Episode: #174

Dopamine In Dog Training: Anticipation, Rewards, And The Transfer Of Value

Speaker Key

SG Susan Garrett

Transcript

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SG Today my friends, I invite you to geek out with me on the topic of dopamine in dog training. That's right - the dopamine - the neurotransmitter that people have always thought was the feel-good chemical that our brain released. It might not be just that.

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Hi, I'm Susan Garrett. Welcome to Shaped by Dog. And as I mentioned off the top, dopamine, which is the neurotransmitter that is released when people do things like amphetamines. It's always been assumed that they did it because it creates a euphoric feeling of happiness. Well, research in the last 15 or 20 years has actually led to us knowing now that it isn't so much about happiness. It's more about the drive to seek out happiness.

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And why is that important to us who train dogs? Because in order to make dog training addictive to our dogs, we have to ensure that our dogs are getting that dopamine release when they are working with us. So, today's podcast, I'm going to do a deep dive to tell you about the science that has led me to the place I am with my dog training.

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Over the last few weeks, I have been doing this massive deep dive into the literature. I'm going to give a shout out to Dr. Pamela Reid, who when I reached out to her and said, "Hey, I'm looking for this particular paper" she actually found one. And it was one that I first heard about back in 2012, I was sitting in a lecture by Steven Lindsay.

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He was up at the University of Guelph giving this lecture where he mentioned a paper by Dr. Schultz. He was doing an experiment where they actually were able to measure the dopamine release in the brains of monkeys. And it was fascinating what they found out. It really made sense to me with the way that I was going about training my dogs at that time.

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But I'm getting a little bit ahead of myself. First let me share with you, how does dopamine even get released in our dog's brains? And actually, you don't need to know this. We're going to get really geeky. It comes from your dog's midbrain and then it travels to glands and muscles all over their body to get them to do things.

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It's what stimulates that action. Hence, it's more about motivation than it really is about happiness. And so, what it does is the animal in training expects a reinforcement or a reward. And when that reward is greater than what they actually expected that's what triggers a dopamine release. It's the difference between what was expected and what was received. And the exact same thing is true if the dog didn't expect the reward. And when that difference is greater that is called a positive prediction error. I know the word "error", it throws you all off but it's okay.

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When it's less than what they expected then that's actually a negative prediction error. And what happens, it shuts down dopamine production for a short period of time. And when it's equal to what they expected they don't get any dopamine for that moment. So, when it's greater than they expected that's what gives the dopamine release.

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I'm going to give a link in the show notes to a video that is narrated by Dr. Robert Sapolsky who is I believe at Stanford University. He was sharing this experiment where they had a cue and a behavior and then a reward. And what they were measuring when the dopamine release happened and how high that dopamine spike was. The cue was a light. A light would turn on and that meant that the animal could now press a lever. If they press a lever 10 times, a reward would come out.

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And as long as that light was on, they could keep pressing that lever and when they got to 10, they would get a reward. They expected that the dopamine spike would happen when the animal got the reward. But that's not what happened. What happened was as soon as the light came on the animal then knew 'game on', and the dopamine spike happened then and stayed up the entire time that the animal was working. And it only dropped when they actually got the reward which you think is weird right?

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Other literature showed that when an animal was given a reinforcement *[I don't know why in all of this literature they talk about rewards rather than reinforcement]*, when the animals given the first reinforcement they were like, "Wow, this is good, thank you." and they got a dopamine spike. But if the reinforcement was of equal value after that or it was what they predicted, then they didn't get a dopamine spike.

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Kind of like if you know, I was lecturing at your favorite dog training conference, and it was in person not these online varieties. You saw me and I was talking to somebody and you kind of came up and tapped me on the shoulder and said, "Hey, Susan Garrett. I got you one of these awesome vegan chocolate chip cookies." Well at first the tap on the shoulder I'd go, "Okay, I'm talking to somebody. Oh, vegan chocolate chip cookies! Well, thank you!" and that would be great. I'd get a dopamine spike, this is awesome.

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And then a little later on if you tap me on the shoulder and you said, "Hey, I got another one of this vegan chocolate chip cookies." "Oh, cool!" I take it. And this one had nuts in it too. "Whoa! My favorite!" Boom, another dopamine spike. And then later the tap on the shoulder I would get excited already, because two big hits. The tap starts predicting the dopamine spike and that's exactly how it was written out in one of Dr. Schultz's most recent papers.

