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## SHORT STACK REVOLUTION



What is shortstacking? By now I assume that most people are aware that it is buying in for the table minimum in order to get an advantage on the bigger stacks lined up around the table, yet relatively few people outside of the online arena really understand how this happens. I think the best way to get started on this subject is to offer a brief history of both how and why shortstacking developed in order to prime you for a new perspective on how poker can be played and strengthen your fundamentals in ways that will be beneficial for any stack size you prefer to play.

People first took notice of the concept on a slow news day back in 2005 when Bluff Magazine printed the headline The Jim Rose Circus: And How to Win \$28.64 an Hour at Poker. Taken from his aptly titled book, Snake Oil, Jim described an uber-basic strategy for no limit that can be summed up in five words: shove with QQ+ and AK. According to Jim, "this is the only move that a pro would make if he was on a short stack." Perhaps the pro who said this was his friend Chris Ferguson, who allegedly tried this and turned \$1 into $\$ 20,000$ in six months.

If you were hoping it would be this easy, load up some Facebook poker and mash away. If you want to learn how to make money that spends, take the red pill and read on.

Soon after, Ed Miller published a legitimate alternative in Getting Started in Hold'Em. It was a fundamental TAG style with standard open raises while answering opponent raises with a shove or fold response. While light on postflop details, Miller's strategy was a viable way to make money during the Poker Boom, as there were still masses of recreational players and wannabe pros with a malfunctioning fold button. Although almost certainly profitable in many soft live games, it was predictable and easily exploited with a bit of discipline, allowing patient players to dodge the big bets whilst whittling down the practitioners' stack.

Miller's rationale was that a short stack could exploit a flaw in the game that was granted by all-in protection. This is advantageous because theoretically, players may continue to fight over the pot and push each other out before showdown, allowing you a free shot to triple up or better with a hand like 99 that might be difficult to navigate in a multi-way pot.

In 2008, academically minded players hijacked the strategy from the nits and gave birth to the modern form of shortstacking. Focusing on a much more prevalent flaw in how the game is played, these players took the exact opposite approach. Rather than jamming with the highest equity hands on average, they were actively willing to take the worst of it. Developed with the mathematics of preflop
fold equity that was previously being used in tournaments and SNG's, they began shoving over raises constantly. In tourneys, chipping up by a few BB with marginal shoves was only a means to an end. Under the new paradigm of shortstacking, it was the end. A modern shortstacker wasn't seeking to double up; increasing his stack to just 27BB was a signal to leave and join a new table, as the edge granted by the short stack would diminish with every blind won. With a short rathole timer, he would be back in 30 minutes for another hit-and-run.

This wasn't happening just by some unintended consequences of the rules. In contrast to the previous tendency of players calling too wide, they were now calling too tightly! Pot-sized raises and larger made big stacked players vulnerable to shoves whose goal was to profit from frequent folds, rather than just straight value. The larger the player would open, the more profitable a marginal shove would become, as it needed to succeed less often to be +EV . The new-school shortstacker was no longer interested in looking to double or triple up; he was looking to score just a few BB per table. Rather than having to dodge the obvious big pair or ace as in days past, the old guard faced a never-ending flurry of paper cuts by a wide range of not only premiums, but also small pairs, broadways, junky suited connectors, and sometimes even any two rags. They could adjust by calling more, but the short stacked bandits would adjust as well by padding more value into their ranges. Six years later, even many great players either don't know how or don't care enough to adjust properly and stray too far from the equilibrium in either direction.

Modern shortstacking wasn't just made possible by exploiting the math of the game. They were implementing highly accurate opponent game play statistics provided by legal poker trackers that came equipped with heads up displays (HUDs). These statistics would appear as percentages that would update in real time, allowing a shortstacker to cross reference them with custom made charts showing which hands to shove. This information was combined with powerful new equity simulators that allowed for EV to be calculated to the penny. For example, a shorty could see that a player was stealing from the button $40 \%$ of the time. In a \$5/10 game with a $5 \%$ rake, if the raiser made it 3 BB and responded to a shove by calling only $23 \%$ of the time with 55+ and AT+, a shorty on the BB would know that even jamming 720 would profit $\$ 1.76$ over and above the BB he posted. If the raiser just mashed the pot button and called with the same range, that extra half big blind was now costing him an additional $\$ 3.81$ !

