Episode 37: Hooked on Mnemonics

Show Notes
How can some people remember scores of digits at a time or repeat back all the cards in a shuffled deck? Do they have exceptional memories? Is it a party trick? Or, is there something more?

Game References
Chess, En Garde, Sushi Go, That's Not a Hat, Wilmott's Warehouse

Research References
Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive Psychology*, *4*(1), 55-81.

Cowan, N. (2001). *The magical number 4 in short-term memory: A reconsideration of mental storage capacity.*Behavioral and Brain Sciences, 24(1), 87-114. https://doi.org/10.1017/S0140525X01003922

Ericsson, K. A., Chase, W., & Faloon, S. (1980). Acquisition of a memory skill. *Science*, *208*, 1181–118. https://doi.org/10.1126/science.737593

Foer, J. (2012). *Moonwalking with Einstein: The Art and Science of Remembering Everything*. Penguin Books.

Miller, G. A. (1956). *The magical number seven, plus or minus two: Some limits on our capacity for processing information.* Psychological Review, 63(2), 81-97. https://doi.org/10.1037/h0043158

Price, J., & Davis, B. (2009). *The Woman Who Can't Forget: The Extraordinary Story of Living with the Most Remarkable Memory Known to Science--A Memoir*. Free Press.

Transcript
Hello! This is Episode 37 of the Cognitive Gamer podcast. I am your host, Dr. Stephen Blessing, professor of cognitive psychology at the University of Tampa. I use games to both explain and explore concepts in psychology. In this episode we're going to examine how people with amazing memories manage this feat.

Have you ever seen a demonstration of someone who has an incredible memory? Maybe they could recite a sequence of 50 or maybe even 100 random digits. Or, perhaps they could look briefly at a shuffled deck of cards and then repeat them back perfectly in order without looking? Maybe they could be introduced to scores of new people, and then easily remember their names, hometowns, and occupations. How can some people do these kinds of things, and some people like me have trouble remembering where they park their car? Are some people just blessed with massive amounts of working memory, and some of us much less so?

What really got me thinking about this recently are two different games I have students in my class play. I mentioned both in the last episode on working memory. The games are That's Not a Hat by Kaspar Lapp and Wilmott's Warehouse designed by Ricky Hagget, Richard Hogg, and David King.The first one, That's Not a Hat people find really difficult to play and keep track of even the few bits of information you need to. You simply have to keep track of a number of items equal to the player count as they get passed around the table. But, it's really difficult, even with only 4 players. The design of the game doesn't lean into how our memory works. Wilmott's Warehouse, on the hand, really does jibe with how our memory works. Working cooperatively and emphasizing good memory strategies, that is, mnemonics, players can pretty easily remember the location of 35 different symbols on the game board. What makes one game really hard to remember items but the other much easier? In this case, Wilmott's Warehouse encourages players to make up stories about the warehouse symbols, linking them to other symbols already on the board.

There are of course individual differences to memory, particularly working memory. The classic work was done by George Miller way back in 1956. He estimated the size of working memory to be 7 plus or minus 2 chunks. That's probably an overestimate, and current estimates, by researchers like Nelson Cowan in 2001 peg it more to be like 4 plus or minus 1. Some people are born with better working memories, but nothing to seemingly get you up above say 8 or 9 pieces of information. If you study people with what appears to be huge working memory capacities, those people who can briefly look at a deck of cards and remember the order of all 52 of them for instance, you'll find that they actually have an average working memory size. Really, they are surprisingly average in their working memory capacity when tested on standard laboratory tests. We talked about chunks a while ago, back in episode 7. If you remember, chunks are meaningful pieces of information. As you get more familiar with material, you can remember more of it. That's what allowed the chess experts in Chase and Simon's 1973 study to remember more pieces on a chessboard. Chess Grandmasters have seen lots of chess games, so they can remember the pieces within middle game chess position much better than a novice chess player, because they don't just see singular pieces on the board, but rather they will chunk 4 or 5 pieces together because that's a configuration of pieces they have seen a lot, and so that's a single chunk for them now. What I want to explore in this episode is the way in which people with average memories can easily commit to memory a large quantity of information. Well, I say easily, but it has taken them years of practice to get to that point, and the willingness to study and work their memory for hours a day, just like an Olympic-level athlete needs to do with their body in order to earn a gold medal.

