Episode 19: Cognitive Gamer Cognalysis: Decrypto and Codenames

Show Notes

I take a dive into Decrypto, comparing how clues are given in it versus in Codenames. Both the similarities and differences shed light into our cognitive processes and how items are stored in our memories. Spoiler alert: Bayes' Theorem is discussed!

Game References

Codenames, Decrypto, Downforce, Monikers, Outburst, Secret Hitler, Taboo

Research References

Gallistel, C. R. (1992). *Animal Cognition*. MIT Press: Boston, MA.

Anderson, J. R. (1996). ACT: A simple theory of complex cognition. *American Psychologist*, *51*(4), 355-365.

Transcript

Hello! This is Episode 19 of the Cognitive Gamer podcast. I am your host, Dr. Stephen Blessing. In this episode I'm going to do a cognalysis of a game that I've grown quite fond of since I got it this spring, Decrypto by Iello games. Hopefully you've had a chance to play it, but if not, I think you will still find this episode thought-provoking. I'm going to compare and contrast it with a game I imagine more people have played, Codenames by CGE games, winner of the Spiel des Jahres in 2016. I've read many reviews of Decrypto that have noted the similarity between the two games, but they all go on to say that in actual play Decrypto is quite different, and most reviews state that you should have both on your shelf. I heartily agree with that statement! Both games are fun and engaging, and gamers and non-gamers alike will find both enjoyable.

Because Decrypto and Codenames share some similarity in terms of theme, and particularly because they are both word games, they also share some interesting psychological phenomenon as well. If you've been with the podcast from the beginning, you may remember that I talked about Codenames in my first podcast, when I discussed activation in long term memory. Decrypto also relies on that concept, but due to differences in how the game is played from Codenames, it relies on it in a different way. Discussing Decrypto and Codenames together will allow for a deeper conversation into how exactly activation works in memory.

Let's get things going with a quick refresher on Codenames, and then I'll describe Decypto in a bit more detail as well. If you haven't played Codenames before, it's played with two teams, red team and blue team. In front of both teams is a five by five grid of cards, and each card has a word on it, perhaps three such card might have seal, duck and net on them. These words represent the codenames given to various people. Each team has one spymaster, and the spymaster needs to indicate to the other members on their team which codenames represent field agents on the same color team as themselves. Of the 25 codenames, eight go with the blue team, eight go with the red team, and seven are innocent bystanders. Depending on who goes first, there will be an additional field agent on either the red or blue team. The last card is the assassin, and if a team chooses that card, they automatically lose. The spymasters have to talk in code though as they try to indicate which field agents go on their team. Spymasters can only say one word and one number. The word should relate to the words you want your team to guess, and the number indicates how many words are related. So, with the three words I mentioned before, seal, duck, and net, if both seal and duck were red field agents, the red spymaster might say "Animal, two" and hope that their team points to both seal and duck to find the field agents. Of course, there might also be a blue field agent or an innocent bystander that also relates to animal, or perhaps even the assassin, and if a red team member points to one of those words, they would lose their turn or maybe the game.

Codenames is a simple game to both teach and play, lots of fun, and, as we discussed on the first podcast, interesting on a psychological level because of how we store information in long term memory. If you remember, psychologists refer to long term memory as being highly associative, meaning that concepts, such as the words in Codenames, are connected to one another, which is why when we start to think about bananas, we may end up thinking about mangoes, because there's a relation in our memory from bananas to fruit, to tropical, to mangoes, and so thinking about one leads to thinking about the others. The challenge in Codenames for the spymaster is to think of an associated word that would link together two or more of the words in their group. In that first episode we also talked about activation of items in long term memory, where more active items are more likely to be remembered and also more quick to come to mind. So, the other challenge for Spymasters in Codenames is to make sure the activation of the relevant words they want their team members to guess is higher than the other words in the group. Ultimately, the more active words are the ones that will be chosen.

