environment to locate a specific target.

Asked to place a mark through a specific letter each time it appeared on a page of randomly positioned letters, Pujols used a search strategy that White had never witnessed in 18 years of administering the test.

“What was remarkable about Mr. Pujols’ performance was not his speed but his unique visual search strategy,” White said. “Most people search for targets on a page from left to right, much as they would when reading. In observing Mr. Pujols’ performance, I initially thought he was searching randomly. As I watched, however, I realized that he was searching as if the page were divided into sectors. After locating a single target within a sector, he moved to another sector. Only after locating a single target within each sector, did he return to previously searched sectors and continue his scan for additional targets.”

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Asked to depress a tapper with his index finger as many times as possible in 10 seconds, Pujols scored in the 99th percentile, a score almost identical to one earned by Ruth on a similar test of movement speed and endurance. White was impressed not only by Pujols’ tapping speed (2.4 standard deviations faster than normal), but also by the fact that his performance kept improving after repeated trials.

“It was interesting that he actually tapped faster in later trials of the task, suggesting considerable stamina at a high level of performance,” White noted. “Most people tap somewhat slower as the test progresses because their fingers and hands begin to fatigue.”

Pujols tapped with such force, in fact, that, at one point, he actually knocked the tapping key out of alignment. Pujols then helped White repair the finger tapper, tightening a loosened screw with his fingernail, she said.

Pujols’ ability to make split-second modifications in a planned response, such as checking his swing at the last moment when a pitch strays outside the strike zone, was tested using a standard psychological test known as a go/no-go task. Pujols was given a visual “go’ signal requiring him to respond as quickly as possible by pushing a button; occasionally, the initial signal would be followed by a “stop” signal requiring him to inhibit the response, if possible.

The Pujols tests, researchers suggest, represent just a small sampling of what secrets modern science might be able to uncover regarding the mysteries of superior performance in homerun hitting, and sports in general.

Yogi Berra, a St. Louis native who starred for many years as a catcher on the New York Yankees, has been quoted as saying that “baseball is 90 percent mental. The other half is physical.”

Perhaps, like this and other “Yogiisms”, the mysteries of baseball will defy the reason and logic of science. But researchers at Washington University are willing to take that challenge.

“We already know that Albert Pujols is a great baseball player – we can see that every day on the field,” Abrams said. “What we don’t know is whether laboratory measures of cognitive, perceptual, and motor abilities will help us predict who the next Pujols or Ruth will be. It sure could be fun to find out.”

Editors’ Note: Broadcast quality video and still images of the Pujols testing are available on request from GQ magazine; contact Lauren Starke at (212) 286-2419.

# [Sports Can Improve Brain Function](http://psychcentral.com/news/2008/09/02/sports-can-improve-brain-function/2863.html)

By [Rick Nauert PhD](http://psychcentral.com/news/author/news-editor/) Senior News Editor
Reviewed by John M. Grohol, Psy.D. on September 2, 2008

An intriguing new research study suggests being an athlete or merely a fan improves language skills when it comes to discussing their sport.

Investigators believe the enhancements occur because parts of the brain usually involved in playing sports are instead used to understand sport language.

University of Chicago researchers studied hockey players, fans, and people who’d never seen or played the game.

[Functional magnetic imaging](http://psychcentral.com/lib/2007/what-is-functional-magnetic-resonance-imaging-fmri/) of the brain showed that a region of the brain usually associated with planning and controlling actions is activated when players and fans listen to conversations about their sport.

The brain boost helps athletes and fans understanding of information about their sport, even though at the time when people are listening to this sport language they have no intention to act.

The study shows that the brain may be more flexible in adulthood than previously thought.

“We show that non-language related activities, such as playing or watching a sport, enhance one’s ability to understand language about their sport precisely because brain areas normally used to act become highly involved in language understanding,” said Sian Beilock, Associate Professor in Psychology at the University of Chicago.

She is lead author of the paper, “Sports Experience Enhances the Neural Processing of Action Language,” published in the on-line issue of the Proceedings of the National Academy of Sciences.

“Experience playing and watching sports has enduring effects on language understanding by changing the neural networks that support comprehension to incorporate areas active in performing sports skills,” she said.

The research could have greater implications for learning. It shows that engaging in an activity taps into brain networks not normally associated with language, which improves the understanding of language related to that activity, Beilock added.

For the study, researchers asked 12 professional and intercollegiate hockey players, eight fans and nine individuals who had never watched a game to listen to sentences about hockey players, such as shooting, making saves and being engaged in the game. They also listened to sentences about everyday activities, such as ringing doorbells and pushing brooms across the floor.