Given this is a podcast about games, particularly board games, let's start by considering how people can remember, or count, cards. Knowing what card is likely to be drawn next is a great skill to have in many games. As a reference, the current record for memorizing a single deck of cards is just under 13 seconds, by **Shijir-Erdene Bat-Enkh** from Mongolia. And, **Kim Surim** of North Korea memorized the order of 2530 cards (the equivalent of almost 50 decks) in a one hour time limit. These are amazing feats, and if you're a card player, would serve you quite well as you play card and board games. For example, maybe you are a University of Florida club fencer, playing Reiner Kinizia's classic game En Garde. This game uses a deck of 25 cards, 5 cards each of the numbers 1-5. As you go through the deck, with your fencer lunging and parrying back and forth across the strip, it helps if you can keep track of what cards have been

played and what cards are still available. That will inform your strategy. How can you keep track of the cards? How do so-called card counters do it, and how do these people who can quickly look at a full 52-card standard deck and memorize their position do it?

As I mentioned previously, it's really about practicing and using certain techniques to help you remember all that information. I imagine if you tested card counters and deck memorizers on their memories for things that are not playing cards, they would test as having relatively average memories. These people have devoted hundreds, probably thousands of hours to the singular task of memorizing playing cards. And, it's practice with a set of specific techniques called mnemonics. The specific mnemonic a lot of card counters use is called the Dominic System, named after its creator Dominic O'Brien. It's also sometimes called the Major Method. To use this mnemonic, there is some prep work you have to do. First you have to create and memorize an ordered list of 100 people, and then you have to memorize an ordered list of 100 actions.

Once you have your lists of people and actions, you can now do something that doesn't look like counting cards, but makes explaining the technique easier. With these two lists memorized, you can now pair 4 digit numbers to cards. Say you have to remember the number 3185. You take the first two numbers, 31, and recall the 31st person on your people list, perhaps Mark Hammil. You then take the last two numbers, 85, and recall the 85th action on the action list, perhaps swimming. You then need to picture Mark Hammill swimming. That's what you remember, the picture of Mark Hammill swimming. When you recall that image, that image of Mark Hammill swimming, you just need to remember that Mark Hammill is person 31 on your list, and that swimming is action 85, and then you can remember that the number to be recalled is 3185. Humans are really good at remembering pictures, much better than other material like words or numbers. So, remembering pictures that are associated with numbers is much better. Some people extend this with also memorizing a list of 100 objects as well, so you can do person-action-object trios. With this third list, you can now memorize 6 digit numbers.

In addition to memorizing numbers, this technique can then be used to memorize cards. The cards will get associated with a number, and then as you go through a deck to memorize it, you retrieve the number for the card (for example, the Ace of Spades might be 11) and its associated person, action or object. As you go through cards, you keep retrieving the words of your pre-learned lists, and make those words interact. If you end up with a trio like Mark Hammil swimming with a basketball on his head, you can then go backwards to retrieve the numbers associated with Mark Hammil, swimming, and basketball, and then retrieve the cards associated with those numbers. Remember the image, and you can unpack it into some number of cards. You can combine this mnemonic with another like Method of Loci, which I'll describe next, in order to remember a fair number of cards all at once. All it takes is hours, and hours, and hours of practice to commit your person-action-object trios to memory and then hours and hours of practice to become facile with creating the image combos quickly so they can be placed into memory for later retrieval.