The truth is winning poker players end up with a high quality problem: lots of cash on hand. This can cause a security concern. Just google:

- "Poker money cab"
- "Poker game robbed"
- "TSA confinscated cash"
- "Poker player's home robbed"

This kind of thing can happen even to winning low-stakes players. I have had a friend that got robbed and stabbed at his own \$2-\$5 home game. In another situation, I have had a friend win some money at a 10 K tourney and make the newspapers. The cabbie knew his name from the reservation and acted very suspiciously-stopping in a bad part of town for no reason. This was very frightening. I feel very comfortable walking inside a casino with any amount of money, but what about the parking lot. What about after the guy in seat three made threatening remarks as I left?

There are some simple things that can be done to minimize your exposure to these threats.

## Carrying cash:

Even if you get the money from an ATM at your destination, you will still end up carrying cash at some point. I have three main methods of carrying cash. My satchel poker bag (always carried across my body) never leaves my person and the session bankroll is in a nice wallet on a chain connected to the bag. I will not accidentally leave it at the cage, and it would not be easy to steal.

What about stealthier techniques?
Thunderwear is a kind of money belt that is slung low across the hips and fits right over the groin under your pants. I was carrying 10 K to the World Series in Vegas. I was chosen for a "Freedom Patdown" by TSA. There is nothing illegal about carrying large amounts of money inside the US, but I would rather not be questioned about the money by anyone. The TSA agent patted me down and found my ankle wallet. He snidely said, "You can't get anything past us" as he put the hidden wallet through the $x$-ray machine. I smiled sheepishly and agreed. He was completely oblivious to the larger amount of cash that he missed in his patdown. Your average mugger would never notice this. You will never accidentally leave the cash in a cab this way either.

An ankle wallet velcros around your ankle and is covered by your pant leg. This is another easy way of carrying cash in an unexpected place that is unlikely to be found under most scenarios. There are many vendors and styles, I do not have a particular recommendation.

I have an old wallet stuffed with expired credit cards, and a decent amount of singles so it looks full. If I am getting mugged, this wallet is the one I would let them steal. It is also useful for storing all those player loyalty cards.

## Storing cash:

Now when you are out and about, you have a way to carry the cash stealthily. What about back in the hotel room or your home? Do you trust the safes in the hotel rooms? I do not. Google "hotel safe default code" to see why. All you are doing is putting your valuables into one easy to find place.

I think everyone should have a home safe. You can buy decent ones at your local home improvement store for about $\$ 160$. These are fire resistant and water resistant. You should never put them on an upstairs floor because they pose a falling hazard in a fire. They can be bolted or cemented down in a basement very easily. If you can not bolt them down, then make them heavy. An easy way to do this is go to the bank and buy boxes of pennies or nickles. Load up the safe with this cheap, heavy metal and it will make your safe very difficult to move.

A friend of mine had a small home lock box, but it was not bolted down and it was not heavy. His home was broken into; his large safe was untouched, but the small lock box was simply carried away to be opened at leisure later.

Safes are meant to be heavy so moving them is not an option. When traveling, this is not practical. There are travel safes that can be cable locked to some immobile item. Since they are cabled down, it would at least require tools to remove. This will keep the casual thieves at bay.

Maybe you carry your laptop and are afraid someone will access it an install trojans so they can see your hole cards. It has happened before at large poker events. Google "poker laptop stolen hotel". You might find a big enough safe and small enough laptop so this is not an issue. If you have a larger laptop, an alternative is to just lock up the battery and power cord.

## Safety:

I get threatened with, "be safe in the parking lot" at least once every couple of months. If I don't, I figure I am not playing aggressively enough. You see fights in poker rooms every now and then. The innocent victims of these fights are often trying to avoid the confrontation but can not. I once had to give evidence to the state police after some poor guy was bum rushed at the table for no good reason by an aggressive drunk. These things can and do happen.

Did you make a big score in a tournament and just want to safely get to your car? Casino security will always be willing to walk you out to the parking lot. This should not be overlooked as an option. If going alone, situational awareness is very important for avoiding trouble before it happens.

