

A QUIET EYE
BRAINY PUTTING
BASEBALL TECH
NO LIMIT

ALAN ALDA I'm going to be trying my hand at calling balls and strikes in one of the most hallowed ballparks in the land, Fenway Park. But I'll be getting a little help from technology.

ALAN ALDA (NARRATION) We see how a system once used for tracking missiles will soon be giving umpires a second look.

ALAN ALDA That's a definite strike.

ALAN ALDA (NARRATION) We discover how a "quiet eye" helps even a novice shoot hoops... And how a Canadian Olympic team is getting a new view of their game.

ALAN ALDA Wow!

ALAN ALDA (NARRATION) I learn how to balance my brain...

ALAN ALDA I'm a cloud!

ALAN ALDA (NARRATION) And become a Tiger on the miniature golf tour.

DEBBIE CREWS Beautiful.

ALAN ALDA (NARRATION) And I hold my breath for longer than I thought was possible -- although not as long as a champion.

ALAN ALDA I'm Alan Alda. Join me and the scientists who are helping athletes -- and the rest of us -- keep our eyes "On the Ball."

A QUIET EYE

ALAN ALDA At whatever level this is I play, I really love playing tennis -- for all the reasons most people enjoy playing sports -- the exercise, the competition, the rush that comes from pulling off a difficult play. But until now, the world of sports beyond tennis hasn't interested me much. And then we became intrigued by all

the science and technology that's now being focused on sports and how that's not only improving performances, it's also offering a new window into how our bodies and brains work together. And as a result I've been in some places I never expected to be: a basketball court, a golf links, a hockey rink, even behind the plate at a major league baseball park. And you know what? It's been fascinating...

BARRY MORTON Ready?

ALAN ALDA Oh yeah.

ALAN ALDA (NARRATION) For instance, there's the question that has long intrigued the University of Calgary's Joan Vickers.

ALAN ALDA Can you get CNN on this?

ALAN ALDA (NARRATION) Joan wondered where athletes look when they are playing their sport -- and so she devised a way to find out.

ALAN ALDA Okay.

JOAN VICKERS So now Alan, would you look at point one? Point two...

ALAN ALDA (NARRATION) That black spot on the screen is where my gaze is resting. The pupil of my eye is being tracked as it scans the target with the aid of the cameras and mirrors mounted on my head.

JOAN VICKERS And nine. Excellent.

ALAN ALDA Okay, here I go.

ALAN ALDA (NARRATION) Now, my experience with putting is limited to the miniature golf courses I play with my grandkids. Which makes me a perfect subject for Joan Vickers, because she wants to know if there's a difference in where a rank amateur like me looks when I'm putting as compared to someone who sinks putts for a living.

JOAN VICKERS Notice how your gaze actually goes with the ball? Ninety-five percent of beginning golfers do that.

ALAN ALDA (NARRATION) David Lindsay is a golfer who doesn't hit putts for a living but plays a pretty good amateur game. And he's been working with Joan for several years now. David has been taught by Joan to use his eyes the way she has discovered the experts do: to look steadily at the target for a second or two,

then look back at the ball and let his gaze rest there -- before and even after the stroke.

ALAN ALDA Your gaze is so steady before you hit. And it's very-it's as steady after you've made contact. I want to see if there's a jump at the moment of impact -- if your eye flicks unconsciously. It's steady.

JOAN VICKERS It's rock steady.

ALAN ALDA It didn't jump at all.

DAVID LINDSAY Well, when I'm doing it well there's no question in my mind my putting improves dramatically. But when my putting is starting to go out the window or that type of thing, it's because my eye movements are starting to become erratic and I'm following the pattern that I've established.

ALAN ALDA (NARRATION) So let's see if any of this helps me. For starters, I'm just going to try one steady look at the target before bringing my gaze back to the ball.

ALAN ALDA It's really amazing. It really works. I only tried to do one thing. Although I was aware that there were two other things that I wanted to do.

JOAN VICKERS Actually you changed a phenomenal number of things.

ALAN ALDA Oh I did?

JOAN VICKERS It's amazing, actually.

ALAN ALDA (NARRATION) By changing how I looked at the target -- one steady stare -- I'd stopped my gaze from jumping around. That obviously helped. But I'm still not holding quietly on the ball as I hit it.

JOAN VICKERS You're still really-

ALAN ALDA Jumping a little.

JOAN VICKERS Actually you'll see the club's coming through there, the ball's coming through there and your eye wants to go with it and it does. It just takes off. But you have to resist that.

ALAN ALDA Okay.

JOAN VICKERS 'Cause you want that really nice solid impact.

ALAN ALDA Right.

ALAN ALDA (NARRATION) This time I'm going to concentrate on looking at the ball with what Joan calls a "quiet eye" before and after hitting it. On my previous tries I'd never made more than three putts out of six attempts. This time...

ALAN ALDA Four under pressure.

JOAN VICKERS Did you stop thinking about the mechanics of the club?

ALAN ALDA I don't know if I was ever aware of the mechanics of the club. Like what? What would be an example of that?

JOAN VICKERS Well, so many golfers are overwhelmed with the mechanics of their stance.

ALAN ALDA Oh, no-

JOAN VICKERS And-where the club is moving--

ALAN ALDA Oh no, see, I would never think of that because nobody told me how to do it.

JOAN VICKERS There you go. You're a free man. That's the other comment we get, that by stressing the focus then all of a sudden you're not completely preoccupied with the mechanics-

ALAN ALDA I can see that.

JOAN VICKERS --Of the stroke and that gives people more strategies and more things to pay attention to and they play better.

ALAN ALDA If I do anything, I think about the cup sucking the ball in. I have bizarre ways of getting the ball in there.