I mentioned the method of loci, sometimes also called the memory palace technique. This is another mnemonic and it's a fair bit easier to employ than the Dominic System. In fact, I will sometimes teach students how to use the method during the class we talk about memory and mnemonics, and they can start using it then and there. This method goes back thousands of years,

to the ancient Greek poets who used it to help memorize their sagas and lengthy poems. Indeed, one story has the Greek poet Simonides of Ceos, who lived around 500 BC using it to help identify the locations of where people were when they perished in the collapse of a building. It is still an effective method to help remember long lists of items.

To use this technique, all you need to do is bring to mind a physical place that's very familiar to you—perhaps the home you live in, your bedroom when you were a child, or maybe a familiar pathway in a favorite park. To start, remember that location as vividly as you can. To remember a list of items, what you need to do is to visualize yourself taking a walk through that location along a specific path. As you walk, visually place the items you want to remember, or items that represent what you want to remember, like Mark Hammil swimming with a basketball on his head, in your location as you take your walk. The more interactive and distinctive you can make the memory, the better. That is, don't just simply place a jug of milk by the front door, if you're trying to remember your shopping list, but rather have milk flowing like a fountain out of your umbrella stand. Then, have a grove of lovely little broccoli stalks coming out of the table that's next to it. When you need to remember the list when you're at the store, simply go back along the walk, and see all the items that you've placed in the environment. People with just a little practice can easily remember dozens of items this way, and with just a bit more effort this method can be used to remember over a hundred items. To forget the list so that they can remember a new list, some people have to go back through their walk and actually remove the items from their memory so they can start with a blank slate the next time.

Let me tell you about a couple of famous studies that have examined how people can learn to remember a crazy number of items. One was done by Chase and Ericsson in late 1970s. In this study, they wanted to show that given time and practice, anyone could increase their memory. They recruited a small number of undergraduates into their study. At the outset, all these undergraduates had normal digit spans, around 7 numbers. But, over the course of hours and hours of practice, they all increased their digit span to an exceptional size. Their practice was straight-forward. They started out with a span of digits that they could easily recall. If they did recall them, the span was increased by one. If they did not recall them, the span was decreased by one. And that's it. The instructions given to the participants were to simply go as high as they could. Chase and Ericsson gave them no instruction concerning mnemonics. They would simply come to the lab for an hour at a time to practice their digit span over a period of weeks. The participant who received the most practice, who they referred to as SF in their initial paper (his name is Steve Falloon, who is listed as an author in the Science article I cite in this episode's reference list), got to where he could recall 76 digits given to him at one time. This took him 250 hours of practice across about two years. The main analysis was how the participants, including SF, recalled all these digits. Participants reported trying to attach meaning to the numbers as they were being read to them. Many used dates. Their star student, SF, turned out to be an avid runner. He would associate the numbers with track times. For example, if the digits 4 1 3 1 came in, he would encode that has 4:13.1 seconds, a pretty good mile time. What enabled these participants to remember all these numbers wasn't increasing the size of their working memory, but rather they all found a way to more quickly transfix the numbers into their long-term memory, using what Chase and Ericsson referred to as a retrieval structure. These structures, based on the dates and running times already familiar to the participants, could be used to quickly store the digits as they were coming in. At retrieval, then, the participants could access

the numbers by going up and down the retrieval structure, this tree-like mental storehouse. The really nice analysis that Chase and Ericsson did was to show that this retrieval structure corresponded not only to the subjective description that these participants reported using, but by carefully timing the latency between number retrievals, Chase and Ericsson were able to verify the organization of these retrieval structures, in that there were very short periods of time as they recalled related numbers, and then longer gaps as they had to traverse the retrieval structure to arrive at the next group of related numbers.

