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PROFESSOR:

OK, so welcome back everyone. This is going to be the first class we're actually talking about poker strategy, so this should be pretty exciting. So the first thing we're going to learn about is position, and this is only three slides long. So positions have different names. They're put in two different groups, and a lot of how we describe what's going in a particular hand is going to be relevant to where people are sitting. Why? Because people in a late position get to act after people in an early position.

And in general, the positions are broken into four different groups. There are the blinds, who pay the blinds and are first act on every street after a pre-flop. There's early position, middle position, and late position, where all these positions have names, except middle position. Starting in the big blind, we call it under the gun, under the gun plus 1, under the gun plus 2. You could also describe these as seat 1, 2, 3, 4 all the way to 9 or 10, although I don't really like that because they all have pretty unique names, and they're descriptive enough to just use those.

So middle position is labeled one, two, and three, and then around the button you describe their relation to the button, where either you are the button or you are cutting off the button. And then some people get a little crazy by calling this the hijack, but I tend to not do that, and then as we eliminate people, we get rid of the least interesting positions to only keep the ones with real names.

So the reason that I'm telling you this now is we're going to be going through hands where I talk about players by their position. The individual person doesn't matter, but it's much to understand what's going on when I refer to them as a cut off, or the button, or whatever. But in general, the later position is better because you get more information. You get to see people acting before you.

And as a result, the money flows, in general, to the late positions. The hand that you're the button, you're going to make the most amount of money, and you can see that in poker tracker. And if you're losing money on the button, you should seriously reevaluate how you're playing that, because that's when you make the most amount of money.

Big blinds are an interesting situation because they get to see the flop for a discount, because they're compelled to pay some sort of bet. So you might think the blinds are in a good position because they get a free flop, but they're actually in a terrible position because when position matters post flop they are the first to act in every single situation. So even though you might think that you're getting a discount for being in the blinds, you're getting a discount and entry into a hand where you're almost certainly going to be at a major informational disadvantage.

However, interestingly, in short stack situations, early position is actually better because you have the opportunity to go all in before the other person does, and you maintain the equity from aggression, the fold equity, which we'll talk about later. It's sort of like a game of chicken where-- so chicken is a game where two people drive at each other until one person turns, where it's like the an infinitely bad return if they both don't turn, and then one wins if one turns and one doesn't. So the proper strategy in chicken is to throw your steering wheel out the window so the other person knows he only has one option if he doesn't want an infinitely big loss.

So with position, it works very similar to that, where if you're in a tournament where neither person wants to see a showdown, neither person wants to deal with a coin flip for their tournament life, if you're in early position, you have the opportunity to be the aggressor and go all in. So you get to discourage the other person from entering into it.

So let's move on to some basic concepts. So a lot of these things are based on odds. So poker is a statistical game, and we're going to be talking about applications of math to poker. So why does drawing matter? So drawing means you're trying to make a hand. More cards that will come out will give you a really

good hand, whereas you don't necessarily have a good hand right now.

In a really common situation, there's one guy that has an OK hand, and there's one guy that has nothing but the potential to have a really good hand. Most of the decision points come down to whether the guy with nothing has equity, has an interest in making his real hand. So really common examples of these are one person has a pair or two pair, and one guy has a straight or a flush draw. If we're talking pre-flop, someone has a pocket pair, and someone else has literally anything else, and they're trying to make anything more than whatever that guy's pairs is.

So what the drawer has to do-- the guy without a real hand-- is to decide whether the bet he is facing or whatever has to pay to see more cards to find out if he makes his hand is worth the cost, is worth what the aggressor is making him pay to see that additional card. And the person who has a hand already wants to make it so that the drawer cannot see his card for a positive equity. He wants to bet so much that a call is bad, because that's where his equity comes from.

So he can either bet enough so that he folds-- the other guy folds-- or bet enough that he'll call and make a huge mistake. Both are equally good. Actually the second is probably better.

AUDIENCE: You're saying [INAUDIBLE].

PROFESSOR: So I'm saying a drawer is someone who has a flush draw or a straight draw, or basically has no real hand at showdown, but has a reasonable chance of, as more cards come out, making a monster hand, like making a hand which will almost certainly win that showdown.

OK, so let's go through a scenario. OK, so this seems pretty straightforward. There's some sort of bet pre-flop. I called, and it was heads up. It came with four to a flush, four hearts, and this guy bet into me. And the question is, what do we do? That's a big question.

And I'm going to be using this format a lot because it's easier to-- at least for me, it's easier to see, and then hopefully it's something you guys will pick up on. I'm only

going to include relevant information, and the cases are going to be written this format where we have the relevant stacks up here. Here are the blinds. This means that small blind is \$20, big blind is \$40, and there's a \$10 ante. This is a pot before anyone does anything. This is a pot as of a flop. These are my cards. The hero is whoever we care about. The villain is the other guy.

And this just shows the order of what happens. So here he raised to \$120 pre-flop. Three big blinds. I call. The flop comes eight of hearts, three of hearts, something that doesn't matter. He bets \$370, all in.

So my decision is, what can I do here? And this is a really common scenario. And what we can do is develop the tools that we need to make this-- to figure out what we want to do here. And rather than should we call, we can come up with a much more resilient answer. What's the biggest bet that we can call? And we're going to end up with a solution set of this, of this area here. That's what we want to figure out.

But first we need to develop something called expected value. So expected value is the same in poker as it is in math. It's just a probability weighted average of all possible results. So it's win percentage times win amount minus lose percentage times lose amount. So in our scenario, we're going to add some variables into it. We're facing about into a pot of 380. Our EV is going to be whatever chance we have to win times a pot of 380 plus whatever the bet is, x , minus our lose percentage, which is $1 - \text{win percentage}$ times that same variable x . And our threshold for call is when EV equals 0.

So pot odds is generally what we call the relationship between the size of the bet you're facing and the pot that you would win if you call that bet and then win the hand. So this is going to be the equation. So it's plus EV. It's positive expectation if the chance you have of winning is greater than the call amount divided by the size of the pot after the call.

So say that we're seeing a bet of \$100. We were seeing a bet a little bit bigger than that, but just for example purposes, we'll use \$100. So your pot odds would be \$100

divided by \$580, where \$580 is whatever was in the pot before plus his bet plus your call. You'll win \$580 if you win this hand. So your call is contributing 17% of the pot.

