Episode 01: You Must Remember This: The Use of Activation in Game Playing

Show Notes

How verbal items are stored in memory affect how they are retrieved. This in turn affects how we play many games, as they require retrieval of items from long term memory. In particular, I consider such games as Codenames, Scattergories, and Taboo.

Game References
Codenames, Monikers, Scattergories, Taboo, Trivial Pursuit, Wits and Wagers

Research References

Loftus, E. F. (1974). Activation of semantic memory. American Journal of Psychology, 86, 331-337.

For those who want to know more about the mathematics computation behind memory retrieval:

Raaijmakers, J.G.W. (2008). Mathematical models of human memory. In H. L. Roediger, III (Ed.), *Cognitive Psychology of Memory. Vol. [2] of Learning and Memory: A Comprehensive Reference, 4 vols. (J.Byrne Editor)*, pp. [445-466] Oxford: Elsevier.

Transcript

Hello! Welcome to the first episode of Cognitive Gamer. I am your host, Steve Blessing. I'm really excited to do this podcast, as I'll be talking about two things that I'm really passionate about: cognitive psychology and games.

Today's topic will be looking into how verbal items are stored and accessed in long term memory, and how that impacts how we play games like Codenames, Taboo, and Scattergories.

Before getting into that issue though, let me take just a brief moment at the outset of the first podcast to introduce myself. As I said, my name is Steve Blessing, and I received my PhD from Carnegie Mellon in cognitive psychology. I'm currently a professor of psychology at the University of Tampa. I've also been at the University of Florida, and I've also worked in private industry as a cognitive scientist at a company called Carnegie Learning. I'm very interested in how cognitive psychology can be applied to everyday life. At Carnegie Learning I worked on their cognitive tutor product, an intelligent computer program that adapts to the student to make their learning more efficient. A current research project has me developing a website for the Glazer Children's museum to make going to the museum more interesting, fun, and educational for both parents and children. As I've become more interested in games, it's just been natural for me to think about how our psychology influences us as we play the game, and

what goes on inside our head during play. I've developed a course at the University called the Cognition of Game Playing that has students look exactly at that issue.

Speaking of games, I intend to cover all types of games as the podcast continues. Each podcast will cover a particular psychological phenomenon or issue, and then I'll select games that best exemplify that phenomenon. Sometimes it might be board games, like today, but other times it might be video games, or games or chance, or some other type of game. So, today it's mostly board games, but a future show might center on, say attention and first person shooter video games. I intend to provide a good mixture of different types of games as we go along.

As I said, today's topic is how verbal items are stored and accessed in long term memory. This of course comes into play in a variety of different games, but particularly those that involve retrieving specific words and connections from your memory. A current popular game that does this is Codenames, but there are also the classic games of Taboo and Scattergories. In each of these, in one way or another, the players must think about words they have stored in long term memory, seeing where there might be connections, so that a word can be guessed. How exactly does that happen? What do psychologists know about how words are retrieved from our memory banks?

Let's start with an example from Codenames. Probably most of you are familiar with this game, but for those of you who aren't, let me explain things just a little. In the game, there are two teams of spies. Each team has one spymaster, and the other players on that team are field agents. Both teams are confronted with the same 5x5 grid of words, where each word represents a possible codeword for an operative. Your team needs to determine which of these 25 people are also on your team. Eight or 9 codenames belong to each team, there are 8 words that are innocent bystanders, and one of the cards is marked as the assassin. You don't want your team to pick the assassin, or else the other team wins automatically! Of course, being spies, the spymaster can't simply say the codenames of your team's spies, but can only provide hints. A hint consists of a single word and then a number. The word tries to relate to as many of your team's spies as possible, and the number tells the field agents how many words to try to guess. As an example, say the spymaster wants to connect three different words: doctor, needle and bed. There's a least one word that does this, Hospital, so the spymaster would say "Hospital 3" and hope their team points to the right words. It's a great game, and many people like it quite a bit.

Now, to bring it to psychology, what governs whether the field agents will be able to make that connection that the spymaster intends? It of course has a lot to do with how items are stored in memory, and psychologists have done a lot of research in terms of memory. I imagine we'll talk a lot about memory in these podcasts. There are many different types of memory, and it's a fascinating, interesting subject. For this discussion, let's limit ourselves to just long term memory. This is the type of memory that allows us to store information for a long period of time, years maybe, without it being in our conscious mind, but then retrieve it after that storage to act on it in some meaningful way—like to use as a clue in Codenames or to blurt out an answer in Taboo!