To discuss mnemonics in a different, perhaps more practical or real-world context, many studies have looked at how servers remember orders in restaurants, particularly those who do not write down the order but rather commit them to memory. Servers have an economic incentive for doing this, as those that do (and remember them correctly, of course), get larger tips on average. Not too surprisingly, servers report a variety of mnemonic techniques that they use, including using location, imagery, and ways to make the meaningless meaningful to better remember orders. For example, wait staff will firmly position in their memory the table position of where a particular order is given They will also imagine the different attributes of the order (what kind of soup, the level of doneness for a steak) using a variety of different visual techniques. And, researchers have found that with the amount of practice they receive, people taking orders can pretty quickly transfix orders from hearing them into a longer term store, much like Steve Falloon could by taking random numbers, associating them with running times, and putting them in a long-term retrieval structure. Ultimately it's all about using a variety of these techniques to overcome working memory capacity constraints. There's no real magic bullet or even secret really, it's just about putting in the work to train your memory to chunk the information differently, developing different strategies to handle the information, and to as quickly as possible transfer information from a shorter term store to a longer term store.

Let me give you a book recommendation, *Moonwalking with Einstein: The Art and Science of Remembering Everything* by Joshua Foer. Joshua is a science writer, and he covered a memory competition. As he interviewed one of the contestants, the contestant convinced Joshua that he could train him for next year's memory event. Joshua jumped in with both feet, trained for the year, and spoiler alert, actually won the next year's competition. The book is a very interesting exploration into memory, both the history of these techniques, how memory is thought about and how that has changed over the last century, and a good description of how Joshua went from having an ordinary memory at the start to having the ability to do certain types of memory tasks extremely well.

What does all this mean for game players? This type of information and these techniques aren't exclusive to card or chess players. Again, remember my example at the beginning of That's Not a Hat and Wilmott's Warehouse. The instructions for Wilmott's Warehouse explicitly tell people to use story-telling and imagery to make remembering the symbols easier. Obviously any game involving cards would benefit from these techniques, because it's generally helpful in any game to remember what cards have been played. Or perhaps it's a card drafting game like Sushi Go by Phil Walker-Harding. In those game it's beneficial to remember what cards are being passed around the table. Likewise, many strategy games, such as chess, benefit from the player having a large warehouse of previous games and moves in their heads that they can retrieve and pattern match on a moment's notice. If you've been playing games for a while, you've probably noticed

it's easier for you to learn new games. Part of this is because you can more easily remember and recognize common mechanisms and when you hear them while learning a game, you can quickly take the rules for the game you're learning and transfix them into your longer term store. This sort of skilled memory is a by-product of practice. Get familiar enough with a subject, physics, art history, or even game playing, and you'll be able to remember more information as it comes at you. Here I'm reminded of my recent foray into learning Root by Cole Wehrle. That's almost like learning four games in one, due to how the different factions play. You first just concentrate on what your faction does, and then branch out to the others. No doubt more experienced board gamers have a much easier time learning and playing Root, due in no small part to the easier time they will have storing the rules in memory. And of course, if you pick up some techniques along the way, like the Method of Loci or some other mnemonic, that's going to help you play just about any game.

Before closing, let me say a couple of words about the apparent exception to this rule. There's a class of people called hyperthymesics who have exceptional autobiographical memory. There's only about a hundred documented cases. Jill Price is one, and she wrote a book and appeared on talk shows a few years ago. These people like Jill can be asked about a specific date and recall exactly what they were doing that day and what was going on in the world. How they remember their day-to-day lives differs from how everyone else does it. There appears to be at least a couple of things going on, including some brain differences and also the way they go about encoding memories. For instance, Jill would keep diaries that she would study. It appears that these few individuals have biological and behavioral aspects that help support their unique ability.

I hope you enjoyed this discussion of mnemonics. Memory is a curious thing, and these techniques shed light onto our memory's strengths and weaknesses. 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, I'm on the different social media sites as Cognitive Gamer. And, if you like the podcast, please give a rating in whatever service you use to play podcasts. Just like most dice rolls, higher is better! This will make it easier for other people to discover the podcast. Until next time, remember to think about what you play, and have fun doing it.