And just so you guys know, people use pot odds in a different way. They talk about 1 to 4 and use a different notation for referring to your chance of winning. I always thought this was very intuitive, so that's what I'm going to be teaching you guys. It's a percentage of the pot that you can contribute.

So if your win percentage is more than 17%, this is a plus EV call, and this should be fairly easy to wrap your head around. And your win percentage can just be calculated based on what cards will make you win divided by what cards are left in the deck. And those are called outs. Cards that result in a win for you based on your best estimate are called an out.

So when you're going for a flush-- so there are 13 hearts. You already know about four of them. They're either in your hand or on the board. There are nine hearts left that you could hit to make your flush and presumably win. So your win percentage-- this is calculating it out exactly-- is just 1 minus your chance of hitting the flush on either one of those cards. So it's 40 out of 49 times 39 out of 48, which is about equal to 34%. So since this 34%, our chance of winning, is more than 17%, the proportion of a call that we're contributing, this makes it a good call. And the fact that this is really big compared to this makes it a really good call.

So this is how I think of it in terms of visualizing it. So this whole pie is the \$580 pot that it would be if you called. This chunk is your 34% pot odds. Now, this chunk can be comprised of the size of the bet you're calling and your expected value from calling. So here, the size of the chunk is \$197, which was 34% of \$580. We can contribute up to that amount. If we get to contribute less of it, that means that any additional chunk is EV. We are making \$97 for making this call. Similarly, if we make a call that's too big, we end up with a negative chunk of that pie.

So I'm teaching you a quick rule for calculating your chance of winning any hand, and the quick rule I'm going to use is by Phil Gordon. So let's talk about Phil

Gordon. So Phil Gordon got-- he seems like an OK guy. He got fourth place in the main event. He won a World Poker tour. He won two British championships. He's the head referee of the World Series of rock, paper, scissors. These guys get into really interesting things when they're not playing poker, and he's the author *Phil Gordon's Little Green Book*.

So Phil Gordon invented this thing which caught on called Gordon's rule of two and four, which basically just says each of your outs is worth 2% for each additional card you get to see for that side of the bet. And it should be fairly obvious where 2% comes from. It's just 1 divided by 50, and it's a rough estimate of what each out is worth over 49, or 48, or however many cards are left. If you get to see both the turn and the river, you use 4%, and that's the whole role. I'm sure someone figured it out before, but he was nice enough to coin it and write in his book, which is why I'm giving him credit for it.

So some examples of these are if you have a low pair and you're trying to get three of a kind by the turn or the river, you have two outs. And if you're trying to figure out your chance of making that three of a kind on the turn, you do two outs times 2% for a total of 4% to make your hand. Simple enough.

Other common examples are flush draw, which should be nine outs to give you odds of 9 divided by 47, or about 18%. An inside straight draw is four outs to give you odds 4 out of 47, or 8%. And you can see this is the exact calculation, but it's really very close to just multiplying by 2.

So back to pot odds. Your break even is when EV is 0. That's a common theme that we're going to be talking about. So the bet is x into a pot of \$380. Your chance of hitting the flush is 9 times 4%, or 36%-ish. we're assuming that we get to see both cards. Why do I think we're going to get to see both cards? Because he's all in, and he can't bet anymore. So win percentage is 36%. Our exact win rate is 34%, showing that this is pretty close. We didn't actually need to do any heavy math to get a good ballpark number.

So the question here is, we're facing a bet of \$370. The pot before we face that bet

is \$380. And the question is, should we call? Because you're not going-- you can solve the threshold conceptually just to get a resilient solution set, especially when you're doing things before or after the fact, but in real time, we're going to want a rule for how to figure this out. So let's talk through this one, and then we'll go through the solution on the next side.

So we have to figure out whether to call this. So what are we drawing to? So we're drawing to a flush. So how many cards will result in a flush here? Nine, right. So there are nine remaining hearts in the deck, and then we get to see one or two cards.

AUDIENCE: Two cards.

PROFESSOR: Yep, I agree. So we get to see two cards because he's all in. So our chance of winning is 4% times 9, so 9%, 18%, 36%. So we can call up to 36%. We can contribute up to 36% of the final pot. So we would contribute \$370 into the final pot of 2 times this plus 1 times this. And just offhand, you can calculate-- you can figure out that's around 1/3, because the pot is about equal to the size of his bet. So we're contributing a little bit less than 33%, so we know that this is going to be a good call. And that's how you would do this in real time. You'd say you're 36% to win. You're contributing 33% of the pot, so you decide to call. And that's how you would make this decision.

So let's do a couple more examples. These are all different situations where this type of thing might come up. So here's a situation where we have asymmetrical stacks, although the blinds are the same. So we have six, seven of diamonds. I'm using the four color deck just to make it easier to see. Something happens pre-flop that doesn't really matter. On the flop, there's \$320 in the pot. He bets \$150. So what we do here?

So what are we drawing to? We're drawing to a straight. So how many outs do we have? How many cards will hit that straight?

AUDIENCE: Eight.

PROFESSOR: Eight, yeah. So we got four nines and then four fours-- will make us hit that straight. So eight outs total. So what's our chance of winning this hand based on what we're calling here?

AUDIENCE: 32%.

PROFESSOR: Yeah, 8%, 16%, 32%. Yep, I agree with that. So based on that, what do we have to contribute to stay in this hand? What percentage of the future pot?

AUDIENCE: Less than 1/3.

PROFESSOR: Yeah, something less than 1/3, because if he get exactly \$320, that would be 1/3. So we know this is way less than 1/3, and since we're 32% to win, this is probably going to be a good call. So going through the questions-- so we have an open ended straight draw, meaning we have eight outs because two different cards would result in the straight. Our outs are any nine and any four. We have a 33% chance of hitting it, and what's the correct play? Call, because \$150 out of \$620, where \$620 is the pot plus \$300 is 24%.

OK, so that wasn't bad. So those are two common draws. One was a flush draw, and one was a straight draw. So let's go to something a little bit different. So we have five five on the button. He raises into us. I call, and the flop comes three clubs, five, ace, six. He bets \$200.

OK, cool. So this is a situation which I'm sure a lot of you may have run into recently. So what hand are we drawing to here? Why do we think we're behind if we have three fives here?

