Episode 28: From Novice to Expert in One Easy Step

Show Notes

What happens, cognitively speaking, as we move from novice to expert in a game? The episode examines changes in memory and strategy as people gain experience not only games, but in other mental and physical activities as well.

Game References
Chess, Incan Gold

Research References

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Chi, M. T., Feltovich, P. J., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive science*, *5*(2), 121-152.

Ericcson, K. A., Chase, W. G., & Faloon, S. (1980). Acquisition of a memory skill. *Science*, *208*(4448), 1181-1182.

Gladwell, M. (2008). *Outliers: The Story of Success*. New York: Little, Brown and Company.

Transcript
Hello! This is Episode 28 of the Cognitive Gamer podcast. I am your host, Dr. Stephen Blessing, cognitive psychogist. I use games to both explain and explore concepts in psychology. In this episode, we will be talking about the interesting topic of expertise. How does one get from just learning the game to becoming a true master at it? And, what are some things that happen along the way, in terms of how you think about and process the information within the game?

This is a topic that gets at a core issue within not only psychology as a broad field, but also tackles an issue that a lot of disciplines think about and do research in. This issue is nature versus nurture; genes v. experience. How much of who we are is due to the genetic endowment we inherited from our parents, versus how much of it is due to the experiences that we have had across our lifetime. And of course, there’s the interaction of the two; perhaps some of our expertise only came about not only because we had the right experiences at the right time, but also because our genetic makeup allowed us to learn from that experience. This is as much a physiological, neurological, and even philosophical issue as it is a psychological one, and we will touch on all aspects as we move through our discussion.

Think about the games you feel like you are really good at. Maybe it’s first person shooter videogames or deck building card games. Where do you think your skill comes from? Do you think are good at that type of game, or perhaps a specific game, because you had natural ability at playing the game, or more because you have put in countless hours playing it? Most people will say it's a mix of both nature and nurture, and of course they would be right. When given these sorts of choices, it's usually not one or the other, but some combination of the two. What becomes interesting, then, is how much of your skill at a game is due to nature and how much of it is due to nurture.

In some areas of human ability in which nature and nurture have been examined, you can statistically figure out, to at least some degree, what percentage is due to one versus what percentage is due to the other. For example, in looking at twins, identical twins versus fraternal twins, and those raised together versus those raised apart, researchers have estimated that between 40 to 80% of intelligence is inherited, with many estimates being at the higher end of that range. So, most researchers will hold that the majority of intelligence is inherited. But, for something like game playing, I'm not aware of any studies that have tried to peg any sort of percentage.

Instead, let me tell you about a large body of research that makes the case that for a lot of physical and mental skills, like game playing, there probably is a larger effect of nurture, of the environment, than of inherent skill. In relating this, I'm not denying that different people were gifted with different abilities at birth. That is obviously the case, and those natural talents will come into play when learning a game; some people are just going to start off better than others. But, I feel that the research paints a very important role for practice in honing any such skill, such that if a person dedicates themselves to learning a skill, that is what is going to determine much of your ultimate success.

An interesting observation in this body of literature is what is referred to as the 10-year rule or the 10,000 hour rule. This got a lot of play in Malcolm Gladwell's book *Outliers*. I've seen some critiques of this notion over the last couple of years, but I believe the general theory is solid. The basic idea is that to become a world-class expert in a field, it takes about 10 years of dedicated, deliberate practice. Or, to calculate it out, about 20 hours of practice every week over the span of those 10 years. The cool thing is, it doesn't matter the domain; violin, mathematics, ice skating, chess, swimming; from the time one starts to study the area in earnest, to breaking out on the world stage, takes about that long, 10 years. It doesn't deny that natural talent plays a role, nor does it deny that one can develop at least some measure of expertise in fewer than 10,000 hours. But, it does place primacy on the role of nurture in distinguishing yourself across a whole swath of physical and intellectual skills.

Benjamin Bloom, an educational psychologist at the University of Chicago, wrote a fascinating book called Developing Talent in Young People. It's a series of case studies looking at how people go from being a novice to being world class. He examined lots of different kinds of skills, from mathematics to swimming to violin. And, across all these disciplines, he observed essentially the 10 year rule. From the time the young person started honing their craft, to the time they gained prominence in their field, such as winning an Olympic medal or the Field prize in mathematics, took about a decade, and there were a lot of other similarities as well, in terms of what the parents and coaches and mentors did and the processes that they followed. Again, raw talent is important, but it needs to be nurtured.