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So as Dr. Schultz says, this is a little bit jargon heavy but I'm going to repeat it with another quote from another great scientist. Dr. Schultz said, "The dopamine response is transferred to the next preceding reward predicting stimulus, the cue, and ultimately to the first predictive stimulus."

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So, if there's more than one thing in the chain you can put a chain of things then, guess what, it also gives you a dopamine hit. So, I'm going to give you another quote from Dr. Mark Humphries. He's a neuroscientist at the University of Nottingham. “The key to dopamine theory isn't just that the dopamine neuron signals the difference between the reward you got versus the reward you expected, it is that they also transfer that signal to unexpected things that predict rewards.” AKA the transfer of value that I've been talking about on pretty much every single one of these podcasts, right?

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The transfer of value. The thing before the thing. You pull out a clicker and your dog says there's a dopamine spike because it means game on. You pull out a target there's a dopamine spike because it means game on. You pull out a food lure, that's the same. So, you might get a dopamine spike the first time the dog tastes it but it's then neutral.

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And that's exactly the question I asked of Steven Lindsay back in 2012 when he first presented the original work of Dr. Schultz. I went down after the lecture was over. I went to the front of the hall, and I said, “Listen, can I ask you a question? That paper that you presented, does that not mean dogs who are trained with lures are not going to get the same amount or frequency of dopamine spikes as dogs whose behaviors are shaped?” And he said, “In my opinion, a hundred percent.”

So, you know what, I always look at these papers and go, “Susan, you're looking through your own colored lens. There's confirmation bias in all of us.” But time after time I'm reading the same thing. And it makes sense to me because that's what I'm seeing in my dogs and in the dogs that I'm helping to train, my students’ dogs, whether they be online or in person.

Another really interesting thing that these scientists did is they then blocked dopamine production. And when they did that what they found is the animal's motivation to work went in the crapper. One experiment they had a corridor where a rat could walk down and experiment and if they turned right there was a pile of food for them. If they turned left, there was a pile of food double the size. However, there was a small little hurdle that the rat had to go over in order to get to that double the size of food.

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Now when they suppressed dopamine production in the rat they always went to the little pile. “Oh, that one is too much effort. I can't go into that one.” But with a normal functioning rat, with a normal level of dopamine production, they always went to the left. They’re always “I can take that little hurdle. Take that in one leap.” and off they went and ate the bigger pile of food.

And so how does that affect our dogs? Well, we know in humans, humans with a suppressed dopamine level, they will suffer from things like inability to focus or depression, lethargy, possibly socially withdrawn, all of that because of low levels of dopamine. And the same can be seen in our dogs. So, dogs that are in physical pain or had have endured some chronic stress or have been sick, those dogs their level of dopamine has been suppressed. Their ability to create a dopamine hit is hampered.

And so that's why you take a dog who's not feeling well, and you ask them to tug or play a game with you they're going to be half-hearted. Or what you'll find is they might play one time but the first time they fail, and you get that negative prediction error they're tapping out “no.” The little dopamine that's there shuts right down. They can't work.

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I've seen that myself and my youngest dog This! who's been dealing with a gut issue since the day she was born. And so, I have to be very, very particular about how I train her. In addition, I'm going to share with you that there's nutrition that is involved in dopamine production.

So, dopamine is reliant on the amino acid tyrosine in order to be produced. Now, tyrosine is naturally occurring in a lot of foods including poultry, chicken, and turkey. It's found in bananas, which by the way also have dopamine in them. Funny thing I love bananas, maybe that's why. It's found in pumpkin seeds.

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My dogs routinely get one and a half teaspoons of ground pumpkin seeds. If you don't grind those pumpkin seeds, you will be visiting them once again on their way out because they do not digest in your dog unless they've been ground. Avocado is another source of tyrosine, and you can feed your dog small amounts of avocado.

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Again, you know you might want to check with your nutritionist or your Veterinarian before you change your dog's diet, but those are things that contribute to the dog's ability to produce dopamine and to produce that dopamine spike.

Now, what about if we go on the opposite spectrum? There is such a thing as having too much dopamine. And you will see that I personally believe that that was a struggle that my long gone now dog, Buzz, struggled with.