AUDIENCE: [INAUDIBLE] two of clubs [INAUDIBLE].

PROFESSOR: Yeah, he might have a flush, certainly to the point where I'm not super comfortable with the set here knowing that it's reasonably likely for someone to have a flush here, or even if he doesn't have a flush and we bet, he's only going to call us really if he has a flush or a better hand. So he has a flush-- what are we drawing to? What beats a flush here?

AUDIENCE: Full house.

PROFESSOR: Full house, good. What else?

AUDIENCE: Four fives.

PROFESSOR: Yep, four of a kind. OK, so what are our outs here?

AUDIENCE: Seven.

PROFESSOR: Yep, I agree. Seven outs. What are they?

[INTERPOSING VOICES]

Yep. So three aces, three sixes, one five. So we have seven outs total. So what's our chance of hitting-- do we count one or two cards here?

AUDIENCE: One.

PROFESSOR: One. Why? Because he has a lot of chips behind, and there's no way, if he's betting this on the flop, he's giving us a free card on the turn, unless for some reason he thinks we have a flush, but we certainly can't count on that. OK, so what did we say? Seven outs. So we use 2% for the next card, or 14%. So we can call up to 14% of the future part.

The future pot is going to be \$2100, \$2300, so we can call 14% of that. So what's a good estimate of that? It's going to be more than my 280 because 14% of \$2000 is \$280, right? So he's betting materially less than that. He's way under betting whatever he has here. If he has a flush, he's not protecting it. If he doesn't have a flush, he's losing.

So this is a very common example of a villain not protecting his hand. This is a situation where I see a lot of newer players screw up. They're betting so little-- they're betting little because they don't want the other guy to fold, but they're actually losing value because the other guy folding here would be preferable. They should bet enough that he either folds or he makes a wrong decision if he calls.

So we're drawing to full house or four of a kind, which you guys got right. Our outs are three aces, three sixes, and one five for seven cards total. Our chance of hitting the draw is 14%, so the correct play is?

AUDIENCE: Call.

PROFESSOR: Yep, the correct play is call, because he's only asking us for to contribute 9% of that pot. Since we're 14% to win, the chunk in that pie is bigger than the 9% chunk that we have to contribute, and the result is this \$122 free that he's giving us.

OK, so I think this is my last example. This one should be a little bit more fun. So this is it. So why is this a draw that we're looking at? We're the first one to act. Why does this matter? Can anyone tell what's going on here?

AUDIENCE: Big blind [INAUDIBLE].

PROFESSOR: Yeah, so the villain here is all in blind with that \$200, because that's the big blind. So by calling here or by doing anything, he is going all in. So really it's like he acted before us, and now we're deciding whether we want to act.

So what are we drawing to here? What are we facing? What does he have in terms of a range?

AUDIENCE: Anything.

PROFESSOR: Any two cards. And then so what are we drawing to? In general, we're drawing to basically anything. We're hoping that we win some amount of the time, and what percentage do we have to win? First let's start with what's a reasonable estimate for the amount we could win, the percentage of the time? So what are some hand versus hand percentages that you know? So what's aces versus anything?

AUDIENCE: 80%.

PROFESSOR: Yeah, it's like 80% or 85%. And then if he doesn't have a pocket pair higher than both of our cards, you're generally-- even if you're dominated, you're like 70/30, and

then the majority of random versus random is between 60/40 in either direction. So say that-- what percentage of the time do we have to win here for this to be a good call? So what's the size of the bet that we're facing here if we're the small blind? \$100, right?

So we're contributing \$100 here to win a pot of \$400, which is going to be on big blind from each of us. So if we're more than 25% to win here, this is a plus EV call. And I see a lot of people screw this up for some reason, but you're virtually always ahead of 25% here. So what we're drawing to here is anything, and our chance of hitting the draw is we're actually about 40% versus his range. And even the worst heads up hand versus any two cards is 32%, so we're really calling blind there. We are always ahead of his range. So the correct play is certainly going to need a call, and the EV is like \$60. So if we fold this, it's worth about \$60 chips.

So let's talk about implied odds. So the solution to an implied odds question is the number of chips that we have to win after hitting our draw. So I'm using that specific language because for pot odds the solution is whether or not you can call, or what's the maximum bet you can call. For implied odds, it's different. It's the number of chips you have to win later to make the call good. It's the amount of basically dead money you need to add to the pot after the fact.

So the way that we do that is we take a look at our percentage chance of winning-- say it's 20%-- and then we figure out what size would the pot have to be to make the bet we are currently facing be 20% of that pot. So here's an example, and we're using easier numbers here because we're dividing by percentages. So say we have a flush draw and we're 18% to hit. If the pot is \$300 and we have a bet of \$180 into us, our call is going to be 27% of the pot.

So if we had a 27% chance of winning that would be a break even call, but we don't. We have an 19% chance of winning. So by pot odds, it says don't call. But to figure out what the amount is that we want the pot to be, we just divide that \$180 by the 18% of our odds to get this \$1000 number. So if the part were \$1000, we could make that call.

So the solution here is this \$340 difference, which is the actual part after we call-- the difference between that and the pot that we need to make this call neutral. That's where this \$340 comes from. And it has to be in dead money. It has to be money that's added to the pot after we already hit our flush.

So to visualize-- so we need that bet of \$180 from the example I just gave to be 18% of the pot. That's what makes it a good bet. As of the time that we make the decision, our bet here represents 27% of that pot. However, if we can increase a pot by \$340, that bet would be 18% of that new pot. So that gives us the right implied odds to make this call. And what we need to figure out is whether this \$340 number is realistic-- the difference between this \$1000 and that \$660. So are we following that? Is that making it easier to understand what we're trying to figure out when we're doing implied odds question?

AUDIENCE: Yes.

PROFESSOR: OK, cool. So I think I have two or three examples here just to walk through that idea. So here's a hand. So here's a decision we're facing, and we need to figure out whether this is a good call. So we have plenty of chips behind. We all started with \$1000, and then we're probably not winning this hand because we have middle pair.

So we're drawing to two pair or three of a kind. Our outs are these, which are five outs total, which gives us a chance of hitting our draw of what? So do we get to see one or two cards?

AUDIENCE: One.

PROFESSOR: Right. We get to see one card, because presumably he's going to bet again. So we multiply by 2% to get a 10% chance of hitting the draw, and then let's go back to this. So what does the pot have to be to make this bet 10% of the future pot?