JOAN VICKERS That's excellent.

ALAN ALDA (NARRATION) Joan Vickers believes her "quiet eye" concept can help other athletes in pressure situations -- and she has the statistics to prove it. For several seasons she's worked to improve the free throw percentage of the University of Calgary's women's basketball team. The team's coach is Shawnee Harle.

SHAWNEE HARLE I want you to look right where the net goes through the little ring on the front of the rim. When you look up there, I want you to say "sight focus" and then you're going to shoot.

BASKETBALL PLAYER Out loud?

SHAWNEE HARLE Yes. It all has to be out loud. Alright?

BASKETBALL PLAYER Yup. Nothing but net. Sight focus.

ALAN ALDA (NARRATION) The "Nothing but Net" mantra is to settle the player down. Saying "Sight, Focus" ensures her gaze is steady on the target for at least one second.

SHAWNEE HARLE Good. One more.

BASKETBALL PLAYER Nothing but net. Sight focus.

SHAWNEE HARLE When I watched our players shoot, I was amazed at how few of them even looked at the rim for probably any more than two to three hundred milliseconds. We had shooters on our team that were looking at the top of the backboard, the bottom of the net, who were completely unaware that they were doing that.

ALAN ALDA This was before they studied the quiet eye technique?

SHAWNEE HARLE Yes. Before we gave them the training.

JOAN VICKERS Shawnee's team was shooting 54 percent when we started working with them. During that first season they improved 12 percent here in this experimental setting. But it didn't show up in terms of that season of play. But the next year-you were what? Thirteenth or fourteenth in the nation that year. In the next year you were second in the country. And they improved by 22 percent which is unheard of.

ALAN ALDA What's happening in the brain when you do the quiet eye thing?

JOAN VICKERS It seems to really recognize how the body wants to really work. The mind wants to get it organized and the body wants to do it. But when you put those two things together, you're putting a tremendous amount of pressure on the whole system and it breaks down. It especially breaks down when a person is under stress.

JOAN VICKERS Okay, Alan.

ALAN ALDA (NARRATION) And speaking of a person under stress...

ALAN ALDA Sorry about that. Let' see if I can do that again.

ALAN ALDA (NARRATION) The idea here is that during the "quiet eye" moment, my brain is absorbing and organizing all the information it needs for taking the shot. Once my body starts the action itself, vision becomes irrelevant. In fact, according to Joan, trying to keep my eye on the hoop as I'm throwing is a harmful distraction.

ALAN ALDA Boy, it's very hard to give up on it, you know, and really-

SHAWNEE HARLE Yup.

ALAN ALDA So, I did take my eye off it as soon as I started to shoot.

JOAN VICKERS That's what you're supposed to do.

ALAN ALDA It builds up trust. Actually seeing this, I believe now that I only have to look at it two seconds and then I can let my body do what it does. And it goes right in. It's amazing.

ALAN ALDA It works. I'm living proof it works.

JOAN VICKERS Excellent.

ALAN ALDA Well that was really fun.

JOAN VICKERS Was it? Good.

ALAN ALDA It's amazing. You know what I love about it? You do what all the scientists on this program do who we interview. You find a way to look at what people haven't looked at yet and to measure it. And you just lift up the carpet and show what's under. And we've been walking on the carpet all our lives and we don't know what's under it. You just take a peek at it and all of a sudden we have a whole new way to look. And it's counter-intuitive.

JOAN VICKERS One of the things I was thinking about when we were shooting is that you actually changed your technique from when you began to a much softer shot. And David in golf was saying the same thing. He's changed the mechanics of his stroke. But we don't teach that. We don't actually teach a change in technique as much as we teach a change in focus and attention.

ALAN ALDA You change the way you look and when you look, hmm? And that changes the way you do things.

JOAN VICKERS Right. And then you reconfigure your body yourself in order to do that.

ALAN ALDA (NARRATION) Knowing my love of tennis, Joan indulged me by setting up a version of a study she's done on return of serve in volleyball. What's she's interested in is how the eye tracks the ball as it comes across the net. What she found is that good players don't try to follow the ball all the way. Instead they let the ball out of their sight once it gets close and hold their gaze steady while they hit it.

JOAN VICKERS If this is the ball coming through here and you know you have to hit it there, then you stabilize the gaze actually in front. But the point is you don't have your eye on the ball

ALAN ALDA (NARRATION) Well it's nice to know I've been doing something right.

ALAN ALDA Take that.

BECKY KELLAR I'm ready.

ALAN ALDA (NARRATION) We obviously couldn't come to Canada for a show on sports science without including hockey.

BARRY MORTON Here's your helmet. How does it feel? Something like your hockey helmet?

BECKY KELLAR A little heavier, but-

ALAN ALDA (NARRATION) Becky Kellar is one of a group of young women hockey players having their gaze tracked in the stadium that housed the 1998 Winter Olympic Games. These players are Canada's best, training for the 2002 Winter Olympics. The idea here is to find out where Becky is looking when she's playing defense -- what she's doing to read the situation in front of her as she and a teammate skate against two opponents. To me, everything happens so fast I can barely see the puck.

JOAN VICKERS The best players are seeing things very soon. Much earlier than we ever imagined. What-on the order of two seconds? Two seconds earlier. And that's what's separating the really skilled players from the not so skilled.

ALAN ALDA (NARRATION) A slow-motion replay of Becky's gaze shows her checking on the positions of all the players as well as the puck as the play comes toward her and she's deciding on her move. Watching the replay with us is the coach of the Canadian national team, Danielle Sauvageau.