Let's bring this notion to game playing. Chess experts, those that have reached the level of master and grand master, have been studied quite a bit, and they too conform to the 10,000 hour rule, to a large degree. It takes practice to be a master at chess, and when researched, those at the highest levels of the chess rankings have logged thousands of hours. Back in episode 7, I talked about chunking and a famous experiment done by William Chase and Herbert Simon on chess experts. A big finding from that study was that chess experts are only really experts in chess, at least when studying their memory. Chase and Simon showed that chess experts did not have better overall memory, they just had better memory for chess positions. Again, that indicates that becoming an expert is less about pure, raw talent than it is having the right experiences.

You have probably noticed this in the games you have played a lot. For those games, that you have played dozens or maybe hundreds of times, you can more readily remember and process the information coming in from the game. That obviously gives you a big boost in actually playing that game. But, that ability is probably pretty specific to that game, or maybe that class of games. Being able to process all the information coming in from a real time strategy game like StarCraft doesn't make you good at processing the information coming in from a first person shooter. Or, being really good at playing a deduction game like Sleuth isn't going to transfer over to a deck builder like Clank. Expertise, and the seemingly better memory that comes along with it, tends to be very compartmentalized, speaking to some degree to this notion of nurture and the importance of practice.

In another experiment done by William Chase, this time with Anders Ericcson and Steve Faloon, a person with a very average digit span at the beginning of the experiment trained his memory to be able to remember and recall a sequence of 80 digits. This person, the Steve Faloon whose name appears on that article in Science, was an undergraduate at Carnegie Mellon University, who took part in this particular experiment. Over the course of 230 hours of practice, much less than 10,000 hours but this is pretty singular skill, Steve went from only being able to recall 7 digits in order to being able to recall 79 digits. In examining how this was done, Chase and Ericcson discovered that Steve had created what they termed a retrieval structure in long term memory that essentially allowed him to bypass working memory in order to store the numbers and fix them quickly into long term memory for later retrieval. Steve was an avid runner, and this retrieval structure was based on running times. When the numbers would come in, Steve would associate those numbers with running statistics, and put them in this long term retrieval structure that he had built up over the course of this 200 plus hours of practice. Ericcson and Chase had other people go through large amounts of practice as well, and they too increased their digit span size. Again, this is emphasizing nurture over nature, at least in terms of memory. And, it works not only for numbers, but also other types of data as well. For example, long-time waiters and waitresses in restaurants have a variety of memory tricks for remembering customer orders, some of which are similar to this notion of a retrieval structure in memory that allows you to quickly transfix items from your attention into a longer term store, kind of doing an end-run around working memory constraints.

I'm sure this holds true for memory about games as well. For those of you that have played a game for a long time, you have retrieval structures in your long term memory that allows you to quickly store information for later retrieval. It would be interesting to do a study into a particular game to get a better handle on what the retrieval structures may look like. For example, I imagine Magic players can quickly scan through a deck of cards and remember most of the cards that are in there, because their memory has been honed to know about frequencies and particular types of cards that might appear in a deck.

Let’s look at other differences between novices and experts besides memory differences. One of the classic studies in novice-expert differences was done by Michy Chi, Paul Feltovich, and Robert Glaser back in 1981. In this study, they looked at novices and experts in the domain of physics. The novices were undergrad physics majors who had just taken their first course in mechanics. The experts were graduate students in physics. Chi and her colleagues had these people do various tasks. One of the tasks was to simply put into similar groups physics problems that were printed on note cards. The novices and experts were free to group them however they would like, they were just told to put them into what they considered similar groups. The physics novices grouped the problems together based on the problems’ surface features. That is, all the problems involving inclined planes went into one pile, all the problems about springs into another pile, and all the problems about pulleys into a third pile. The experts, though, grouping the same problems, didn't group by the surface features of the problems, but rather by the problem’s deep structure, how the problem would actually be solved. So, all the Newton Second Law problems would go into one pile, regardless if they were overtly about inclined planes or pulleys, and then all the conservation of momentum problems, say, would go into a second pile.