AUDIENCE: \$1000.

AUDIENCE: \$900.

PROFESSOR: Well, it needs to be \$1000, because we're contributing \$100 of some pot that we

have 10% equity in. So it needs to be \$1000, which means how much additional money do we need to add after we call that? So after this call it's going to be \$100, \$475, \$575, because we're calling \$100, so that's going to be in the pot, too. And then it's the delta between that and \$1000 that we care about. So it's going to be \$1000 minus \$575. We need to draw \$425 in addition at the end.

So I have a 10% chance of hitting. Our odds are 16%, meaning we can't call it there. However, if we can pull out that \$100 bet divided by the 10% odds that we need, it creates \$1000 pot with the difference of \$575. So we need \$425 more on that after we hit our draw to make that a good call, which in that situation seems reasonable. So he got \$100 into a pot of \$400. Presumably he'll bet like \$200 or \$300 next hand, and then we can re-pop him for anything. Even if it's a min bet, which he'll presumably be obligated to call, especially because this is a very hidden draw, we'll be able to make this a good call. So I think this is reasonably a good call based on I think we could get \$400, \$500 more at least.

So let's do another one of these. So I'm going to make these all from the same position and all the pre-flop actions the same just to make it simple to see what's going on. OK, so here let's go through the same steps. So what are we drawing to here?

AUDIENCE: Straight flush.

[INTERPOSING VOICES]

PROFESSOR: Yeah, so several things. So we're drawing to a straight. We're drawing to a flush. We're drawing to anything else.

[INTERPOSING VOICES]

So, I would agree we're drawing to a royal flush also. And I'm going to say the over pair might not be good. One pair I wouldn't consider a great hand, especially when we're-- what were blinds here? \$50, \$100? So we have an m of like \$50? Something like that. So I think our m-- our top pair is not that great here, but I do

think the flush is good. Probably like a king high flush is good, and then the straight is good, too. So how many outs do we have here? So how many outs to the flush?

AUDIENCE: Nine.

PROFESSOR: Right, so we have nine other clubs in the deck. And then how many outs to the straight?

AUDIENCE: Eight.

PROFESSOR: Eight, right. So we have 17 outs, and then how many are overlaps?

AUDIENCE: Two.

PROFESSOR: Two, right. So let me make sure I got that right. So 9 plus 8. 17 Minus 2. Yep, 15. So we have 15 outs here. And then how many cards are we going to see?

AUDIENCE: One.

PROFESSOR: We're going to see one. I really wouldn't estimate that we're going to see two cards, unless someone is specifically all in. So use one card here. So we have 15 outs over one card, so what's our percent chance of winning on that next card?

AUDIENCE: 30%.

PROFESSOR: 30%, good. So what would the pot have to be eventually to make this a good call with our 30% chance of winning this hand?

AUDIENCE: \$1800?

PROFESSOR: It would be-- so I think it would be \$600 divided by 30%. Right? So what's that? So \$600 divided by 3/10. No, I think it's going to be more than that, because we're going to multiply by 10/3. So it's going to \$6000 divided by 3, or \$2000. Would you agree with that? So this pot has to be \$2000 by the end. Now, what's it going to be when we call here?

AUDIENCE: \$1425.

PROFESSOR: Yeah, let's see. So it's going to be \$600-- his \$600 plus our \$600. \$1200 plus \$275. Yeah, \$1475. So how many additional dollars do we need in the pot after hitting one of our draws?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Good, right. So I think that's right. So drawing to straight or flush. Any ace, any nine, seven other clubs that aren't ace or nine for 15 outs. We are 30% to hit this. So right now the pot odds are 40% because he's betting \$600-- or we'd be contributing \$600 into a total pot of \$1475. We need to win an additional \$525 after it to make this a good call. So that's it. So that's how you do implied odds. Just make sure you understand what the future pot has to be, and then you can use your own judgment for whether that's a realistic amount to win here.

I think here \$500 is totally reasonable, because he already bet \$600. Even if a flush comes, he's probably pretty obligated to make at least another a \$500 bet or at least a \$500 call if he checks. So I think that's good.

To make it a little simpler for you guys, I made explicit all of the formulas that we went over for drawing, just to help with the case. So our normal EV formula is just-- so x is always going to be what we're solving for. Our EV is just is the either benefit or cost of the decision that we're facing. It's just going to be the combination of our win percent and loss percent and the win amount and loss amount.

How you determine pot odds is just a decision rule. Yes or no-- do you make this call? It's just your win percentage of the hand-- the chance you hitting your draw, whether that's greater than the call amount divided by the pot plus 2 times the call amount, because the bet amount and the call amount are the same thing. If it is greater, then you make the call. If it's less than, you fold. Implied odds, which we just went over-- it's going to be the bet amount you're facing divided by your chance of winning the hand minus whatever the pot is going to be after you make that call. I think that's it.

So these are all the formulas you need to make these decisions. You can generally

remember them when you're at the table. I think they're fairly intuitive, and if not, they seem fairly easy to memorize.

Anyway, so let's do a live example of this. So this hand happened at the World Series of Poker last year when it was 10 handed, which means there's it was one hand before the final table bubble, where they get to-- how it works in the World Series is they play down to nine, and then they have a break for three months where they build up the final table, and they advertise it, and they play it live. So this is a situation that was very tense for these guys, and an interesting hand happened which I think is a great example of what we're trying to do. Anyway, so let's watch.

[VIDEO PLAYBACK]

The very first year of the World Series in 1970.

PROFESSOR: There we go.

No final table. Champion determined by a vote of all the players. Johnny Moss was the winner. Under the gun, Martin Jacobson, ace, jack of clubs.

Very accomplished tournament player. Four World Series final tables.

Raise. \$650,000.

The dealer announces raise, but I don't think Martin has the right denominations out there.

Hold on, hold on, hold on. Hold the action. Hold the action. Just call. Just a call.

So they're making it just a call for \$300,000.

By the way, that was World Series dealer of the year, Andy Tillman. Frankly, I think the dealer of the year thing has gone to his head. He's dealing with a lot more attitude now.