While the subjects listened to the sentences, their brains were scanned using functioning Magnetic Resonance Imaging (fMRI), which allows one to infer the areas of the brain most active during language listening.

After hearing the sentences in the fMRI scanner, subjects performed a battery of tests designed to gauge their comprehension of those sentences.

Although most subjects understood the language about everyday activities, hockey players and fans were substantially better than novices at understanding hockey-related language.

Brain imaging revealed that when hockey players and fans listen to language about hockey, they show activity in the brain regions usually used to plan and select well-learned physical actions.

The increased activity in motor areas of the brain helps hockey players and fans to better understanding hockey language. The results show that playing sports, or even just watching, builds a stronger understanding of language, Beilock said.

Source: [University of Chicago](http://news.uchicago.edu/)

**The Brain**

# The Brain: Why Athletes Are Geniuses

#### **Neuroscientists have found several ways in which the brains of top-notch athletes seem to function better than those of regular folks.**

By [Carl Zimmer](http://discovermagazine.com/authors/carl-zimmer)|Friday, April 16, 2010

The qualities that set a great athlete apart from the rest of us lie not just in the muscles and the lungs but also between the ears. That’s because athletes need to make complicated decisions in a flash. One of the most spectacular examples of the athletic brain operating at top speed came in 2001, when the Yankees were in an American League playoff game with the Oakland Athletics. Shortstop Derek Jeter managed to grab an errant throw coming in from right field and then gently tossed the ball to catcher Jorge Posada, who tagged the base runner at home plate. Jeter’s quick decision saved the game—and the series—for the Yankees. To make the play, Jeter had to master both conscious decisions, such as whether to intercept the throw, and unconscious ones. These are the kinds of unthinking thoughts he must make in every second of every game: how much weight to put on a foot, how fast to rotate his wrist as he releases a ball, and so on.

In recent years neuroscientists have begun to catalog some fascinating differences between average brains and the brains of great athletes. By understanding what goes on in athletic heads, researchers hope to understand more about the workings of all brains—those of sports legends and couch potatoes alike.

As Jeter’s example shows, an athlete’s actions are much more than a set of automatic responses; they are part of a dynamic strategy to deal with an ever-changing mix of intricate challenges. Even a sport as seemingly straightforward as pistol shooting is [surprisingly complex](http://discovermagazine.com/2010/11-the-brain-by-carl-zimmer?portal_status_message=Changes%20saved.). A marksman just points his weapon and fires, and yet each shot calls for many rapid decisions, such as how much to bend the elbow and how tightly to contract the shoulder muscles. Since the shooter doesn’t have perfect control over his body, a slight wobble in one part of the arm may require many quick adjustments in other parts. Each time he raises his gun, he has to make a new calculation of what movements are required for an accurate shot, combining previous experience with whatever variations he is experiencing at the moment.

To explain how brains make these on-the-fly decisions, [Reza Shadmehr](http://www.shadmehrlab.org/) of Johns Hopkins University and [John Krakauer](http://www.columbiampl.org/staff/krakauer.html) of Columbia University two years ago [reviewed studies](http://www.springerlink.com/content/2253374773600417/) in which the brains of healthy people and of brain-damaged patients who have trouble controlling their movements were scanned. They found that several regions of the brain collaborate to make the computations needed for detailed motor actions. The brain begins by setting a goal—*pick up the fork*, say, or *deliver the tennis serve*—and calculates the best course of action to reach it. As the brain starts issuing commands, it also begins to make predictions about what sort of sensations should come back from the body if it achieves the goal. If those predictions don’t match the actual sensations, the brain then revises its plan to reduce error. Shadmehr and Krakauer’s work demonstrates that the brain does not merely issue rigid commands; it also continually updates its solution to the problem of how to move the body. Athletes may perform better than the rest of us because their brains can find better solutions than ours do.

To understand how athletes arrive at these better solutions, other neuroscientists have run experiments in which athletes and nonathletes perform the same task. This past January [Claudio Del Percio](http://www.brainon.it/delpercio_claudio.html) of Sapienza University in Rome and his colleagues reported the results of [a study](http://dx.doi.org/10.1016/j.brainresbull.2009.02.001) in which they measured the brain waves of karate champions and ordinary people, at rest with their eyes closed, and compared them. The athletes, it turned out, emitted stronger alpha waves, which indicate a restful state. This finding suggests that an athlete’s brain is like a race car idling in neutral, ready to spring into action.