ALAN ALDA When I was wearing the helmet I would be surprised sometimes to find out I wasn't looking where I thought I had been looking. Do you find that with your players, too? Do they come back and tell you "I was looking at her, I was looking at her"? And you'd say "no, here's where you were looking."

DANIELLE SAUVAGEAU This is an excellent point because sometimes a player's gonna say "yes, this is where I was looking" because they know this is where they should be looking but with that kind of analysis we could go back and say "well, no, here, see, you were looking at that."

ALAN ALDA It's a tool then not just to improve a player's ability but to improve communication among all of you so that you understand the player's experience better.

DANIELLE SAUVAGEAU That's right.

ALAN ALDA So you really can see it through the player's eyes.

DANIELLE SAUVAGEAU Yes. Sports science helps us coaches in today's way of coaching to understand a little bit more of the players and to help them understand a little bit like how it's all about.

ALAN ALDA (NARRATION) Before we left Calgary, I asked to wear the helmet one last time. My question was this: How does a juggler -- even an amateur -- keep track of several objects at once.

ALAN ALDA I always wondered where your eye was when you saw things peripherally and now I see that you can look at something and never move your eye and beware of all this stuff happening peripherally. It's great. You have a vision into stuff that's happening that nobody ever saw before.

BRAINY PUTTING

ALAN ALDA So what is this? What are you going to do to me?

DEBBIE CREWS We're going to hook up some electrodes to your head and we're going to look at the electrical activity in different parts of your brain and they're going to be an indication of what state you're in. Okay, so, when you perform in sport... you play tennis, right?

ALAN ALDA Yes.

DEBBIE CREWS You play golf?

ALAN ALDA No.

DEBBIE CREWS You're going to play golf today. That's right.

ALAN ALDA Well, I can tell you right now what state I'm in.

ALAN ALDA (NARRATION) Here we go with the headgear again, this time a brand new helmet designed to pick up my brainwaves.

ALAN ALDA Well, this is a rubberized one. I've never had one like that. I know all the fashions in these caps.

DEBBIE CREWS You do. That's a new one, isn't that right Steve? That's the newest.

ALAN ALDA This is probably nice for street wear. Blinking. One, two...

ALAN ALDA (NARRATION) With my brain on line, it's time to choose my putter.

ALAN ALDA Well, this seems nice. I don't know what's good or not.

DEBBIE CREWS You like that one?

ALAN ALDA Well how would I know?

DEBBIE CREWS Feel.

ALAN ALDA Feel? Yes.

DEBBIE CREWS Look and feel. You got it.

ALAN ALDA That seems nice. Is this part of it? Picking out your putter? So I feel like I'm in touch with it. Always be in touch in your putter, folks. Okay. Are you sure Tiger Woods started this way? About seven.

ALAN ALDA (NARRATION) As I make each putt. Debbie's asked me to rate how I feel about it, on a scale of one to ten.

ALAN ALDA That seems pretty good...like a seven or an eight. Um...another eight.

DEBBIE CREWS Nice.

ALAN ALDA A six.

DEBBIE CREWS Nice putt.

ALAN ALDA An eight.

ALAN ALDA (NARRATION) We've come here to Arizona State University straight from Calgary, and my quiet eye training is paying off.

DEBBIE CREWS 1,2,3,4,5...

ALAN ALDA Pretty good, huh?

DEBBIE CREWS Six...yeah.

ALAN ALDA You know what's... you've been keeping track...

DEBBIE CREWS Six out of twenty.

ALAN ALDA But it feels like, I got closer when I thought, when I felt better about it, you know? There seemed to be a real correspondence there.

DEBBIE CREWS And you smiled.

ALAN ALDA And I smiled? I smiled when? Before I shot?

DEBBIE CREWS When you were getting ready.

ALAN ALDA No kidding.

DEBBIE CREWS Yeah.

ALAN ALDA Oh, that's right. I started to notice that...I was starting to feel...

DEBBIE CREWS You were smiling.

ALAN ALDA In fact I was starting to act-Toward the end I was starting to get the feeling-this doesn't make any difference . It's fun. I'm just playing. There's a hole. And I'll just swing and I'll let the ball go in the hole.

ALAN ALDA (NARRATION) It turns out that -- without realizing it -- I'd been doing pretty much what Debbie's research suggests is the key to good putting -- getting the two halves of my brain in balance.

DEBBIE CREWS As you're getting ready and you're getting prepared and you're reading your line and you're making decisions, the left hemisphere which is your analytic side, your verbal side, your self-talk is going to be quite active. As you get closer and closer to actually moving the club, the left hemisphere must quiet. That's the consistent finding we've had through all the sports. It must quiet. In essence, the right hemisphere becomes a little more active. The right hemisphere is your rhythm, timing, balance, coordination, creativity, imagery. And, so what you achieve in the last second before you move, which is where you're still focusing attention... You achieve a state of balance in essence between the two hemispheres.

ALAN ALDA (NARRATION) So the question is: How do you get your brain into a state of balance?

ALAN ALDA What's the idea? Just to go back and forth?

DEBBIE CREWS No, the idea is to balance.

ALAN ALDA Oh balance? Oh balance? That isn't easy. Boy, that's impossible. Whoa!

ALAN ALDA (NARRATION) Exactly what balancing my body has to do with balancing my brain isn't immediately obvious. But as I stop trying to figure out how to balance -- a left brain activity -- and let my body take care of itself -- helped by a little right brain imagery -- things get easier.

ALAN ALDA I'm a cloud.

DEBBIE CREWS Ha! Very good.

ALAN ALDA Every time I think I'm a cloud...

DEBBIE CREWS That's your imagery.

ALAN ALDA It balances. That's really weird.

DEBBIE CREWS That's your imagery. That's excellent. You're done.