Okay, that's Codenames and a quick refresher on activation and how items are stored in long term memory. Decrypto has some similarities, but the differences are such that make it very interesting on both a game playing level as well as a psychological one. Decrypto also has a bit of a spy theme, and I love its art style. It's also played in teams, a white team and a black team, and the challenge here is to break the code of the other team while still making sure you are decoding your messages appropriately.

Both teams have 4 words in front of them, and everyone on a team can see their own team's words all the time. These words stay the same throughout the game, and the game takes place over several rounds. You never see the other team's words. Each word is associated with a number 1 through 4. As an example, your team's words might be word 1 black, word 2 dragonfly, word 3 cocktail, and word 4 sombrero. Players on a team will take turns being the encryptor. The encryptor for the current round draws a code card, on which is a three-digit code such as 3-4-1. These numbers correspond to the words that everyone on the team can see, cocktail, somberero, black, in my example, if the code was indeed 3-4-1. The encryptor needs to come up with 3 clues such that their team members can guess the three digit code, 3-4-1. The clues can be any length. The encryptor could say, "drink, hat, and white" if they wanted to be obvious, or maybe, "Tom Cruise, Steve Martin, and Johnny Cash" if they wanted to be less obvious. Usually the encryptor wants to be less apparent, as you'll see. Remember, teams do not guess the words, they guess the code, and also remember, that members of the same team see the words the clues were derived from. The encryptor says the clues out loud, so that members of both teams can hear them, and the other team should write them down and keep a record of what was said each round. The other team first gets a chance to guess what the code might be. If the other team can guess two codes right in a game, they win. The encryptor's team also needs to say what the three digit code is. If they don't get the code for a round, because the encryptor was too obscure, then they get a mark against them, and if a team gets two such marks in a game, they lose. Because the words are always in front of them, the encryptor's team should be able to figure out the code, but not if the encryptor went too obtuse in their clues. But, over subsequent rounds, as the other team hears more and more clues relating to a particular word, figuring out the other team's code becomes more likely. It's a race to see which team can figure out the other team's codes first.

Like Codenames, Decrypto is pretty easy to teach and play, and it's easy to get sucked in, wanting to figure out the other team's codes and words, though again, figuring out the words isn't really necessarily. But, as you see clues like hat, Steve Martin, and mariachi, it's likely the team will hone in on the word being sombrero, or at least something in that ballpark.

You can probably easily see how Decrypto also relies on this psychological notion of association of memory items and activation. Like in Codenames, the person giving clues wants to provide such hints that are associated with the appropriate items in their teammate's memory, and make sure the activation of the relevant item is as high as it can be in order to ensure that's the one that gets said. But, if you think about it, the strategies that the clue giver uses between the two games are quite a bit different. In Codenames, the clue givers wants to give as obvious of a clue as possible in order to raise the activation level of the word to be said, but in Decrypto, the less obvious clues are generally better, in order to better obscure what the true word might be to the other team. This makes guessing the codes harder for the other team. And, if you can provide a clue that could somehow relate to a past clue given in an earlier round that actually related to another of the four words, that would be an awesome play.

That difference in strategy between the two games is ultimately related to a psychological difference in how the activation levels are being manipulated between the two games. These differences can be illuminated by considering a very precise way in which researchers have theorized how exactly items are stored in long term memory. Now then, fair warning, we are going to go a little bit into the details here, and the details involve a smidge of math. Just like some people are surprised that some game designers really get into math when they design games, some people are surprised that some psychologists really get into math when they develop theories. I think you'll find it a very fascinating journey though, and for some you, you will be surprised at how carefully these things have been considered. I'll keep it as high level as I can, and there will not be a quiz at the end. I want to peel back the curtain a little bit so that you can appreciate the care that some researchers have done in thinking about these issues.