Del Percio’s team has also measured brain waves of athletes and nonathletes in action. In one experiment the researchers observed pistol shooters as they fired 120 times. In another experiment Del Percio had fencers balance on one foot. In both cases the scientists arrived at the same surprising results: The athletes’ brains were quieter, which means they devoted less brain activity to these motor tasks than nonathletes did. The reason, Del Percio argues, is that the brains of athletes are more efficient, so they produce the desired result with the help of fewer neurons. Del Percio’s research suggests that the more efficient a brain, the better job it does in sports. The scientists also found that when the pistol shooters hit their target, their brains tended to be quieter than when they missed.

Good genes may account for some of the differences in ability, but even the most genetically well-endowed prodigy clearly needs practice—lots of it—to develop the brain of an athlete. As soon as someone starts to practice a new sport, his brain begins to change, and the changes continue for years. Scientists at the University of Regensburg in Germany documented the process by scanning people as they learned how to juggle. After a week, the jugglers were already developing extra gray matter in some brain areas. Their brains continued to change for months, the scientists found[145](http://discovermagazine.com/2010/apr/16-the-brain-athletes-are-geniuses)

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Even as practice [changes the brain’s anatomy](http://www.nature.com/nature/journal/v427/n6972/full/427311a.html), it also helps different regions of the brain talk to one another. Some neurons strengthen their connections to other neurons and weaken their connections to still others. Early on, neurons in the front of the brain (the prefrontal cortex) are active. That region is vital for top-down control, which enables us to focus on a task and consider a range of responses. With practice, the prefrontal cortex grows quiet. Our predictions get faster and more accurate, so we don’t need so much careful oversight about how to respond.

Several years ago Matthew Smith and Craig Chamberlain of the University of Northern Colorado examined the connection between the quieting of the cortex and athletic ability. They had expert and unskilled soccer players dribble a ball through a slalom course of cones. At the same time, the players were asked to keep an eye on a projector screen on the wall to see when a particular shape appeared. Even with the second task, the seasoned soccer players could dribble at nearly full speed. Unskilled players did much worse than when they were undistracted, however. The disparity suggests that dribbling didn’t tax the expert player’s prefrontal cortex as heavily, leaving it free to deal with other challenges.

As the brains of athletes become more efficient, they learn how to make sense of a new situation sooner. In cricket, for instance, a bowler can hurl a ball at 100 miles an hour, giving batsmen a mere half second to figure out its path. In 2006 Sean Müller, then at the University of Queensland in Australia, and his colleagues [ran an experiment](http://www.ncbi.nlm.nih.gov/pubmed/17095494) to see how well cricket batsmen can anticipate a bowler’s pitch. For their subjects they chose three types of cricket players, ranging in skill from national champions down to university players. The cricketers watched videos of bowlers throwing balls. After each video was over, they had to predict what kind of pitch was coming and where it would land. In some cases the video was cut off at the point at which the bowler released the ball. In other cases the players got to see only the first step, or the first two steps, that the bowler took while the ball was still in his hand.

Elite cricket players did a much better job than less skilled ones at anticipating the outcome of a pitch. They could make fairly good predictions after watching the bowlers take just a single step, and if they got to see the pitch up to the moment of release, their accuracy improved dramatically. The less skilled players fared much worse. Their early guesses were no better than chance, and their predictions improved only if they were able to watch the pitch until the ball had left the bowler’s hand and was in flight.

Predicting the outcome of a task seems to involve the same brain areas that the athlete develops in practice, which would explain why athletes tend to fare better on challenges like these. In a related study, [Salvatore Aglioti](http://w3.uniroma1.it/aglioti/) of Sapienza University assembled a group of people, some of whom were professional basketball players, and [scanned their brains](http://www.nature.com/neuro/journal/v11/n9/abs/nn.2182.html) as they watched movies of other players taking free throws. Some of the movies stopped before the ball left the player’s hands; others stopped just after the ball’s release. The subjects then had to predict whether it went through the hoop or not. The pros in the group showed a lot of activity in those regions of the brain that control hand and arm muscles, but in the nonathletes those regions were relatively quiet. It seems that the basketball players were mentally reenacting the free throws in their minds, using their expertise to guess how the players in the movies would perform.

These studies are beginning to answer the question of what makes some people great athletes: They are just able to rewire their brains according to certain rules. As neuroscientists decipher those rules, they may find ways to give people better skills. In February 2009 Krakauer and Pablo Celnik of Johns Hopkins offered a glimpse of what those interventions might look like. The scientists had volunteers move a cursor horizontally across a screen by pinching a device called a force transducer between thumb and index finger. The harder each subject squeezed, the faster the cursor moved. Each player was asked to move the cursor back and forth between a series of targets, trying to travel the course as quickly as possible without overshooting. The group trained 45 minutes a day for five days. By the end of training, the players were making far fewer errors.