If all else fails, pepper spray is a great tool and equalizer. I recommend Cold Steel brand, it comes out as a gel, much like silly string. As an example of it in use, my pit bull unexpectedly went aggressive on an unleahsed dog. I was able to use the pepper spray to stop my dog, without harming the bystanders or other dog. If this stuff can stop 55 pounds of angry pit bull in a few seconds, I am convinced of its efficacy. Please check local and state laws about legally purchasing, possessing, using, and traveling with pepper spray.

## Doug Hull


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## Verbal Poker Tells: Preview of Elwood's new book next issue.

Freeroll: Poker Strategy You Can Use • Page 2
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How many cards do you need to play a challenging game of poker? 52? 30? Actually, just three will do. Let's take an Ace, a King and a Queen from a standard deck and call our two players John and Tom. We'll make them both put $\$ 1$ into the pot, deal a card to each of them and tell John he has to check. Tom can then check if he wants to, and their two cards will be shown down. An Ace beats a King beats a Queen for the $\$ 2$ in the pot. Alternatively, Tom can bet $\$ 1$, after which John can either fold, and let Tom have the $\$ 2$ pot, or call the $\$ 1$, and go to showdown. If you've not seen this game before, please think about what your strategy should be before you read on.

If Tom has the Ace he will bet, and if John has the Ace he will call a bet. The Ace is the nuts.

If John has the Queen, he will fold to a bet. He doesn't beat anything.

Now we're left with the more interesting decisions. First of all, what should Tom do with the King? If he bets, John will call with the Ace and fold the Queen. Tom can't make John either fold a better hand or call with a worse hand, so he should check and show down his King. He may think he has the best hand, but betting is not the best play. This seems fairly straightforward, but it's a concept that is poorly understood by many players. Real poker games are far more complex than three card poker, and it's much harder to tell when you have the equivalent of a King - a hand with showdown value. The temptation to bet is often too strong, and if your opponent folds, well, you won the pot. The result gives you no feedback on your poor decision.

All that's left to discuss is how Tom should play the Queen and what John should do with the King
if Tom bets. If Tom has the Queen, he knows that he has the nut low. Should he bluff and try to get John to fold if he has the King? He'll never make him fold the Ace. If John has the King and Tom bets, John knows he only beats a bluff, so should he call? If John calls whenever he has the King, Tom can exploit him by never bluffing with the Queen. If John folds whenever he has the King, Tom can exploit him by bluffing whenever he has the Queen.

If you show this problem to an expert in Game Theory, he'll tell you that the solution of the game, by which he would mean a pair of strategies from which neither player can deviate without losing money, is for Tom to bluff one third of the time that he has the Queen and for John to call one third of the time that he has the King (I'll spare you the math). By using this strategy, Tom wins on average, and John therefore loses on average, about five and a half cents per hand. Tom has position on John, and can show down his Kings. John can't realize the showdown value of his Kings and therefore loses in the long run.

That's what a Game Theorist would say, but in reality, if this game is played repeatedly between two real people, things become more complex. John may deviate from this equilibrium strategy, perhaps bluffing with less than one third of his Queens in an attempt to lure John into folding more than one third of his Kings. If he can get John to fold too often, he can start to bluff more often.....until John starts to notice that Tom is bluffing too much, when he may call more often...and then Tom may start bluffing less often....and so on. A complex, dynamic interaction between the players can lead them to play ever-changing strategies in an attempt to exploit each other. This also assumes that both
players are purely rational. What if John correctly calls with one third of his Kings, but Tom has a great run of cards and repeatedly shows down the Ace? Maybe John will start calling more often because he feels that Tom 'can't always have it', or start folding more often because Tom'is such a luckbox'. Real people can be irrational and stubborn, even before they start to tilt.

Many of the elements of the poker games that you play are present in this simple three card game - even some of the psychological elements. If you add in all the complexities of a game like No Limit Hold'Em - for example, variable bet sizing, check-raising, four streets of betting and a board that changes on every street- you can start to see how complex a game poker is. However, if you can understand the Ace-King-Queen Game, you'll have taken the first step on the road to understanding the theory of poker.