In short, then, novices were very much tied to a problem’s content or surface structure, whereas experts give much more credence to a problem’s deep structure, or how you would actually go about solving the problem. You can easily see how much more beneficial this would be. And, this basic result has been found in many other domains, not just physics, but also domains like algebra, economics, and marketing.

Game designers often talk about theme versus mechanics, and when I hear these conversations, I think about this body of research that shows how much novices depend on content; or in other words, its theme. That’s why when I heard Geoff Englestein in one of his podcasts talk about this topic, and propose a thought experiment related to it, I took particular notice. Geoff talked about the press your luck game Incan Gold. In the game, you play as an Indiana Jones type, exploring an Incan temple for gems and riches. On each turn, you and the other players decide for yourselves if you want your adventurer to press on into the temple, or exit. If you exit, you can pocket the gems you have found so far. If you press on, you might get more gems, or you might find a hazard and not get any gems that round. Geoff wondered if you kept the deep structure the same, the mechanics, but swapped out the cover story to something like firefighters, if that would change how players approached the game.

After hearing this, and being a research cognitive psychologist interested in games, I thought we should actually do the experiment. So, I contacted him and asked if that would be okay, and how much involvement he wanted. A fuller story will be told on Geoff’s GameTEK podcast that alternates with Ludology, and it will come out later in this month of November 2019 (It will be episode 213.5). To steal a bit of thunder, the two experiments that we did showed a small but persistent effect of content. Our participants changed their gameplay depending on content, with those in the firefighter condition being more risky than those in a condition devoid of any real content. These were almost entirely non-gamers, or in other words novices at the task, and so this finding is consistent with the past research. And, while obviously we didn't have them play 10,000 hours of the game, but rather just under 1 hour, they did play multiple rounds of the game during the session. And, across rounds, as they gained more experience with the game, they changed their play style. This change of play style across games also depended on which context they were in. We thought this was a very interesting result, and we're currently writing it up for publication. Check out the GameTek episode if you want to hear more! Or, contact me, and I can share with you a poster that we've presented at a conference and the initial results from the two experiments.

That study done by Michy Chi and her colleagues also looked at other differences between novice and expert physics students. I think you will see these other differences show up between novice and expert game players as well. I'll mention two of them here. In one of the later pieces to their study, they asked their participants how they would approach a particular set of problems. Given their reliance on content, it's not surprising that novices tended to not have great agreement amongst themselves as to how to approach solving a particular problem. Experts, on the other hand, do show good, general agreement as to how to approach a problem. I imagine that's the way it would be with game playing as well. If you show novices a game state, for any number of different games, and asked them what would be the best next move, or the best strategy to follow from there, they would be all over the place in describing what to do. But, if experts in a particular game was shown a game state, they would probably generally agree what the best next set of moves should be. They would be aware of the most efficient and best steps from any particular starting point, and conversely would also know what strategies would not be good ones to pursue.

The second piece that I will bring up here, based on that part of the physics study, is that novices got bogged down with the numbers. They were very much tied to what they thought the numbers should be and the details, whereas the experts were less concerned with the numbers, and more concerned with the overall general patterns found within the problem. That is, they did much more qualitative analysis of the problem. And again, I could see this being true about game players as well. Novices get very intrigued by the small picture details, what the pieces do and the particulars of the situation, whereas experts are looking at more the big picture type things.

There was one curious similarity between novices and experts in that study, and that was that they both chose the same keywords within the problem as to which words were most important. So, the novices knew what they should be looking at, but as this discussion shows, they obviously did not know how to use those keywords and information. Rather, the hallmark of being an expert is to not only identify the important pieces of a problem, but also how to use them. The same is of course true in game playing. I may know what part of the board or the screen I should look at in order to play, but if I don't know how to use that information, I may be dead in the water. And, most often time, going from novice to expert takes a bit skill sure, but it takes dedicated time in figuring out how best to use the information as it is presented to you.

That brings us to the close of this episode on expertise. As always, I welcome any comments or questions you may have, so please email me, steve@cognitivegamer.com and also visit my website, cognitivegamer.com. Also, you can like me on Facebook, Cognitive Gamer, or follow me on Twitter, @cognitive_gamer. And, if you like the podcast, please give a rating in whatever service you use to play podcasts. This will make it easier for other people to discover. Until next time, remember to think about what you play, and have fun doing it.