Most people probably have this vague notion that items in our memory are connected to one another. It's what allows us to have a conversation that goes from talking about what we had for dinner, which leads us to talking about one of our favorite restaurants, which ends up talking about the city where that restaurant might be in. All of those things are connected in our memory, and thinking about one leads to thinking about the other. To be good at the types of games that we are talking about depends on the players making use of those connections.

What do psychologists know about how those items are stored and retrieved? This is a topic that has been examined since about as long as there have been psychologists. Hermann Ebbinghaus was one of the first psychologists, and did his research in the late 1800's. He was most interested in how items are forgotten in memory and the time course of forgetting and relearning, and so used mainly nonsense syllables in his research, so that the stimuli, the words, wouldn't interfere with each other. Of course, Codenames and the others use real words, which is much more interesting, because there are a lot of connections between those words.

Long term memory is what a psychologist calls highly associative. That is, items in our memories are associated, or connected, to one another. We know about bananas, and bananas are associated with the color yellow, other fruits like apples and pears, chimpanzees perhaps, because they like to eat them, and maybe if you're a runner, you know that they are considered a superfood. Now, until I mentioned bananas just a few seconds ago, they were not in your conscious thought, or what a psychologist might refer to as a working memory. We'll talk much more about working memory in a later podcast, because that's a whole other interesting psychological construct. But for now, at the mere mention of banana by me, you were able to retrieve it from your long term memory, and start thinking about related issues to bananas.

Once an item has been retrieved from long term memory and within your working memory, a psychologist would refer to that item has having been activated. Activation, then, is a quantity associated with items in long term memory. The more activation that an item has, the more likely it is to be retrieved from your long term memory, and the quicker it is retrieved. Every long term memory item has an activation value associated with it, and once that item gets above a certain value, it can enter our conscious awareness. A lot of research has investigated what affects these activation values. Indeed, some cognitive psychologists, those that really like math and computers, have gotten so particular at it that they have created mathematical and computer simulations of how activation in long term memory happens and how that affects what people retrieve from their memories. We won't get into those specifics here, but if you are interested, I'll put some additional reading up on my website, cognitivegamer.com, in the show notes for this episode. For now, appreciate the fact that we can be reasonably precise as to how this notion of activation happens to long term memory items, and that this will come into play when your team is trying to figure out which words to point to in a game of Codenames or what word to say in Taboo or Scattergories.

There are three main things that affect how much activation an item has in long term memory: practice, recency, and what we'll concentrate on here, the spread of that activation to related

items. Before we cover spread of activation, let's talk about practice and recency. I believe you'll find these two pretty straightforward.

First, there's practice. The more practice that an item receives, the more activation it will have. I think that just stands to good reason: the more practice, the easier it is to recall that item. For instance, if I ask you for your birthday, that's extremely well practiced, and you'll be quick to tell me. But, if I ask you for your mom's birthday, you will hopefully be able to retrieve it, but probably a bit more slowly than your own birthday. It doesn't have as much practice as your own birthday. We're only talking fractions of a second here, probably, but in terms of shedding light on how memory works, those fractions of a second matter. As another example, in looking at people's retrieval of math facts, people are really good at retrieving simple math facts that involve small numbers, like 2 plus 3 and 1 plus 4. They do those quickly and without a lot of errors. But for slightly larger math facts, those that still involve retrieval, like 9 plus 8 or 7 plus 6, it takes them slightly longer and they are more likely to have a retrieval error. Again, this is due to the amount of practice that those smaller math facts have over the math facts of the larger numbers. This can of course impact game playing, as those pieces of information that you have seen and practiced a lot in a particular game will be easily brought to mind.

The aspect that affects activation that I mentioned second, recency, is also pretty straight-forward. The more recently an item that is stored in long term memory has been accessed the more activation it will have, and the easier and more likely to be remembered. This is why a game like Monikers works so well. In that game, players go through describing words in the first round, to get their team mates to guess them. All of those items are now going to have more activation associated with them. You use the same words in the next two rounds. So, in those next rounds, you are primed, so to speak, and much more ready to provide the correct words due to the recency of having used that word. Elizabeth Loftus, who is a big name in memory research, did a classic study back in 1973 looking at how recency affects activation of items in long term memory. The participant had a very easy task to do: they essentially played Scattergories! On the computer screen, a category name would flash along with a letter. The participants had to say an example of that category starting with that letter, just like Scattergories. Loftus timed how long it took people to come up with the example. On the very first go, it took 1.53 seconds, on average, if what they saw was "fruit-b" and then said "banana." They then went through many, many trials of playing this game. Loftus did a clever thing though, in that she would repeat certain categories after certain intervals. For instance, some people might see "fruit-s" on the very next round, but others might not see "fruit-s" until two other rounds had already passed; these other intervening rounds did not involve the category fruit. On average, it took people 1.21 seconds to say "strawberries" for "fruit-s" if it appeared immediately after "fruit-b," but 1.33 seconds to say "strawberries" if there were two intervening items. Notice both of those times are less than the original 1.53 seconds to come up with the original example, but there is a small, but significant, difference between the times for zero intervening items and two intervening items. Again, 100 ms isn't a lot of time, but that difference is statistically significant, and does shed light on how memory works. And, recency of practice affects how quickly and accurately items are retrieved from long term memory.