The scientists also trained another group of people on the same game, but with a twist. They put a battery on top of the head of each subject, sending a small current through the surface of the brain toward a group of neurons in the primary motor cortex. The electric stimulation allowed people to learn the game better. By the end of five days of training, [the battery-enhanced players could move the cursor faster and make fewer errors than the control group](http://www.pnas.org/content/106/5/1590.full). And the advantage was not fleeting. For three months Krakauer and Celnik had their subjects come back into the lab from time to time to show off their game-playing skills. Everyone got rusty over time, but at the end of the period, the people who had gotten the electrode boost remained superior to the others.

[Krakauer and Celnik’s study](http://www.pnas.org/content/106/5/1590.full) hints at a whole new world of ethical issues that may lie ahead for sports. Would it be cheating for a tennis player to wear a portable electrode as she practiced her serve? She would, after all, just be hastening the same changes that come with ordinary practice. Today’s controversies over doping in sports focus mainly on muscles. But tomorrow we may have to decide how much athletes should be allowed to take advantage of neuroscience.

Performance Enhancement Attitude Scale

From New Mexico State University (2007)

**Below are statements showing what many people think and feel about sport and performance enhancing drugs. How strongly do you agree or disagree with the following statements?**

Please read each item below carefully and circle the appropriate number after each statement,

which shows the level of your agreement, using the scale below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Strongly****Disagree** | **Disagree** | **Slightly****Disagree** | **Slightly****Agree** | **Agree** | **Strongly****Agree** |
| 1 | 2 | 3 | 4 | 5 | 6 |

***My opinion regarding sport in general is that…***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Doping is necessary to be competitive. | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | Doping is not cheating since everyone doesit. | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | Athletes often lose time due to injuries anddrugs can help to make up the lost time. | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | Only the quality of performance shouldmatter, not the way athletes achieve it. | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | Athletes in my sport are pressured to takeperformance-enhancing drugs. | 1 | 2 | 3 | 4 | 5 | 6 |
| 6 | Athletes, who take recreational drugs, usethem because they help them in sport situations. | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | Athletes should not feel guilty aboutbreaking the rules and taking performance- enhancing drugs. | 1 | 2 | 3 | 4 | 5 | 6 |
| 8 | The risks related to doping are exaggerated. | 1 | 2 | 3 | 4 | 5 | 6 |
| 9 | Athletes have no alternative career choices,but sport. | 1 | 2 | 3 | 4 | 5 | 6 |
| 10 | Recreational drugs give the motivation totrain and compete at the highest level. | 1 | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Strongly****Disagree** | **Disagree** | **Slightly****Disagree** | **Slightly****Agree** | **Agree** | **Strongly****Agree** |
| 1 | 2 | 3 | 4 | 5 | 6 |
|  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 11 | Doping is an unavoidable part of thecompetitive sport. | 1 | 2 | 3 | 4 | 5 | 6 |
| 12 | Recreational drugs help to overcomeboredom during training. | 1 | 2 | 3 | 4 | 5 | 6 |
| 13 | There is no difference between drugs,fiberglass poles, and speedy swimsuits that are all used to enhance performance. | 1 | 2 | 3 | 4 | 5 | 6 |
| 14 | Media should talk less about doping. | 1 | 2 | 3 | 4 | 5 | 6 |
| 15 | The media blows the doping issue out ofproportion. | 1 | 2 | 3 | 4 | 5 | 6 |
| 16 | Health problems related to rigorous trainingand injuries are just as bad as from doping. | 1 | 2 | 3 | 4 | 5 | 6 |
| 17 | Legalizing performance enhancementswould be beneficial for sports. | 1 | 2 | 3 | 4 | 5 | 6 |

Arousal and Performance Likert Scale

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Strongly****Disagree** |  | **Disagree** | **Slightly****Disagree** | **Slightly****Agree** | **Agree** | **Strongly****Agree** |
| 1 |  | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | I interpret pre-game arousal as anxiety | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | I interpret pre-game arousal as excitement | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | I have a tendency to get more anxious when I have nervous feelings | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | I often get physically sick when my state anxiety is high | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | It is thoughts of failure that usually drive me to get anxiety | 1 | 2 | 3 | 4 | 5 | 6 |
| 6 | It is thoughts of self-doubt that drive my anxiety | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | I very rarely ever get nervous before events | 1 | 2 | 3 | 4 | 5 | 6 |
| 8 | My self-confidence is higher when I feel pressure | 1 | 2 | 3 | 4 | 5 | 6 |
| 9 | I get restless when I experience anxiety before events | 1 | 2 | 3 | 4 | 5 | 6 |
| 10 | I tend to get really focused when I have any level of anxiety | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. | I tend to get quiet to fool others into thinking I am confident | 1 | 2 | 3 | 4 | 5 | 6 |