## John Billingham

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# I Autographed books from Freeroll authors 

When I first started learning poker, I spent a lot of time reading and posting in online forums. I remember one day seeing a single-sentence response to a post.
"Deception runs the industry."
I knew I didn't understand the significance of the statement - if it had any - but I always kept that phrase in the back of my mind. The more I learned about the game, the more I was impressed with how effectively poker preys on the weaknesses of human reasoning.

The luck in the game is the catalyst for the deception in the game.

Different games have various mixes of luck and skill. How many matches of chess would you win against a grand master? I don't know about you, but I could play a million games of chess against a grand master and never win one. I could even play him when he's stone-drunk and I'm sharp as a tack, and I'd probably still get crushed. I'd never dream of playing him for money. If he asked me to play him for $\$ 2 k$, l'd be better off just lighting my money on fire and doing something else with my time.

If for some reason I accepted that challenge, I'd have to be deceived somehow into thinking this is a good idea for me.

Now, we've all seen the guy at the poker table who's playing every hand and telling everyone how he's God's gift to the game. How can a person who plays every hand really think he understands the game and is better than most of his opponents? Well, he's played at the casino five times and has come away with more money four out of those five visits. It's obvious, isn't it? He's a naturally talented poker player; he's never even read a book about poker.

When an unskilled player wins occasional pots, those wins allow him to think he's good at the game. These sporadic, positive results offer him an opportunity to confirm his suspicions of natural talent.

That confirmation will often create conclusions stronger than anything else he may experience. A host of experts could give him their negative opinions about his abilities, but such criticism won't faze him. He could go on to lose large amounts of money, but his conclusions will remain unchanged.

This delusion funds the poker world. Other's self-deception is the most valuable commodity in a professional poker player's world. Without it, you would be hard-pressed to find a lesser-skilled player dumb enough to play against you. Good table selection would not be possible. Winning money would be out of the question.

When an unskilled player takes a few pots from you, realize you're funding the ruse. And that is one of the best investments you can make in the game; a healthy part of poker. Embrace those bad beats and encourage your opponents to continue. Other's self-deception is the most valuable commodity in a professional poker player's world.

I often see players berating bad opponents, which is just a terrible idea. You want them to be happy and stick around. What is it you hope to accomplish with your scolding? Do you want them to leave and have better players sit in their seats?

If you're looking for a curt word to express your frustration, mum's the word.

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## Short stack: continued from page 1

Shorties also had statistics to sniff out guys who had little regard for their blinds, as most had strict guidelines of hands they considered playable, thus consistently giving up without a fight. Such tendencies gave rise to the concept of stealing 100\% on the button or small blind. Since many players would bail after missing the flop, shortstackers could profit automatically with just a half pot bet, hit or miss. It was eventually taken a step further when the shorties began noticed that a 2 BB raise had nearly the same success rate as larger ones and began exploiting the more cost efficient raise size heavily.

Since there had previously been no incentive for pros to calculate EV in mere fractions of a big blind, some shortstackers with good technique but only modest poker talent were able to compete at the highest limits, with the top players making incomes in excess of $\$ 1$ million per year skimming the likes of David Benyamine, Gus Hansen, and even Phil lvey for thousands of dollars per session. Rumor even has it that Phil Ivey himself used his pull at Full Tilt to raise the buy in in the legendary Rail Heaven games to shut down the practice.

The pool of pros eventually wizened up and began reducing the size of their opening raises while increasing the frequency of their steals to combat a perceived weakness in the shorty's ability to play postflop (which was true to some degree). This was an effective way to slow the bleeding, but the outrage caused by this seemingly unexploitable strategy of merciless steals and shoves to accumulate tiny edges had already ignited massive controversy everywhere. The residual effects from this time period have led to permanent changes in how the game is played. If you have been playing online for many years and noticed that a 4BB open raise has gone the way of the flip phone, then you have witnessed ripple effects that can be attributed directly to the science of modern short stacking!

Despite little public information available for this zealously guarded strategy, eventually some spilled through the cracks and a new internet gold rush began as players jumped on the shortstacking bandwagon and descended like a hoard of locusts upon the online poker world. The most notable offenders were the Russians, who, shielded from outsiders via their language barrier, freely swapped information on Pokerstrategy.ru, eventually clogging every low to high stakes table and waitlist as if Golden Corral started offering free bingo on seniors' night. Not only were the pros ill equipped to combat the new play styles, they were being constantly blocked from the easy money, as attempts to isolate the weak players would trigger a shove from a shorty that a hand like T9s couldn't possibly call. If the shortstacker left, a new one would just sprout up in his place as surely as cutting off one head of the Hydra would spawn two more. In hindsight, I believe that this proliferation of short stack knowledge was the final bell toll of the Poker Boom when science finally triumphed over what was long considered to be predominantly an art.