ALAN ALDA I'm done.

DEBBIE CREWS You're done. Very good.

DEBBIE CREWS Stand.

DEBBIE CREWS Okay, we're gonna have you putt.

ALAN ALDA Have me putt now?

DEBBIE CREWS Yup.

ALAN ALDA Okay, over down there by the hole? Oh, eight.

DEBBIE CREWS Beautiful.

ALAN ALDA Also eight.

ALAN ALDA (NARRATION) The EEG confirmed my brain was more balanced after balancing my body -- and I'm giving better ratings to my putts

ALAN ALDA That felt good. Eight or nine.

DEBBIE CREWS Now that's a competitor. They always put the last one in the hole. That's true.

ALAN ALDA (NARRATION) But Debbie isn't finished getting my brain into the right putting mode. Just as I'm getting used to the idea that relaxing and letting go is what's important, here I am on a stationary bicycle, getting all pumped up.

DEBBIE CREWS 60 seconds. Okay, we don't give you much warm down on this one. Putter? We're gonna hook you in, it'll take a couple seconds for the signals to come in.

ALAN ALDA Yeah.

DEBBIE CREWS We're on.

ALAN ALDA (NARRATION) This time my EEG shows my brain is definitely revved up -- but, crucially, the extra activity is still pretty well balanced between the two hemispheres.

ALAN ALDA Eight.

DEBBIE CREWS Wow.

ALAN ALDA Eight.

DEBBIE CREWS That was a nice putt. That's in. My tape can't stop it. That's a nice putt.

ALAN ALDA Um...nine.

DEBBIE CREWS Beautiful putt. Last one.

ALAN ALDA I knew it was a nine before I saw it go in.

DEBBIE CREWS Excellent.

ALAN ALDA That was good, too. That was like nine.

DEBBIE CREWS Beautiful.

ALAN ALDA Last one in.

DEBBIE CREWS That's right. Always last one in.

ALAN ALDA You should tell me that on every shot.

DEBBIE CREWS But you know what? When you get your arousal state up--just like here--if we say last putt and we get your arousal up, that means you have more activity to work with. And you focus it, which you did beautifully on that putt, and the ball goes in the hole.

ALAN ALDA That true for me on the stage, too. Before I go on stage, I do a lot of exercises.

DEBBIE CREWS That's right.

ALAN ALDA And the audience of course gets you up.

DEBBIE CREWS Yes.

ALAN ALDA There's an excitement. And you're...It's very interesting that that extra charge you get helps you concentrate sometimes.

ALAN ALDA (NARRATION) Debbie has got me tuned up just in time for one of those little surprises the producers of the show love to pull every now and again. Also invited to Debbie Crews' lab today is a real golfer, LPGA tournament player Tina Tombs.

ALAN ALDA Whoa.

TINA TOMBS It's luck.

ALAN ALDA How much of the game is putting, Tina?

TINA TOMBS The older I get the more I think that putting is basically all of the game. It comes down to hitting a drive. I mean, don't think you have to think as much over a drive, at least I don't-I don't as much over a t-shot as I do over a putt.

ALAN ALDA (NARRATION) Tina's here to add her expert brain to Debbie's EEG data -- but also, I'm just now discovering, to put me under pressure and up the ante on my new found putting skills.

DEBBIE CREWS I think what we'll do now, is we're gonna go sets of five. And we'll look at number of putts made and go back and forth and put a little money of the condition.

TINA TOMBS How many did you make?

ALAN ALDA Oh, I don't remember.

DEBBIE CREWS Oh, I don't remember. I have it right here, Tina.

TINA TOMBS That's alright. That's alright.

ALAN ALDA I'm so competitive it's just unbelievable. Everybody thinks I'm a nice guy. Is that the hole over there? It's a little thing we developed at the institute.

ALAN ALDA (NARRATION) Debbie has done several studies on what golfers call choking.

DEBBIE CREWS And you get a dollar for every one you make.

ALAN ALDA I know, I know. You're trying to make me nervous.

ALAN ALDA (NARRATION) That's when anxiety about performing under pressure means your game falls apart.

TINA TOMBS One for one. But you've never played?

ALAN ALDA No.

ALAN ALDA (NARRATION) Of course, I was getting a little help from the special rules of this particular green.

DEBBIE CREWS Two for two.

TINA TOMBS Are we counting that? Even though it's the speed?

DEBBIE CREWS If it goes through.

TINA TOMBS Are you serious? So I can belt it? So even if it goes through, it's in?

ALAN ALDA Can we have it quiet on the golf course?

TINA TOMBS Sorry, but I'm trying to get it in the hole-

ALAN ALDA Do you know how many years I've devoted to this game?

TINA TOMBS And that would never stay in the hole. But that would never stay in a hole.

ALAN ALDA (NARRATION) It feels as though with my quiet eye and newly balanced brain at work -- and most importantly with low expectations -- I can do no wrong.

TINA TOMBS I think that's a made putt. That one was terrible.

ALAN ALDA (NARRATION) Tina, for some reason, who clearly should be beating the pants off me, is having a hard time.

TINA TOMBS There it is.

DEBBIE CREWS She doesn't have a chance in getting the ball in the hole in the state she's in because the state is having the perception that she should be beating and winning the match. What Alan's doing is he's looking at the hole, going there, coming back, getting the bottom of his breath and go. His mechanics aren't anywhere near as solid as hers. But he's putting the ball in the hole.

TINA TOMBS Are we done?

DEBBIE CREWS Actually, you can just pay him. No, I'm just teasing.