One of these players will join the likes of John Hewitt, Jordan Smith, and Don Barton as main event 10th place finishers. Action on to William Tonking. Jack, nine in the

small blind. He wants to play. He limps in. In the big blind, Dan Sindelar checks his option. Three for a bargain. And here is our flop. 7, 8, 10, 2 clubs. Tonking with a jack high straight. He checks it to Sindelar, middle pair with a gut shot. And he's reaching for chips, bets a half million. Jacobson with flush and straight draws.

If Jacobson raises under the gun as he intended to, Tonking likely would have folded. Instead, they're now on a massive collision course that could define the November nine.

Jacobson obviously loves his hand was straight and flush draws. Unfortunately, he's run into Tonking, who flopped a straight, but there is a raise to a \$1,750,000.

So the 2% hand bets, and the second worst hand raises. Lon, this is a game I need to be in. A dream scenario for the short stack that still could turn into a nightmare for William Tonking.

All in.

And Tonking announces all in. Sindelar folds.

[END PLAYBACK]

PROFESSOR: So let's figure out what's going through his head right now. So here are all our players. That's our hero with ace, jack clubs. It's a little hard to see when they broadcast it on TV, but he was under the gun. He called. Called around. He bet. He raises. He check raises all in, and now Jacobson facing a decision here.

So clearly, what is he drawing to? Flush, and then if he hits that flush is he going to win? Probably. And then what else is he drawing to?

AUDIENCE: Straight.

PROFESSOR: Straight, right. And then if he hits that nine, he's probably going to win with a straight, although not all the time, because he doesn't have the best straight. If a nine comes and then this guy has queen, king-- or sorry, jack, queen, he's going to actually lose. So the question is, what does he do here? This is what it looks like.

So our hero here raises \$1750. He re-raises \$4525 more to being all in for \$6275. So he's drawn to a flush and possibly a straight. So how many outs do we have?

So you can count partial outs. You can say I'm going to win half the time if I get this, just to be conservative. So you can say all these clubs are good because you have the best possible flush, and maybe this nine will work, so let's count it as half a card, half an out. We'll win half the time if we do that. So we have 10 and 1/2 outs. So our chance of hitting the draw-- how many cards do we get to see?

AUDIENCE: Why 10 and 1/2? [INAUDIBLE].

PROFESSOR: Because you can just say, if we hit this nine, we're going to win half the time. We're probably going to win more than that, but it's a situation where if he has a jack we split, and if he has jack queen, we lose. So I'm not really comfortable calling those complete outs, and in the end, you can see it doesn't really matter. But the more conservative move is just saying half the time we'll win with those, and with these nine outs we're going to win all the time. You can just count them as half outs, or you can count them as 2/3 outs, or something like that.

Anyway, so we get to see both cards because he's all in. You have a question?

AUDIENCE: This would actually be a [INAUDIBLE] this will always-- when it's half [INAUDIBLE] that the other person has a jack. So under that condition, [INAUDIBLE] under all other conditions of this [INAUDIBLE].

PROFESSOR: No. We lose if he has jack, queen.

AUDIENCE: Right. If he has a jack-- he can have a jack, queen. That's fine, but if he has a jack, then it's the 1/2, but if he does not have a jack, then any nine wins.

PROFESSOR: Yeah, that's right. This is a conservative play.

AUDIENCE: This is a really-- this is the worst case scenario.

PROFESSOR: Yeah, I would agree. If this says call, then we're definitely calling. It's a real pain to have aggressive estimates, and then it says call, and you need to wonder [? why

their ?] estimates are wrong. So this gives us a more clear example.

Anyway, so the correct play is going to be to call here. It's a little bit difficult to see, but we're going to say that what's in the pot are all the bets that happened before he was re-raised. So that's the original part of \$1400, that one guy that bet \$500 for some reason, and then this, which would be our all in call, which was the \$6275 2, because he bet that, and we called that. This was a small blind. I don't know if you saw.

The small blind here just called \$500 and then folded when he bet into him, so that's dead money in the pot. So the total amount is \$14,450, and we're facing a bet of \$4525, so 31% of the pot we're contributing. We're 42% to hit our draws, meaning that this is a pretty clear call. And when we do the EV, even with this conservative estimate, it says we're making about \$1.5 million chips for making this call. So this should be pretty easy. Let's see what happens, and let's see if this works.

[VIDEO PLAYBACK]

Boo.

[END PLAYBACK]

PROFESSOR: Anyway, OK. So he won that. The guy, Jacobson, I'm pretty sure ended up winning the World Series that year.

OK, so we have a bunch of be carefults. Do not draw to a hand that may not actually win when you hit it, which means if you're drawing to a flush that's not even that good and maybe dominated by another flush, you probably shouldn't count all those as full outs, or the lower end of a straight is really, really bad. It's really common for people to draw to that and then just go broke, because they think they made their hand, but as it turns out, they made the second best hand.

In addition, don't draw out to a worse made hand than is already possible. So people refer to something called a paired board, which means two cards on the board have the same number. That means that four of a kind or full house are

possible. So if you're drawn to a straight or a flush, you might not even. You might be-- drawing dead, is what it's called. You like you might be 0% to win that hand, so be careful on drawing on a paired board.

In addition, do not assume you get to see both cards. It's really common for players to think that, OK, there are two cards left. He doesn't seem too aggressive. I'll probably get to see both cards for cheap, and then find out that their assumptions when calling the flop ended up being really bad and costing them EV. So very rarely does someone check the turn. Unless the turn is really scary, like you hit your draw obviously, or it looks like you did, no one is was going to give you that for free.

Another thing to be careful about is don't overestimate how easy it is to extract additional chips. It's really, really obvious when someone hits a flush draw, because there aren't that many reasons people are going to call a bet on the flop when there are two clubs on it and then bet when another club hits on the turn. Flushes are really obvious and everyone is keeping an eye on that. Straights are less obvious because a lot of different boards can have a straight on it so they can't really just assume that you're going to have a straight if there are any like four cards that are near each other by the turn.

And sets, like when you have a pocket pair and you hit a third of that pair on the turn, are basically invisible. There's no way they can put you on that. So your implied odds for sets are huge, whereas your implied odds on flush draws are very, very small.

In addition, on the other end, if you have a made hand, don't bet so little to give them the odds to reach their draw. Basically, most of your flop and turn bets should be like 2/3 of the pot just to punish them if they want to chase their draw. OK, so that's it for implied odds.