All across the poker forums, irate players were pleading for the sites to raise the minimum buy in and lengthen the rathole timer. Enjoying the massive rake generated by the multitude of small pots and fearful of the unknown side effects of tampering with the poker eco-system, the sites dragged their feet on making any changes until April of 2010, when Cake Poker became the first network
to raise the buy in to 30BB. Not wanting to have the shortstacker rake walk across the street, Cake Poker added small stakes "shallow tables" where all players bought in for 20BB, but didn't have a large enough player pool to support these games. Other sites tried this as well, but only Full Tilt had the volume to fill these types of games, which still run in
(continued on page 8)


## Excerpt of Expert Heads up No Limit Hold'em, Volume 1

We can organize all of the possible decisions in a HUNL hand into a decision tree made up of decision points linked together by player actions. Each point in the tree, except for the leaves, which represent the end of a hand, represents a particular state of the game and is a spot where a player (or Nature) has to make a decision. The game will move into one of several new states depending on the choice. We saw that the full decision tree representing HUNL at any appreciable stack size is too large to handle. However, there is a lot to learn from approximate games. For example, a tree representing a river situation where there is just one bet left in the remaining stacks is shown in the figure.

A player's strategy specifies how he will make any decision he can face in a game. In practice, a strategy must specify the range of hands with which the player takes each action at each of his decision points. We can visualize this as follows. Both players start the hand with a range consisting of $100 \%$ of each of the 1,326 distinct hold 'em hands. At each of his decision points, a player partitions or splits his range into several portions, one for each of his strategic options. In this way, a player's range tends to get smaller and more clearly defined as the players get deeper and deeper into a hand.


Figure: Decision tree representing river play with one bet left behind.
The expected value or EV of a holding for a player at a particular decision point is his total stack size at the end of the hand, averaged over all the ways the hand can play out from that point onward. Our convention for EV is different than that of some other authors. We work in terms of total stack sizes, as opposed to changes in stack sizes. The basic approach to decision-making at any point is to consider the EV of each of our available options and then go with the largest. A best response or maximally exploitative strategy is one that maximizes a player's EV in this way with every hand in every spot. Given a game described
by a decision tree and Villain's strategy for playing that game, we saw how to compute Hero's best response in Chapter 2.

When both players are employing maximally exploitative strategies simultaneously, we have a Nash equilibrium. When two players adopt their equilibrium strategies in HUNL, neither has any incentive to deviate. They cannot improve their expectations by doing so since they are already playing maximally exploitatively. An equilibrium strategy is also known as unexploitable since it is the best a player can do against an opponent who is aware of his strategy and capable of quickly adjusting to it. When two sufficiently smart players face each other, they can do no better than to play their equilibrium strategies. Thus, when we find a game's equilibrium, we say we have solved it. In this book, we use the terms GTO, unexploitable, and equilibrium as synonyms to refer to such strategies.

A solution for the full game of HUNL is not known, but the result of an attempt to get close is called pseudo-optimal or near-optimal play. We have seen that pseudo-optimal play is appropriate not only against mind-reading super-geniuses, but also against more run-of-the-mill opponents whose strategies are simply unknown to us. When facing a new opponent, many different exploitative strategies could be best depending on his tendencies. When these tendencies are unknown, however, any deviation from GTO play on our part is just about as likely to hurt as to help us. Without knowledge of a player's weaknesses, we cannot expect any particular deviation from equilibrium to increase our EV. Although it is not entirely rigorous, we can think of unexploitable play as our best response given complete uncertainty about our opponent.