ALAN ALDA Here's the thing: You have a lifetime of experience hitting, playing real golf. This is a toy thing that's all chaotic. You couldn't...it was different...all the bumps were different every couple of times you hit. It doesn't matter to me...all my whole experience in golf is on this stupid rug. You know, so...

TINA TOMBS You should play.

ALAN ALDA If I could take this rug out to the golf course, I'd be great.

ALAN ALDA Okay, step back.

ALAN ALDA (NARRATION) Ah, if only...

ALAN ALDA I almost fell over.

ALAN ALDA (NARRATION) Once out on the driving range, my true golfing skills are quickly exposed. But even here, apparently, things aren't hopeless. The Arizona State research program that Debbie Crews is part of is best known in golfing circles for its work on imaging. The pro golfer Phil Mikelson ascribed a recent tour win at least in part to imaging techniques he'd learned here at ASU.

DEBBIE CREWS What we're gonna do at this point is we're gonna put an image in first of what you want to have happen. There's two things you can do. You can put an image of the ball flying, landing in that target, okay? And that's gonna prep everything to set up the motor program to perform. Then the other thing is, you can put an image, you know, of how you want to swing. Do you have any idea of how you swing?

ALAN ALDA Of course not.

DEBBIE CREWS I don't think so.

ALAN ALDA No.

DEBBIE CREWS So we're gonna skip that one.

ALAN ALDA (NARRATION) So here we go. A little arousal... add a pinch of imagery -- there's the ball sailing into the target -- stir in a little brain balancing, and for old times sake, top it all off with a nice quiet eye.

DEBBIE CREWS Yeah!

ALAN ALDA Where was it?

DEBBIE CREWS Just in front.

ALAN ALDA Just in front?

DEBBIE CREWS Beautiful.

ALAN ALDA (NARRATION) But enough about me. The real reason we're here is to see Tina at work out here where it counts while Debbie is actively monitoring her brain-- something that's never been done before.

DEBBIE CREWS So it's really exciting. We're gonna look for that state--same as we did before--a second before. And theoretically she gets very quiet, so we should be able to get the data. She's doing full swing outside into a target. And now we have the technology where we can actually go outside and do that.

ALAN ALDA (NARRATION) And Tina, of course, now that she's where she belongs, drops the ball right into that impossibly small square in the middle of the target.

BASEBALL TECH

ALAN ALDA (NARRATION) Last baseball season, the Boston Red Sox were kind enough to let me spend a little time behind the plate...

ALAN ALDA Strike one.

ALAN ALDA (NARRATION) ...trying my hand at what is surely one of the toughest jobs in baseball.

ALAN ALDA That's a strike, huh?

CATCHER That was a strike.

ALAN ALDA (NARRATION) What I'd find most alarming about the job is that you can't second-guess yourself -- though plenty of other people do.

ALAN ALDA That was outside the zone, wasn't it?

BATTER That was a strike.

ALAN ALDA Was that a strike? No kidding, was it?

PAUL BAIM You're the umpire.

ALAN ALDA Jeez, I know. I would talk it over. I mean, don't we want to arrive at consensus here? We don't want to be, I mean, dictatorial, you know?

ALAN ALDA (NARRATION) It's clearly time for a review of the strike zone, courtesy of baseball buff Paul Baim.

PAUL BAIM The area over the plate, okay, from the hollow just below his knee--.

ALAN ALDA Oh, all the way down there.

PAUL BAIM To about-to about here.

ALAN ALDA (NARRATION) Paul Baim is also an engineer in an aerospace company, whose specialty is tracking fast moving objects -- usually things like missiles, but more recently baseballs.

PAUL BAIM Now where was that. Outside? Looked outside to me.

ALAN ALDA Looked outside to me. I'm just watching out for my life here.

ALAN ALDA (NARRATION) Paul's been working with the company that has brought pitch tracking to television, allowing viewers a 3-D graphical view of where a pitch goes and at least a good approximation of the strike zone. It gives TV watchers yet another way to second-guess umpires.

ALAN ALDA Whoa! That just dropped in, didn't it? That's a definite strike. This guy's doing better and better. And he's not hitting me hardly at all.

ALAN ALDA (NARRATION) But the current commercial system isn't accurate enough -- especially in defining the top and bottom of the strike zone -- to be useful to umpires themselves.

PAUL BAIM No one else in the park has as good a view of the pitch as the umpire does. So there's really no opportunity for umpires to get any sort of feedback on what they're doing that's objective. They get lots of feedback but most of it isn't pretty.

ALAN ALDA It's kind of instantaneous.

ALAN ALDA (NARRATION) So Paul Baim set out to give umpires some objective -- and almost instantaneous -- feedback by upgrading the pitch tracker already installed in major league ballparks like Fenway.

PAUL BAIM One of the interesting things about Fenway is that because it's a very old park and everything here is pretty much set in its ways, is finding locations for the cameras that would number one, not get in anyone's way and number two, get the job done that we need to get done.

ALAN ALDA So where are they?

PAUL BAIM Well, we have a pair of high cameras that actually track the ball are up in the rafters and you can see there are a pair of cameras there up above the first base line. A pair of identical cameras are up in the rafters up off the third base line.

ALAN ALDA So from the time the pitch leaves the mound here, what is happening?

PAUL BAIM What we do is we concentrate on a piece of that corridor that the ball travels through, with the cameras running continuously. And what the system does is it automatically determines when a ball size ball-shaped object traveling in the right direction at about a reasonable speed enters the field of view. And at that point the system says "Well, this is probably a pitch.

ALAN ALDA (NARRATION) These images show both the predicted and the actual path of the ball on its way to the plate. A graphic is constructed from the images showing the ball's flight from different viewpoints. The cameras stop tracking the ball where the batter might interfere with the image -- which raises an obvious question.