So let's move on to fold equity. So here's an example. So where you guys following what was going on in that hand? Basically, I had position pre-flop to make this call. Then on the flop I had an open ended straight draw. He be small enough that I should call. Same thing on the turn. I think he checked behind me on the turn, and

the river he checks. Why? Why is he checking the river here?

So he's checking because he's worried. He knows I'm drawing to something because I flat called, and look. I could've been drawing to a flush, and he thinks I just hit it. So this is a perfect bluffing opportunity, because we are basically representing a flush. So the question is, how often does this have to work to be a good bet versus just checking behind and losing nothing? With bluffing, if it's a bad bet, we're just going to lose money most of the time. So we have to figure out, what proportion of the time does this have to win to make it worth it? And that's what we're going to be looking at here.

The concept that will give us the value of making this bet is called fold equity. So fold equity is the value that you're getting in a hand from the likelihood that the other player is going to fold. So with regard to fold equity, I'm saying your showdown value, which is this acronym here, is 0. You can't win at showdown, which is our situation there. If he calls us, we definitely, definitely lost.

So the formula for this is-- at least the EV formula is just-- so it's a derivation of the normal EV formula that we always see. It's just the pot times your chance of winning-- i.e. his fold percentage-- minus the chance of losing. And you lose that bet if you lose, but your risking the bet to win the pot. If we have the chance to win after he calls, we can add another variable where just, instead of us just losing this bet for the amount he calls of the time, when he calls, we're going to get some amount of EV, which is still presumably going to be negative, but it's going to be a less negative than just losing the entire bet. So that's the basic formula for semi-bluffing here.

Some I'm defining bluffing is a bet where it has positive expectation because the fold equity is more than 0. Just this term, just the proportion of the pot that you expect to win from him folding is greater than the weighted chance of you losing that bet. That's just going to be called a bluff, an outright bluff. And I differentiate that from semi-bluffing, where this is actually negative, where if you have a 0% chance of winning, it's actually a bad bet, because he calls you more times than makes that

valuable.

But a semi-bluff actually becomes positive expectation because of your showdown win percentage. Your showdown win percentage is sufficiently high to offset it, and this is where the value comes from, because you have the opportunity to steal pots, but you also the opportunity redraw to a winning hand. And that's why in tournaments this becomes something that you're going to be doing very often, because you're not going to always have made hands, but you're always going to have something that could become a made hand, and that becomes good enough.

So how often does this have to work to be profitable? So I'm just going to give you a formula here. So we're betting \$150 into a pot of \$350 where we have no chance of winning if he calls. Our EV, which is just taking it from that formula, is $\$350 \times \text{fold} - \150 , times the chance he calls. So we can solve this for EV equals 0 and then solve for fold to get this formula. We get \$150 divided by the pot plus our bet. So this is our bet, because the idea is that we are putting \$150 into that pot for a chance of winning that whole pot back. He won't add that \$150 to the pot if we win it, so that's the idea there. So it's our bet divided by the pot after we bet to give us our neutral EV fold percentage. So that's the chance of him folding that makes this a good bet.

So I think this is pretty cool. You can use this to determine what's a good bluff and what's a bad bluff by just saying, is he going to call this more than 1/3 of the time? And just the EV calculation, looking at using this formula to prove that we reach a neutral EV is just 30% times this \$350, the pot minus 70%, him calling, times our bet. That equals 0. And that's our quick-- I like plugging this back into the EV formula just to make sure we messed around with the variables properly.

So are we OK with this so far? Because we're going to move on to something a little bit more complicated. In this one, we bet \$75 like he did before, but we are raising \$150. Why? Why are we raising \$150 here rather than just calling? Yeah, because we have an open ended straight draw, where even if he calls, we still could win, and that fundamentally changes what we need to make this profitable.

So here, our chance of winning is 16%. 8 times 2. We get to see just the river. So it's \$150 into a pot of \$350 where our win percent is 16%. This is still our chance of taking now the pot uncontested, and then the 1 minus f percent, the chance that he calls, is multiplied by our marginal EV, this 16% times winning the pot. \$500 is \$150 \$350-- \$150 our bet, \$350, the pot-- minus \$150, our bet. I guess a \$150 here would be his bet, but still we have a chance to \$500 or lose \$150.

One of the reasons fold equity is really hard to teach is because there's no real intuitive way to memorize this formula. So what I did here is I just solved for EV equals 0 for our fold percentage. So we could solve this-- I just plugged this into Wolfram Alpha, and I got the neutral fold percent is just 12%, compared to here we need to win this bluff 30% of the time, and here we need to win 12% of the time. That shows the value of the semi-bluff here. So to check with EV, you win \$350 12% of the time, and 88% of the time you have to deal with this.

So that shows, at least intuitively, what the value is but let's see if we can figure out exactly how important this win percentage is. So we're going to have to use calculus for this. So when we graph this formula, we see a clear trend, and it would be intuitive. When your showdown win percentage goes up, the amount you need him to fold goes down. If you win 0% of the time, he needs to fold a lot, but then if you win some amount of the time, he only needs to fold a smaller amount of the time. So that's what this thing is saying.

And there are a couple of interesting points on this graph which I want to point out. So what's this point here? It's our break even fold percentage for having a 0 EV. So the idea is, if he folds, how you read this is, if we have a 16% chance of winning if we're drawing to an open ended straight for one card, if he folds more than 12% percent of the time, if we're in anywhere in this area, it's positive EV and for anywhere down here it's not. So that's how we're reading this graph here.

So what about this point here? It's a complete bluff because we have 0% chance of winning, and you recognize this 30%. It's from all the way back here. It's when we had a 0% chance of winning. So that's that point up there, which I think is pretty

interesting, but it gets even cooler. OK so that's what that is. It's our \$150 divided by \$150 plus \$350, which is our formula for determining what our break even fold percentage is for a complete bluff. That's our 30% here, but check this out.

So what is this number? It's our pot odds break even. It's the size of the bet that we could call if he was betting to make us neutral EV. That's what this 23% is. It's our \$150 divided by the pot after our call. What that means is, if he folds 0% of the time, I, similarly, did he just bet, and then we have the option to call. That makes a 0 EV. So this graph connects all of those variables for us, and that lets us derive something very interesting with regard to implied odds.