Furthermore, understanding unexploitable play can help us recognize exploitable tendencies in our opponents and understand how to adjust our own ranges to take advantage. For example, one of the simplest river situations we looked at in Volume 1: the PvBC game. One player's range is made up of the nuts and air, and his opponent holds only hands that beat the air but lose to the nuts. We saw that under many conditions, the equilibrium strategies here are for the first player to bet all-in with all of his nut hands and enough bluffs so that his opponent's EV if he calls is the same as if he folds. Similarly, the second player's GTO play is to call enough to keep the first indifferent to bluffing.

What about exploitative play? If the polar player bluffs a bit too much, his opponent should always call, but if he bluffs even slightly too little, the bluffcatcher should always fold. On the other hand, if the bluff-catcher calls too much, his opponent should never bluff, and vice versa. Of course, "too much" and "too little" are defined in terms of the unexploitable strategies. So, our understanding of GTO play makes it very easy to understand and describe all of the opportunities for exploitative play in this situation. Despite the fact that HUNL's true equilibrium is likely too large to memorize and
too complicated to fully understand (and not even the best approach versus most opponents), the players with the best knowledge of game-theoretic play are also some of the best exploitative players because of their understanding of the game. With this in mind, we have focused on learning about equilibrium strategies to develop intuition and understanding of the structure of HUNL play. In this volume, we will continue our careful consideration of a variety of spots and how we might want to split our ranges when we encounter them.

Although we will describe refinements later, our general approach to match play begins by playing pseudo-optimally. From this defensive posture, Hero can observe his opponent's tendencies and determine appropriate adjustments. Of course, it is rare that a new opponent is a complete unknown. In practice, we may do well to make some pregame adjustments based on our knowledge of population tendencies - the tendencies of an average individual in our player pool. However, this caveat does not give us a free pass to just make "standard" plays without good reason. Any deviation from equilibrium play should be justified by reference to a particular exploitable tendency, whether of the population on average or of a particular opponent.

Although this is a book on heads up play, it's worth noting that many of the properties that make Nash equilibria so useful do not hold in games with three or more players. In particular, if we play an equilibrium strategy in HUNL, we are guaranteed to at least break even (neglecting rake) on average over both positions. That is not the case in 3-ormore player games, where playing an equilibrium strategy provides no lower bound on our expected winnings. Thus, the Nash equilibrium is much less useful outside of heads up play, and anyone selling the idea of "GTO" strategies for 3-or-more player games should be viewed with suspicion.

## Will Tipton


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Short stack: continued from page 5
2014. Almost all other sites soon followed suit and a buy in of 30,35 , or 40 BB became standard.

As the industry's largest player, PokerStars had the luxury of observing these changes before acting themselves. Nearly a year after war was declared on shortstackers, they created the most profitable solution of all: 20BB CAP tables. In 20BB CAP, everyone buys in for 20BB and can only bet 20BB before being all in. This levelled the playing field, with no single player gaining an inherent advantage and eventually led to unconceived layers of complexity being introduced to the art, with the Russians residing as the dominant force. I've played over 3 million hands in this cutthroat environment and the challenges of finding edges in what is often a two or three street game has honed my abilities beyond what I ever thought was possible.

With its heavy reliance on tools only available for online play, there's no need to fear Russian shortstackers parachuting down into your casino like a new Red Dawn sequel. Clearly, no such software exists for live play, but years of experience have allowed me to build up a large reservoir of experience from which to create a hybrid strategy, bridging the gap between the classic Ed Miller strategy and the highly exploitive tactics of today in a way that will allow you to do much better than just scoring a few big blinds before heading off to the deli for an hour.

In upcoming issues of Freeroll, I will reveal theoretical concepts that you can use in your regular game that won't require any new math and will allow you to play higher stakes and reach more final tables. Make sure to check back in next month for your first lesson!

## Lorin Yelle


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It's hard to spend time around poker players without listening to a bad beat story. It's hard to play poker without coming up with some of your own.
"So there I was, sitting around all night, waiting for a good hand. I had been cold all night until I look down and see two queens. My salvation, right? Well...the flop comes out queen-eight-four and this guy check/raises me. We get the money in, and guess what he's got? Queen-eight! Great spot, right? Well, of course the turn and river are the two last eights in the deck, and I lose to quads. Do you know what the odds are of that happening?"