ALAN ALDA If the cameras can't take a picture of the ball for the last three or four feet, how are you able to give us a picture here of what happens to the ball when it drops off sharply and that kind of thing?

PAUL BAIM What we do is use a model of the physics of the baseball in flight. And apply that to the data that we actually measure. And that lets us extrapolate the path of the ball for those last three to four feet very accurately. The system is accurate to within essentially about an inch and a quarter in the case of the commercial system. And in the case of the umpires' system, it's accurate to about half an inch.

ALAN ALDA (NARRATION) The trickiest thing to measure accurately is the top and bottom of the strike zone. Because it's set by the batter's height and stance, it's different for every pitch. The new system uses two additional cameras -- located in the dugouts -- to take a snapshot of the batter just after the pitch is thrown. This snapshot is used to define the strike zone as the pitch crosses the plate a few tenths of a second later. The Umpire Information System generates a CD-ROM within an hour of the game's ending. Popping it into his official Major League Baseball laptop, the plate umpire can check out any pitch in the game. Calls the system disagreed with are marked N for no. Clicking on them brings up a graphic showing the pitch's actual location as well as a 6-second video clip of the play. Paul Baim and Major League Baseball are emphatic that the system isn't meant to replace umpires or publicly second guess them. Rather it's to give umpires a sort of instant post-game self-analysis.

PAUL BAIM The issue here is not about helping umpires get those pitches quote right that they miss by half an inch. The point is not to split hairs. The point is to give them the view of pitches that might be within the upper part of the strike zone that they're not necessarily used to calling a strike but in fact was a strike. Or pitches that curve a lot and fall through the bottom of the strike zone and get caught by the catchers down near the ground and to everyone watching, look like well, that obviously must have been low but in fact was passed through the strike zone because it's curving so much. Those are the pitches that we are trying to help the umpires get another view of.

ALAN ALDA If umpires routinely start to look at the pitches again after the game, do you have any evidence that that is going to improve their behavior when they're on the field the next time?

PAUL BAIM Because nothing like this-nothing even faintly like this has ever been available. We don't know.

ALAN ALDA (NARRATION) But he'll probably soon find out. As this year's baseball season gets underway, the plan is to equip most of the major league ballparks with the system now at Fenway.

ALAN ALDA That looked like a strike to me.

ALAN ALDA (NARRATION) Then umpires around the country will not only be calling them as they see them. Later, in the privacy of their hotel rooms, they'll be able to see them as they called them.

ALAN ALDA Strike! Three of them. Out. He's out. And I'm in the shower.

ALAN ALDA (NARRATION) While in major league parks this spring the sound will be the familiar crack of the ball on wooden bats, on college ball-fields the sound will be very different. Aluminum bats replaced wood for college ball in the early 1970s to save money -- aluminum bats are essentially indestructible. But they also hit the ball much harder and faster than wood. In 1998, concerned at the increasing potency of aluminum bats as the manufacturers competed on performance, the NCAA called a bat summit meeting in Kansas City.

JIM SHERWOOD The college World Series had just been decided by a game with the score of 21-14. More like a football game as opposed to a baseball game. They were concerned about players possibly being injured from batted balls, particularly pitchers, even though they didn't have a lot of data showing that pitchers were dropping like flies. There still was the potential for this occurring. So with that they said, we're gonna to have a ceiling on performance and we're gonna go out and study this.

ALAN ALDA (NARRATION) Jim Sherwood's lab in Lowell, Massachusetts, is one of the few in the country equipped with a machine that can swing a bat at a ball that is at the same time being flung at the bat. We filmed both wood and aluminum bats with a high-speed camera. Much of the energy of the collision goes into squashing the ball. But the compression is less with aluminum than it is with wood. The reason is that the hollow aluminum bat itself is distorted by the impact. This stored energy flings the ball off an aluminum bat at speeds up to 5 miles an hour faster than it comes off a wood bat. As the NCAA struggled with how to set a ceiling on the performance of aluminum bats, Jim Sherwood came up with a simple suggestion....

DAN Taking a hit.

ALAN ALDA (NARRATION) Restrict aluminum bats to hitting no better than wooden ones.

JIM SHERWOOD And with that the baseball research panel elected to go with a wood-like rule and they chose to base it on the largest wood bat that a college player could potentially use. We would test that on the Baum hitting machine and whatever the best wood bat hit, that's what the speed limit would be.

ALAN ALDA (NARRATION) But as every player and fan knows, how well a bat hits depends on just where the ball makes contact. So the Lowell team adjusts their machine to hit the ball in different places along the bat, moving it a half inch at a time. For a wooden bat, every half-inch makes a big difference. The fastest speed off the bat is typically about six inches from the tip, at what players often call the sweet spot. From tests like these, the lab established the speed limit for a ball coming off an aluminum bat. Now the lab spends much of its time checking

sample aluminum bats from the manufacturers to ensure they meet the NCAA specifications for size and weight, as well as observing the speed limit when hit in the machine. Outside, on the UMass Lowell's baseball field, another key difference between wood and aluminum bats is about to be investigated.

BOB COLLIER What we'd like you to do is take a few hits right on the sweet spot area. Make it a good hit, really go for it, and then move the ball contact area out to the end of the bat. Do three or four hits there, really consciously trying to meet the ball on the end of the bat. And then move into the handle area and we'll pick up the acoustics for those three areas.

ALAN ALDA (NARRATION) Bob Collier and his colleague Ken Kaliski are fascinated by the sounds of baseball. Today they're recording the sound of wood bats -- which the Lowell team routinely uses for batting practice -- to see how different the satisfying crack of the bat is when the hit's on the sweet spot... From the sound of a hit off the end of the bat... Or off the bat's handle. BOB COLLIER When they hit on the end or, particularly those last handle shots--very, very different sound. Of course, that compounded by the feeling, the sting--poor batter. "What did you tell me to hit it in on the handle for? Oh!"