The story actually begins a couple of hundred years ago, in the late 18th century. Reverend Thomas Bayes thought about how the probability of an event begin true is affected by what evidence you have collected. Bayes was essentially an armchair mathematician, finding it an enjoyable hobby in between giving sermons. He was interested in how people did inductive reasoning based on evidence. His findings now have a whole class of statistics named after him, Bayesian statistics. Again, we won't go into the details or all that much depth, but I will talk about one central aspect of Bayesian statistics, namely Bayes' Theorem. Bayes' Theorem is a precise formula of how the probability of an event being true should change based on the collected evidence. It turns out that modern day psychologists argue about how closely humans reason according to Bayesian probability. That is, do the decisions we make resemble what one would predict if we were following something like what Bayes' Theorem would suggest. There's some evidence on both sides of this particular ledger.

Before we talk about this evidence, though, and how it relates to how we play games like Decrypto and Codenames, let's talk about Bayes' Theorem in a little more depth. Conceptually, it's pretty simple. Bayes' Theorem states that the probability of an event being true given certain evidence is equal to how likely the event was to happen one way or the other, times the probability of the evidence existing if the event did indeed happen.

Okay, that maybe sounded a bit deep. Let's break it down; there are three pieces. First, what we are computing, the probability of an event being true given the evidence, is also sometimes known as the posterior probability. Or in other words, the probability after the fact, once all the evidence has been gathered. The posterior probability is equal to the product of the other two terms, the first of which is known as the prior probability. That's the probability of the event being true given no evidence, or the probability of this thing happening on any given day. If historically it rains 30% of the days where you live, then the prior probability of it raining today is 30%. The prior probability is multiplied by the last term, which is sometimes known as the likelihood ratio. That is, what is the likelihood that this particular evidence will be seen given that the hypothesis that I'm wondering about is true. We all know that the actual probability of it raining today is affected by many different factors, and that's the evidence that a meteorologist will use to state the actual probability of it raining today.

How does this apply to game playing? It's all over the place actually. I recently picked up Downforce by Restoration Games to use in my Cognition of Game Playing class. I've played it a couple of times here recently to make sure it's going to be a good fit. At certain points during the game, players bet on which car will ultimately win the race. That's making a decision based on probability given certain evidence, and one could consider how Bayes' Theorem fits in. At one point in the game, bets are placed after a car crosses a particular spot. What's the probability that the first car that crosses the first yellow line ultimately wins the race, not considering any other evidence? That's the prior probability, which in theory could be computed based on all the games of Downforce that has ever been played, or perhaps even from a statistical analysis of the cards in the game. You multiply that by the likelihood ratio, which is the evidence that you have, such as the current positioning of the other cars, the other player's powers, and the cards in your hand, that the car that just crossed the yellow line will win the race. Again, that's the likelihood ratio, because it's based on the current state of the game, the evidence. Multiply that likelihood ratio by the prior probability, essentially, and you have the posterior probability of that car winning the race, which should inform your betting.

Game players specifically, and people in general, make those sorts of decisions all the time. What's the probability of us having chicken tonight for dinner? What's the probability that while playing Secret Hitler my friend is a fascist? What's the probability that I get a raise next month at work? What's the probability of this clue in Codenames or in Decrypto pointing to this word versus that word? Anytime we reason based on evidence and prior probabilities, Bayes' Theorem could come into play. In Secret Hitler, I know how many fascists and liberals there are, and I know some of what's been seen in the policy deck. I can use that information, in conjunction with the evidence such as how I know how my friends play Secret Hitler, to figure out my best play. Using Bayes' Theorem is all about how much this might influence us in making inductive reasoning choices, and we do that a lot, both in games and real life.

So, the question becomes, do people reason and make decisions using something that really resembles Bayes' Theorem? In any of this, let me be clear that I'm not implying that people are actually getting out their calculators and computing actual probabilities, but rather that our brain machinery has adapted itself such that Bayes' Theorem is an adequate predictor of people's choices. As I mentioned, there is evidence to support both sides. In Episode 17 I talked about a decision-making fallacy called base rate neglect. The base rate is essentially the prior probability. Remember, that's the probability of something happening on any given day, without any particular evidence. As the name base rate neglect implies, and as I gave examples in Episode 17, in at least some instances people are bad at estimating the base rate of certain events. In some circumstances we place much more weight on the likelihood ratio part of the equation, giving more credence to the evidence, because it's more representative of the situation as I mentioned in that episode, than we really should.