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And Buzz, you may know I wrote a book about him called Shaping Success. He was an awesome dog, but he was a little bit high, like a lot high. Now he came to me as an eight-week-old puppy. He never would settle. He was always running around. He was a bit cray cray back then. But, back in 1996 when Buzz came on the scene, I had made a commitment that I wanted to train my dog in obedience and agility without the use of any physical or verbal corrections.

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I had made that transition with my dog before him, Twister, when she was about two, but this was my first dog from a puppy on up, I was going to do it just all with shaping behavior. Nobody was doing this back then. Nobody was doing it in sports that's for sure. And so, I was the pioneer making a ton of mistakes.

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And the biggest mistakes that I made was in my experimental design in how I set up my training environments and how many mistakes Buzzy made. And so, what he would do - "wasn't that? Okay, it must be this! I'm gonna try this!" - and every time he failed; he would get another dopamine hit because he was one step closer to getting it right.

And so Buzzy was on such a random schedule of 'you're right' that he could get higher and higher and higher. So too much dopamine in the body and what can happen, is that you get frantic behavior, frenetic behavior, the inability to relax, the "Oh my gosh! I got to do something! I got to do something!" And Buzzy I always described him as a dog who worked hard and then crashed.

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And so, looking back I believe he was a dog who maybe had too much dopamine in his body. And one of the things that I do with my own dogs, kind of as a detox, as you may know if you're a listener to this podcast I love to take my dogs for walks. And my dogs, three of them Border Collies, love to run and herd each other and chase each other. And that goes on for almost the entire walk.

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Well, at least one day a week I will have them not do all of that ripping. You're just going to walk, and you can sniff, and I don't put them on leash, but I tell them “with me” and they just have calm walks. It's like our dopamine detoxing walk once a week. So, you might identify with your dog in one of those two categories.

And so, you might need to make adjustments one way or the other. But the most important thing I'd like to encourage you to think about is, is your training addictive to your dog? Is your dog getting healthy dopamine spikes throughout the training?

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Because if you're training with a food lure, there's a very good chance the first time they get that bite of food they are going to get excited and get that dopamine hit. But if it's the same food for the rest of your training, it's now neutral. So, it's harder for that training to become addictive. And that could be a reason why your dog might not be as addicted to your training as you would like them to be.

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And finally, as long as we're on the topic of dopamine why don't you go and grab yourself a banana or a handful of pumpkin seeds, maybe a chicken leg, and jump on over to iTunes or wherever you're listening to this podcast and go ahead and leave us a favorable review.

You know that's going to give me a dopamine hit. And if you're watching this on YouTube you know I love reading your comments. I'll see you next time right here on Shaped by Dog.

Resources:

Paper (PDF): A Neural Substrate of Prediction and Reward - Authors: Schultz, W.; Dayan, P.; Montague, P.R.

YouTube Video: Wolfram Schultz - Dopamine: from movement via reward to rational choice

YouTube Video: Dopamine Jackpot! Sapolsky on the Science of Pleasure

Paper: Dopamine reward prediction error coding- Author: Wolfram Schultz, MD, FRS

Article: Why does the brain have a reward prediction error? – Author: Mark Humphries

YouTube Playlist: Reinforcement, Permissions and Transfer of Value in Dog Training with Susan Garrett

Paper: Dopamine Modulates Effort-Based Decision-Making in Rats – Authors: Mark E. Bardgett, Melissa Depenbrock, Nathan Downs, Megan Points, Leonard Green

Book: Shaping Success by Susan Garrett

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About Susan

A world-leading educator of dog trainers, Susan is also one of the most successful agility competitors of the last three decades. She has won multiple Gold Medals at National or World Championship events with every dog she has ever owned over the past 30 years. Susan was one of the very first dog trainers to share knowledge online when she opened her "Clicker Dogs" website many years ago. Susan has helped hundreds of thousands of people enjoy a great relationship with their dogs through her workshops and keynote speaking around the world, award winning books, DVDs, magazine articles, blog posts, podcasts, free dog training and dog agility video series, and online dog training programs.

A natural teacher and an entertaining speaker, Susan is world renowned for her dog training knowledge and practical application of that knowledge. Her understanding of how to apply science-based learning principles to both competitive and family pet dog training has been pivotal in changing how dogs are trained.

Susan is now helping many thousands of dog owners in 82 countries have the best relationship possible with their dogs. The real joy for her comes from bringing confidence to dogs and their owner through playful interactions and relationship building games that are grounded firmly in the science of how animals learn.

Meet Us Online

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