ALAN ALDA (NARRATION) A wood bat, like a piano string, vibrates when struck. In this exaggerated view, there's a node -- a point where the vibration is at a minimum -- near the sweet spot. A ball hit on this node meets the bat solidly, giving that satisfying sharp crack. Hits on the end of the bat or on the handle, where the vibrations are greater, make a duller thud. Some outfielders claim they can use this difference in sound to help them field the ball. What Bob wants to know is whether aluminum bats also sound different depending on where they are hit.

BOB COLLIER End.

ALAN ALDA (NARRATION) The question is complicated by the fact that aluminum bats are so noisy.

BOB COLLIER This ping that you're hearing is a good 15-20 dB louder than the, even the crack of the bat. Wow!

ALAN ALDA (NARRATION) The ping is made by those same vibrations that make the ball pop off the bat. What's more, the bat rings like a bell pretty much wherever it's hit. The question is, are there still subtle differences in the ping that reflect the quality of the hit.

BOB COLLIER The analysis will show us whether we're talking a 3-dB difference, which is very difficult to detect, or a 10-dB, which you can recognize very very

easily. So just what those shades of difference are -it's interesting. That's what's interesting as far as the ball players are concerned.

DAVE With the aluminum bat I think it's definitely a lot harder to tell the difference because the ball just jumps off the aluminum bats. With the wood bat, if you get jammed, you can definitely tell because it's not that crisp crack you get. But with the aluminum bat it's all like the same so it pretty much, it pretty much sounds the same.

ALAN ALDA (NARRATION) And indeed it does. Bob and Ken's analysis showed the quality of the ping to be almost identical for the different hits. But there were slight differences in loudness -- barely enough for the instruments to detect, and probably at the limit of a human ear's ability to discriminate.

BOB COLLIER It's the human air brain system that's something that gains our respect, you know, and admiration. We can, there are people that can do things and understand things way beyond what our instruments can do. They can just give us an indication of what is happening and maybe just lead us into some channels of thought that can be helpful. And that's why I think that human engineering, which I like to think what I do, is what makes life so interesting.

NO LIMIT

ALAN ALDA (NARRATION) Surfacing into the sunshine off the south of France is Loic Leferme, a superstar in a rapidly growing international sport. In a deep dive contest called No Limit, he's just set a new world record -- 452 feet without drawing a breath. Loic is a member of the French national apnea team - in France, apnea means not breathing. Today they'll be using the same underwater sled Loic broke the record with. It's the team's regular Saturday morning training session, 4 months after the record dive. As they practice, the team members will also be supporting Loic, who today is preparing for a 300-foot training dive.

PHILLIPE AFFRAIT If you want to be great at that discipline, you have to be more quiet, to relax and to have a psychological preparation, as he does.

ALAN ALDA (NARRATION) Relaxation is essential. Exertion just consumes the precious single lungful of air. Loic's companions practice an event which requires swimming directly down. They move slowly and deliberately. Loic starts breath-holding exercises. Learning how to stay under like this is the basic skill that deep divers have to develop. The best in the team can do seven minutes, while most people can manage a minute or less.

ALAN ALDA How long will they stay like that?

PHILLIPE AFFRAIT I've heard here now only one minute and a half.

ALAN ALDA Only a minute and a half.

PHILLIPE AFFRAIT Yeah.

LOIC LEFERME 5, 4, 3, 2, 1. OK Alan, try to relax your face and your neck here.

ALAN ALDA (NARRATION) I tried several dives using Loic's relaxation techniques, and my breath-holding did begin to improve.

LOIC LEFERME You close your eyes.

ALAN ALDA (NARRATION) These techniques can be very powerful. We can actually defeat our body's own signals to breathe - and then black out and drown. That's why teams like these always train in a group, and always watch each other like hawks.

ALAN ALDA That was worse. Oh no, it was longer, wasn't it?

LOIC LEFERME One minute and five.

ALAN ALDA I stayed under about 10 seconds longer.

ALAN ALDA (NARRATION) Surface breath-holding is a competitive event, and I could see the fun in it, but it has to be done with others, who know the very real risks.

ALAN ALDA It's possible to black out and not realize that you're blacking out.

CLAUDE CHAPUIS Of course, you never realize...

ALAN ALDA You never notice it. You never realize. So you need somebody else there with you to read the signs.

CLAUDE CHAPUIS Of course.

ALAN ALDA You need an experienced person.

LOIC LEFERME It's like climbing. If you climb alone without any rope, you take your risk. If you have a rope and you know how to use it, if you are both... two, it's easy.

ALAN ALDA (NARRATION) This little finger clip detects Loic's heart rate and oxygen level in the blood. His low 70s heart rate, with 99% blood oxygen saturation, are about normal. Loic is going to perform a long breath-hold, while we monitor his heart and blood. He's going to be down for 4 minutes. The secret to these amazing performances is in something called the dive response. It's a primitive reflex, triggered when our faces are plunged into water, and found in all mammals. One consequence is a dramatic drop in heart rate.

PHILLIPE AFFRAIT You see, he has lost from 10 to 15 beats per minute, after one minute of breath-holding. He's OK.

ALAN ALDA (NARRATION) Loic's heart rate continues to drop. He's taking a natural reflex and amplifying it through his well-practiced and profound relaxation.

PHILLIPE AFFRAIT Two minutes and 15 seconds. The O2 saturation is perfect.