Kahneman and Tversky of representativeness heuristic fame don't sound so favorable on Bayes' Theorem as a way to predict human behavior. But, they really liked to look at the edge cases where our reasoning faltered. Maybe in more everyday situations, it works out better? An academic book that made the rounds when I was in graduate school, Animal Cognition edited by Charles Gallistel, described situations in which animals make decisions that resembled Bayes' Theorem. For example, if you have two old men in a park feeding pigeons, but one man gave out bread at twice the rate of the other man, how does the flock of pigeons arrange themselves between the two men? In theory, any one pigeon should stay where the most food is, so presumably by the one giving out twice as much food. But the flock arranges itself maximally adaptively, such that twice as many pigeons are around the man who is twice as generous. And, if you look at the behavior of the flock, it's not static, such that you will see individual pigeons going back and forth, but at any one time, there will be twice the number of pigeons around the one guy. This is called probability matching, and the pigeons are modeling Bayes' Theorem. So if pigeons and other animals do it, who don't humans?

Well, it turns out there are a lot of situations in which humans do follow something that could be modeled with Bayes' Theorem. And, those situations include decision making and problem solving, like we do in playing games like Downforce, and also in retrieving words like we do in Codenames and Decrypto. My thesis advisor in graduate school, Dr. John Anderson at Carnegie Mellon University, developed what's referred to as a unified theory of cognition. That's a theory that attempts to tie together a whole bunch of cognitive phenomena. I may be biased, but his theory, the ACT Theory, is one of the better of such theories out there. I'll put a very readable reference in the show notes if you want to find out more. For now, I'll just note that at the heart of how we do memory retrievals and solve problems has Bayes' Theorem at its heart.

For memory retrievals, according to the ACT Theory, the probability that a memory item will be retrieved on a given cycle in a given context is equal to the base rate of that item times the likelihood of the current context suggesting the need for that item. Again, that's Bayes' Theorem, and that same underlying mechanism can explain how we approach the different strategies of Decrypto versus Codenames, along with Taboo, Outburst, Monikers, and any other game of that ilk.

How exactly does that work into how we play Decrypto and Codenames? According to Bayes' Theorem, your choice in choosing clues and words in both games should be whichever word has the highest posterior probability. In other words, given the clue that serves as the evidence in this case, what word is most probable? On any given turn, the prior probability, the base rate, will be about the same. At the start of the turn, 1 out of 4 for Decrypto, and at the start of the game, 1 out of 25 for Codenames. That will change as the round plays out and the game progresses, but the point is that the base rate isn't as important here. What changes is the likelihood ratio; given the clue that my partner just gave, what's the probability it's a reference to this word? In a game of Decrypto, the encryptor just said Tom Cruise. Does that better suggest black, dragonfly, cocktail, or sombrero? If you know movies, then the posterior probability of cocktail should be higher than the rest, and in this case, pretty high. Good clues in Decrypto depend on making what might be considered tenuous connections with your clues in order to perhaps just barely nudge out the others so that across rounds, the other team won't be able to figure out how your clues all fit together. Good clues in Codenames tend to be more obvious, to really ensure that the posterior probability of the intended words are raised to where it's obvious what words your teammates should point to. If three of your same color field agents are all animals, then "Animals: 3" is a great, obvious clue, that should work to get your fellow spies to point to the right words.

As advertised, that was a bit of a deep dive into probability and psychological theory making, and I appreciate you sticking with it to the end! I think this is a very important and interesting issue, and one that you can hopefully really see how it affects your decisions as you play games, in terms of how you give and interpret clues in games like Decrypto and Codenames, and also how you make choices in games like Downforce and social deduction games like Secret Hitler. 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.

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