Yes! We do know the odds of that happening. It's 989-to-1 against. We know this because we learned about odds in Part 4: Know The Odds. On the flop, there are 45 unknown cards. (That's 52 minus the 3 cards on the flop, the 2 cards in our hand, and the 2 cards in our opponent's hand.) The turn will be an eight 2 out of 45 times. On the river, there are only 44 cards left in the deck because we've already seen the turn card (which we'll assume was an eight). There is only one eight left in the deck now, so the river will be an eight 1 time in 44 . Multiply 45 by 44 and you get 1980. Since there are 2 ways for this to happen out of 1980 possible sequences of board run outs, we divide 1980 by 2 and get 990 . So it will happen once in 990 tries.

Stated differently, the odds are 989-to-1 against this worst-possible beat occurring. Top set of queens will hold up 989 times for every 1 time the queen-eight makes runner runner quads. So what's the moral of this story? Our hero got impossibly unlucky? No.

Our hero did get exceptionally unlucky, but not impossibly so. This is as unlucky as you can get in a hand of Texas Holdem. The opponent needs two precise cards on the turn and river and gets both of them. But the takeaway here is that if you play this scenario out enough times, our hero will lose about one out of every thousand trials. That 1 in 990 means that this will eventually happen to you if you play enough poker. A $0.1 \%$ chance of something happening (1-in-1000) is extremely small if it has only one chance to happen. But $0.1 \%$ of $1,000,000$ trials is 1,000 events. That's rather a lot.

Most bad beats are not this bad, because this is the worst one possible. Most bad beats are something like, "I flopped a set and the flush got there." How often will a flush draw beat a set? About 1 time in every 4 trials. So if you get it all in a few times with a set against a flush draw, you're likely to lose one of those
pots. That's the way poker is built. It's a drawing game.

So what should I do?
Embrace variance. Don't just accept it. Embrace it. Variance is the only reason you can make money as a poker player. Without variance, almost no one would play poker, and even fewer would play it for money.

If you are a weak poker player who gets your money in bad (i.e. you make bad bets against the odds), then without variance you would never win a big pot. That's no fun. And people play poker for fun.

If you're a decent-to-good player who is trying to play with weaker players, then you won't get much action. The weaker players will quickly discover that they cannot beat you and they will quit playing.

Lots of people love going to the casino and making negative EV bets. If they make these bets over and over and over again, they'll eventually lose money. Guaranteed. But if they just play for a few hours, there's a decent chance they'll go home a winner. Even if they lose on the trip, they'll win some of their bets and have some fun.

Imagine a casino that pays out the exact odds instead of spinning the roulette wheel. You bet $\$ 100$ on black? Great. Here's $\$ 94.74$ of it back. You want to let it ride? Now you've got $\$ 89.75$. You've just lost $\$ 10.25$ with no chance of winning. Does that sound fun to you? Probably not. The element of chance makes the game fun for some people. That's what gambling is.

In addition to adding excitement and unpredictability to the game of poker, chance also obfuscates the relative skill levels of the players. In a game of chess, a great player will quickly demonstrate their superiority to a weak player. But in poker, this can take much longer. It takes thousands of hands before the results show which player is stronger. A skilled player may be able to tell the difference simply by watching one hand, but an unskilled player may have no clue.

But sometimes I lose four sets in a row!
Yep. That's gonna happen. It's good for the game in the long run, but it sucks for you in the short run. If you're supposed to lose 1 out of 4 tries, that doesn't mean that you will lose exactly 1 out of every 4 tries. It means that out of the total number of times you ever have a set against a flush draw, you should expect to win about three-quarters of those.

If your opponent has a 1 -in-4 chance of winning that first hand and a 1-in-4 chance of winning the second, then there's a 1 -in-16 chance
that he'll win both times. There's also a 9-in-16 chance he'll win neither time. So you'll escape unscathed over half the time.

If we look at the chances that you'll lose all four of those sets in a row, it's 255 -to- 1 against. Those are long odds. It's probably not going to happen this time. But if you play poker long enough, you'll see it happen. You'll see a lot of crazy things happen. Some of them will be excruciating. Some will be pretty awesome.

But I still hate bad beats.
Yeah. I'm with you on that. They're no fun. But without them, there would be no poker. So find a way to deal with them. Stay on your game. Do not deviate to avoid discomfort. In the long run, strong play against weaker players will get the money. So go get the money.

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