ALAN ALDA (NARRATION) The dive response also contracts blood vessels in Loic's limbs, concentrating blood in the vital heart, lungs and brain.

PHILLIPE AFFRAIT 3 minutes, 30 seconds.

ALAN ALDA (NARRATION) By three and a half minutes his blood oxygen is way down. Again, Loic's mental discipline prevails.

PHILLIPE AFFRAIT The concentration of oxygen in his body is really decreasing, even in his tissue in the heart, in the brain. But you see that he can bear it. Me, I can't bear it, but he can. OK. Put it on your nose.

ALAN ALDA What you're doing now is just to get a baseline?

PHILLIPE AFFRAIT Yes, just to get a base.

ALAN ALDA (NARRATION) Loic is not only mentally disciplined, but he trains to keep his body physically very flexible. That's so he can use a technique for increasing lung capacity, which we're just about to measure.

PHILLIPE AFFRAIT Third time. Then after it will be up to you. Take your air in max... take it, take it, and then blow very fast, blow, blow, blow, keep on, keep on, go on, go on, go on, OK, OK, OK. OK it's good. Fine.

ALAN ALDA (NARRATION) Loic scores 5.9 liters - normal for his body size. For the second test, Loic uses a special pumping technique.

PHILLIPE AFFRAIT Alan, look what his technique does is to increase that capacity.

ALAN ALDA (NARRATION) The pumping blows up Loic's lungs, literally like a balloon.

PHILLIPE AFFRAIT OK. Blow, blow, blow, blow...

ALAN ALDA (NARRATION) The result is dramatic.

PHILLIPE AFFRAIT Blow, keep on, keep on. OK.

ALAN ALDA So he went up a whole liter. He went up from 5.9 to 6.9.

PHILLIPE AFFRAIT 5.99 to 6.9 Cinq, quatre, trois, deux, un. Top. Whenever you want.

ALAN ALDA (NARRATION) Back at the team's training session, Loic is still warming up for his 300 foot -- or hundred meter -- dive. Actually, we should say, he's slowing down. He's relaxing to heighten the dive response, while minimizing exertion.

PHILLIPE AFFRAIT For that first attempt he is going very slowly. Usually it doesn't take a lot of time. You can go to 20 meters very fast.

ALAN ALDA (NARRATION) This is just a 20 meter - 60 foot - warm-up, but the hundred meter dive Loic's going to do today would have broken the record in the 1970s, and now techniques like Loic's are allowing divers to aim for 150 meters. That's nearly 500 feet. Loic drifts back to the group at the surface, satisfied his dive response is fully functional.

PHILLIPE AFFRAIT OK.

LOIC LEFERME That was good. The training is always like this. It's not like zen and yoga. But it's another way to relax yourself because then your head is with the group, and you have time to relax, you have time to play.

ALAN ALDA (NARRATION) Now the group checks out the weighted sled that will carry Loic down.

LOIC LEFERME It's the team which is the most important, because the team make someone go down very deep. And without the team you don't do anything.

ALAN ALDA (NARRATION) The sled is raised with an airbag, inflated from a scuba tank that's attached to it. Loic will bring himself up from his deep dive this way, too. Everything is in order. While safety divers stand by, Loic prepares himself. He gets his face wet, to stimulate the dive response. His heart rate now starts to drop. The safety divers head down to wait at a hundred feet. Although Loic is going below normal scuba limits, they may be needed when he comes up. Loic breathes deeply, then pumps to expand his lungs. The safety divers flash past.

PHILLIPE AFFRAIT 40 seconds. He's 50 meters. It takes more than one minute, one minute 15 seconds to go up to a hundred meters. Almost at the bottom. We will see perhaps the rope - it will pull down... in ten seconds.

TEAM MEMBER One minute.

ALAN ALDA (NARRATION) At this depth Loic feels great - the pressure has collapsed his lungs to one tenth their size at the surface, forcing most of the available oxygen into his blood.

PHILLIPE AFFRAIT He has taken one minute and 4 seconds, and now he's going up.

ALAN ALDA (NARRATION) Now comes the dangerous part. Loic's lungs rapidly re-expand, pulling oxygen back out of his blood. He could black out. 30 feet down he releases his air bag.

PHILLIPE AFFRAIT We see the balloon, and there is a safety free-diver with him, and they are coming up very slowly. He's here. We can see him now. OK.

ALAN ALDA (NARRATION) The last 15 feet, when the lungs expand the most, are the riskiest. Everyone's relieved to see Loic in good shape. Well, I'm not diving to a hundred meters, but I am going to try extending my breath-holding performance.

LOIC LEFERME You try to relax. Your arms. Your neck. 3, 2, 1.

ALAN ALDA (NARRATION) I'm about as relaxed as I can manage with an underwater camera pushed into my face. But it's totally relaxing to know Loic is watching me every second.

LOIC LEFERME He's OK. Relax your neck. OK you feel good. You feel good. Close your eyes. Good.

ALAN ALDA Wasn't much longer. Probably the same. What was it?

PHILLIPE AFFRAIT What do you feel? What do you feel?

ALAN ALDA A minute and thirty two.

PHILLIPE AFFRAIT A minute and thirty two? A minute and forty five.

ALAN ALDA Really?

PHILLIPE AFFRAIT Yeah.

ALAN ALDA Oh. So, OK that's better.

ALAN ALDA (NARRATION) After just a few hours training, I had almost doubled my breath-holding, and that was no surprise to Loic.

LOIC LEFERME In training one month, perhaps you will do four or five minutes, and sometimes people, they say, Oh - it's impossible. Yes, it's possible. You just have to train, and you have to put your mind in the way of apnea. That's all. And that's simple.

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