We could just figure out how implied odds impacts our fold percentage by looking at this secant line and coming up with a good estimate. So let me work through this graph, talk through what we're seeing here, because I think this is really cool. So to be clear, this blue line is our neutral fold percentage, and then this slope is-- it's the derivative of how much of a bonus we get to fold percentage for every 1% win rate. So for each additional one out, each additional 2%, he needs the fold 3% less for us to break even there. That's what this is telling you.

When you have a 10% chance of winning, you just reduce this amount by 15%. You multiply it by the one and a half slope. Although it undershoots it by a little bit, it gives you a very, very close estimate to using these implied odds in real time. And then so I went ahead and figured out, OK, so that's for a specific bet size. How's it work if we look at for a much bigger bet or a much smaller bet? I found something really interesting.

When the bet becomes-- when we go towards infinity, the partial derivative is 2. You only get as much of a bonus as 2 times your win percentage. So each additional out gives you like 8% percent reduced in break even for fold percentage. And then when your bet approaches 0, you only get a 1% decrease. So these are our bounds. For a pot size bet, it's 1.5% percent your bonus, and regardless, you know your bonus is going to be between 1 and 2, at least in terms of the average across win percentages. That's what we discovered here. And what this is letting us do is

it's less letting us create a quick rule that implements implied odds.

So to go over what these rules exactly are, let's back up to a complete bluff. So our fold needed is just the bet divided by the pot and the bet combined. If you want to bet the exact size of the pot, which isn't that bad for a bluff, you only need to win half the time. And then you can, if you want, scale linearly down to 0. You could just say, all right, if I bet half the pot, I have to win 25% of the time. It's a little bit off. It's like 33% of the time, but it's not that bad.

So this gives you a very easy way to determine when you should bluff or not, and obviously there's a bit of judgment because you've got to figure out whether this is a reasonable number, but it gives you idea of you don't need to win that bluff 80% of the time. And then when you actually have a chance to redraw to win, it becomes even more interesting. So in general, when you have a draw, your value is higher because you still have a chance to win the hand. And in general, you're going to see very rarely will people actually make complete bluffs, because they would prefer-- the chance of you winning the hand at the end materially makes your value better.

So a simple assumption is just each 1% your showdown increases you decrease your fold percentage by 1.5%. And your fold percentage are going to be much, much smaller. They're going to be like 15% to 20-ish percent, somewhere in that range. So decreasing that by 5% actually makes you quite a bit more likely to win, or at least have a positive expectation decision. And when we talk about pre-flop, which is going to be nothing but figuring out semi-bluffing opportunities, we're going to be heavily using this type of thing.

So let's do some examples. OK, so what is going on here? So just to watch that again-- so it looks like the villain raised something pre-flop. I had position, so I called. And then he showed weakness for three straights in a row, I don't know what he has, but it seems to be worth taking a stab at it. So then what proportion of the time does this step have to work to make it a good bluff? So is this going to be bluff or a semi-bluff?

AUDIENCE: Bluff.

PROFESSOR: Bluff. Why?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Yeah, I barely beat the board. I think my 10 high plays, but only very close. So there's no way he can call this with the worse hand. So the question is, how often does this have to work to be valuable? Which is a very common question you might ask yourself. So do you remember how to figure this out?

So the formula is going to be this. It's just the bet divided by the pot plus the bet. So difference between this and the pot odds formula is one bet. Pot odds formulas is pot plus two bets, ours and his. This formula is just the pot plus our bet only, because he never adds his bet in.

So to figure out our chance of winning here, let's just go to this one. We just do what? We take this side of our bet and divide it by this plus this number. So we add those together, it's what? \$625. So we'd just take \$250 divided by \$625, which is what? It's 40%. So this needs to work 40% of the time to be valuable. So it's actually not as interesting as I would have guessed. This needs to work a pretty big amount of time. And given that he's shown so much weakness, he's probably guessing that we're probably bluffing.

But anyway, if he calls 25% of the time, does that make that a good bet or not? Yes, because that means he folds 75% of the time, which is more than our 40%. So that makes that a good bet. And just to plug into the EV formula, what is our value from this bluff if our estimate is right here that he calls 25% of the time? It's \$200, so the pot is what? I think the pot is \$400 here. So that makes sense to me that 75% of the time we're going to take down that pot, so it's worth about \$200 to us. So that's it.

Let's do another example. OK, so what's going on? Something happened on the flop, and then what are we doing here?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Exactly. So we're betting \$450 into a pot of \$775. So the question is, is this a good

bet? Should we have done this? And we're going to be facing these decisions all throughout the tournament.

So this one is going to be kind of complicated, but not really. Let's see what we can piece together for now. So what's our chance of winning this one at showdown? So we have 16% chance of winning.

AUDIENCE: [INAUDIBLE].

PROFESSOR: It's hard to-- I prefer not counting-- you can proportion partial outs to whatever you think your real chance of winning if you hit that is-- say, that's worth 1/3 of an out. But in terms of being conservative and making this simple, we could just say, let's say we have to hit the straight to win, although you can consider yourself having a little bit more equity if you just say maybe I'll win if I hit a 10 or something.

So we're betting for \$450 into this pot of \$775. So we know we have a 16% chance of winning this hand if we are called. If we have no percent chance of winning the hand if we are called, what proportion of the time do we need him to fold to make this good? \$450 divided by \$1225. That \$1225 is going to be \$450 plus \$775. Is that right? What was the bet? Yeah, \$450 plus \$775 \$1225.

I think this is-- \$11-- \$1225. I think that's right. \$1225? OK, so we have a 37% chance of-- that's our break even if we have no chance of winning, but then we get a bonus for the 16% chance of us winning, and then a general estimate is going to be 1.5 times, because we're making approximately a pot size bet. We're making it a little bit smaller so maybe this is over doing it by a little bit, but this is at least giving us an OK estimate. This might be a little low. It might be like 18%, but we can't differentiate between a margin that small.

So the 60% chance is related to our chance of winning. We get a bonus that's proportional to that. I'm saying 1.5, which seem to be about in the ballpark, to give me 13% chance break even for that fold rate. So even if he calls 80% of the time, it makes it a good bet, and 80% is a huge amount considering-- I don't remember the situation. He could potentially have nothing here. He definitely showed some sort of

weakness, so it's totally reasonable that he won't call more than 80% of the time there. So we calculate our equity just based on the formula earlier, which is our chance of taking the pot down uncontested, 20%. And then our 80% chance of winning 60% of the time and losing 84% of the time, where we're winning the pot plus his bet, and we're losing our bet.