Okay, so that's two of the three things I mentioned, practice and recency. Those are fine and interesting, and as you can see from the data, do affect how items are retrieved from memory. However, it's the third factor that affects items in memory, spread of activation, that I want to concentrate on, as I feel it comes into play most often in types of games we're talking about here. In the banana example I mentioned previously, I said that our memory of banana is connected to the color yellow, probably green as well, other fruits such as mangos, apples, and pineapple, along with any other connection to banana that we may have. I had a banana today for lunch, so I would have connections between bananas and the other items that I ate. There are hundreds of thousands of connections between our items in long term memory, where one could find a path between essentially any item in our memory to any other item. Once one item in memory is activated, that activation will flow to related items. How much activation flows, and the time course of how it flows, will be related to the strength of the connection between those two items. Items can be strongly connected, like bananas and yellow, or more weakly connected, perhaps bananas and green. Those connection strengths will have to do with practice, mostly, like discussed above. That spread of activation between items happens beneath conscious awareness; it just does its thing. You'll be thinking of bananas, and then all of sudden, may start thinking of this restaurant where you had a particularly good dish of Bananas Foster.

Remember, activation affects the speed and probability of retrieval of items of long term. The experiments and examples I gave for practice and recency mostly had to do with speed, but with spread, let's consider the probability of retrieval. Let's play an anagram game! I'm going to give you a simple, 4-letter word to unscramble. As soon as I've given you the letters and you've unscrambled it, say it out loud or write it down. Ready for the letters, here they are: A C O T. I'll give you a few seconds: A C O T. Got it? How did you unscramble that? How many got "COAT?" That's what I would guess a majority of people got first. How many got "TACO" though? Obviously both are right. I do a demo in some of my classes, where this is the second part of the demo. In the first part, I give half my students List A of words to unscramble, and the other half get List B. The words in both lists are about the same difficulty to unscramble and there are an equal number of words, six, but the List A words are all articles of clothing: sweater, shoes, vest, whereas the List B words are all types of food: pizza, chili, spaghetti. After they spend 30 to 45 seconds attempting to unscramble whatever list they got, I then put up on the projector the word I gave you all: A C O T, with the instruction to unscramble it as quickly as possible and to write down the first thing that comes to mind. This is a great demo, because usually without exception, the people who were unscrambling the articles of clothing mostly unscramble the target word as COAT, and almost none as TACO, and the people unscrambling the food items are the ones that mostly get TACO, though with a few COATs. The explanation is straight-forward: if you are unscrambling food items, that activation is spreading between all related words, mostly foods, like TACO, so when you are asked to unscramble A C O T, the probability that it will be unscrambled as TACO increases quite noticeably.

Let's bring all this talk of activation back to games. If you are the spymaster in Codenames, or you are trying to get your team to guess a word in Taboo, your job, cognitively speaking, is to get the activation of the target word to be greater than the activation than any other word in

your team mate's memory. That is what will hopefully get your team to guess the right word. Use clues that increase that activation via the spreading process! Finding that one clue that links items together in a game of Codenames can be oh so satisfying, because you can make that spread of activation work in your field agent's minds and have them point to the right clues. That's also is essentially what is happening when you play trivia games like Trivial Pursuit or Wits and Wagers, as you try to retrieve facts and figures from your long term memory.

This may be obvious, but this is why playing these games like Taboo, Monikers, and others with family and friends is easier than playing with strangers, because you have more insight into what items are connected in their memory. I'm able to give a clue in Taboo to my kids like, "This is the thing that you two don't like to go on at DisneyWorld, but Mom and me do" and have a reasonable probability of getting the right answer, roller coaster.

I hope you have enjoyed the topic for this podcast and have learned something about how your mind processes information. In the next podcast I'll stay on memory for another episode, but will concentrate more on visual memory and representations. Between now and then, if you have any questions or comments, please email me at steve@cognitivegamer.com. I would love to hear from you, and if you have a question, I may answer it in a later podcast. Also, be sure to like my facebook page, Cognitive Gamer, and to visit the website cognitivegamer.com. Until next time, remember to think about what you play, and have fun doing it.