OK, so let's jump to another live example.

[VIDEO PLAYBACK]

Junior world champion bowling and horseshoes for [INAUDIBLE], Foosball, and maybe poker.

Sorry, what's your name?

Mark. [INAUDIBLE].

Mark already plays this final table [INAUDIBLE].

I've heard-- sorry. I have no idea.

Listen, Billy is a world champion in another sport.

PROFESSOR: That guy is pretty cool, too.

What sport? [INAUDIBLE] Foosball.

Yeah?

Yeah.

Well, that's pretty awesome, as well, huh?

Yeah, that is awesome.

PROFESSOR: This is considered very high quality banter by poker standards.

[INAUDIBLE]

Secret is out.

Absolutely.

Jacobson, pocket sevens. \$650. Confirming with [INAUDIBLE]. Yeah, that's \$650, and that's a raise. Politano, 10 trey suited. [INAUDIBLE] to Pappas now with ace, queen.

I wonder if there are different surfaces of Foosball, like the French open of Foosball, the Wimbledon of Foosball. And is there an ace, queen in foosball?

Yeah, right.

PROFESSOR: The worst joke ever.

Several brands of championship tables. Billy's a tornado guy, by the way.

Tornado.

Billy, with ace, queen re-raised to \$1 million \$425,000.

The main event is a grind, but Billy Pappas says he doesn't get tired here because he's used to Foosball tournaments, which are 14 hours a day on your feet for several days.

[? And ?] [INAUDIBLE] folds. The ace of hearts is exposed. Back to Jacobson.

Jacobson trying to become the first Swede to make the main event final tables since Chris Bjorin in 1997. Bjorin tied for sixth all time in the World Series caches. Bjorin and Jacobson both born in Sweden. Both moved to London.

Jacobson made the call. We're heads up. King, jack, trey. Jacobson ahead so in the sevens. Pappas picks up a Broadway draw. Jacobson checks.

[END PLAYBACK]

PROFESSOR: So Let's take a look at what actually happened before we got to where we paused. So this guy's in position. He's in the cut off position. Jacobson raises. He re-pops

with ace, queen in position. Newhouse throws out an ace for some reason. So Jacobson checks, and then he's going to make the standard bet.

So the question is, is this a good bet? And then something we can definitely figure out is what percentage of the time does this have to be a fold to make this a good bet. If showdown win percentage is 0, it's going to be \$1800 divided by the pot plus \$1800, his bet-- 33%. But if he actually has a chance of winning-- he has an inside straight draw. He has a 10, and then he has the best possible straight. He gets up 8% of the time, reducing his break even fold percentage by approximately 8%. So it's 8 times 1.5, 12. So this minus 12 is at 21%.

And then this is solving it out exactly. I gave them half outs for an ace. Maybe ace wins 1/2 the time. It turns out that 21% is basically dead on. So let's see what happened.

[VIDEO PLAYBACK]

King, jack, trey. Jacobson ahead so with the sevens. Pappas picks up a Broadway draw. Jacobson checks.

Of course Bruno Politano trying to become the first Brazilian to make main event final table.

[INAUDIBLE]

What happened to the Canadians? Our record ten [INAUDIBLE] since 2013.

Non grata Canadian.

I think they got too cocky.

And now Pappas comes out with a draw for \$1.8.

Pappas was rather aggressive earlier in the main event, again showing his aggressive side right now.

Martin folds. Pappas will drag the pot. Now he's sits just shy of \$20 million. A world

champ in two different games? It just could very well be. Billy Pappas makes good use of that scary boarded take down the pot.

[END PLAYBACK]

PROFESSOR: OK, so that's a very common type of bet, which we'll talk about later. That's called a continuation bet. So he showed aggression pre-flop. It's checked him on the flop. It's almost always going to be the right move to bet again on the flop, because you're already indicating that you have a good hand, and then two face cards show up. It's reasonably likely that you're going to have at least top pair there, so it's uncommon for the other guy to try to push up against you since presumably you have at least a pair of kings or jacks most of the time.

Let's do some be careful abouts. This is a lot of stuff I notice from the more recent tournaments. So don't bet too little on a bluff. That makes it very obvious, and then it's usually pretty clear-- if you bet 1/3 of the pot, which is something that's generally not common for normal players, it kind of screams that you're not too attached to the hand. And a 2/3 of the pot bet only really needs to win a small percentage of time to be profitable. I get the no one likes to lose money on a bluff, but 1/3 bet works much less of the time than a 2/3, and you actually get much less value out of it.

So bet enough. Bet like you had a normal hand. Bet enough that, if someone is drawing to something, they don't have the odds to make that call. Alternatively, don't bet too much on the bluff, and I'm making pretty wide ranges here so don't think that I'm contradicting myself here. One of the biggest tells for a bluff is someone betting more than the pot, just because it means they didn't actually think through the numbers, and they're just like I want to bet a lot so that makes the other guy fold. But in general, don't bet too much, and by too much I mean more than the pot.

And in addition, if you're short stacked, don't bluff an amount that, if he raised, you'd have to call anyway. In which case, you should just bet all in there. So don't be afraid of getting caught bluffing. So this is a reason people don't bluff live. It's because they're afraid of showing down nothing. Don't worry about that. One of the

best indications to me of someone being a good player is they'll and show down a bad hand and just be like, yep. That's how you play poker, and that'll be the end of it. So don't worry about-- what you have when you bluff is completely immaterial. So just having a losing hand that's really bad is no different than having a marginal losing hand.

So don't be afraid of being bluffing, especially live. People get embarrassed when they get caught bluffing. Don't worry about it.

So semi-bluffing is great compared to bluffing because you have a chance of winning the hand, but if you're in position, sometimes it's better just to take a free card. If he shows weakness and checks into you when you have an open ended straight drawn, in some cases it's just going to be right to check and get your free card. You have to compare your EV of checking to your EV of bluffing.

And don't bluff calling stations because a lot of your value from these guys will come from value betting. The only way you'll possibly lose to them is if you try to bluff them. You might be in a situation where you're ready to run over calling stations, but you don't have good cards and bluffing is not the way to go. So don't do that. Let's wrap it up there. Thanks everyone.

[APPLAUSE]