A Conversation with Michael Platt

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Michael Platt is a Professor of Neuroscience at the Perelman School of Medicine, Professor of Marketing at the Wharton School, and Professor of Psychology in the School of Arts & Sciences at the University of Pennsylvania.

Jan Witkowski: I'm going to read a sentence from your work on human beings and on macaque monkeys: "Our findings suggest deep homologies in the biological origins of complex social function in human and nonhuman primates." That's a pretty big claim to make.

Dr. Platt: It's a bold statement, isn't it?

Jan Witkowski: It is indeed. So tell us a little bit about your research and that line.

Dr. Platt: It is a bold claim to say something is a homology, because that really means that it basically arises from the same biological substrate. It emerges developmentally in the same way, it serves a similar function, and in terms of behavior it looks the same, as well. My statement isn't just based on our work, but of course many other people as well. We have been fascinated by nonhuman primates and macaques in particular because their behavior, especially their social behavior, bears so many hallmarks of our own. They, like people, live in large groups that have males and females. They live a long time. They identify each other on sight, they know who is related to whom, they know who outranks whom. They understand third-party relationships.

One of the things that I think is really important about these animals is that they engage in behaviors that are very similar to ours to form cooperative alliances that they use to advance their own causes. Some monkeys invest a lot of time and energy in developing friendships. Friends come to their aid. We know that—just like for people—the deeper, more numerous connections that a monkey has, the better he or she is going to do. They're going to live longer, they'll be healthier, less stressed out, have more offspring. With people, it's more or less the same thing: live longer, happier, healthier life, even make more money.

The functions and the behaviors themselves are very similar and what we, and others, have begun to discover is that essentially the system in the brain—the circuitry that allows us to manage our connections with others—is exactly the same as what the monkey has in his or her brain. It's the same bits of stuff wired up in very similar ways. We have identified by comparison between mon-

keys and people that when we engage in various kinds of social interactions like this, the way that our brains process that information looks virtually identical to what we see in monkeys using complementary techniques.

Jan Witkowski: The experimental basis was essentially game playing, where a monkey would do better by being cooperative. Describe that.

Dr. Platt: Historically, much of the field of social neuroscience conducted in nonhuman primates relied on just showing monkeys pictures of other monkeys or showing them videos and looking at how they responded. But over the last five years or so our group has been one of the pioneers in actually creating controlled situations where monkeys can interact with each other, sometimes spontaneously, but other times through an interposed computer device. We teach monkeys to play video games with each other that are very similar to what we humans play with each other. One of the games is based on a classic economic game called "Chicken," where basically you have two cars. It's like James Dean in *Rebel Without a Cause* and they are driving at the cliff and we're going to see who's the first one to jump out of the car. In this case, the cars are driving at each other and each monkey controls a car.

Jan Witkowski: These are virtual cars on a racing track?

Dr. Platt: Yes, they are virtual cars. We display tokens on the screen that tell them what they could get if they drove straight ahead versus turning away from the other monkey so as not to run into him. We changed the game a little bit by adding a bar, a cooperation bar, that if both monkeys can convince each other to coordinate their behavior and take the risk that they won't be the only one doing it, they can unlock a jackpot. That takes, at minimum, coordination. It takes recognition of what the other animal's going to do. And it takes resisting the temptation to go straight ahead and potentially get a bigger reward, but at the risk of crashing.

Jan Witkowski: So by going ahead they could get the maximum reward.

Dr. Platt: That's right.

Jan Witkowski: By cooperating they get a smaller reward, but more guaranteed maybe?

Dr. Platt: Let's say there are 10 tokens straight ahead, three tokens for turning away, but if both monkeys turn away they can push the bar and unlock seven tokens. So they can do better than they would if they just acted alone.

Jan Witkowski: Seven tokens each?

Dr. Platt: Each, absolutely. There is always the temptation to go straight ahead, but then if they both do that they crash and nobody gets anything. It's a very interesting game.

Jan Witkowski: And you've presumably done various permutations. Have you tried gender?

Dr. Platt: That's a great question that always comes up and is very interesting. We have not, in that game, done the permutations with gender in monkeys, although we have in other studies that we've done. One thing we have varied is the relative social status of the animals, which has a big impact on how they play. Generally, dominant monkeys get to be a little bit more despotic. They take a little bit more than subordinate monkeys, and they can kind of coerce subordinate monkeys to cooperate with them under certain conditions. Overall, you see a flattening of the curve for cooperation as monkeys become more and more dominant. We don't know if that's true in people, but I suspect it might be, at least for—maybe not dominance per se, or power—certain personality types.

Jan Witkowski: Do monkeys that know each other cooperate faster or more effectively than strangers?

Dr. Platt: It's a great question. For us to believe that this is really a fundamentally social task, that the animals are treating it as a social interaction, you'd want to know that some aspects of the social relationship are actually modulating behavior. We know social status does, so that's one observation in support of that. Varying familiarity would be really important. We haven't had enough animals at our disposal to do that yet, but we hope to be able to do that soon. We have seen that in other studies. For example, the simplest game we ever had the monkeys play was a Dictator game and the monkey has the choice of picking a stimulus that will give you a reward or throw the reward in the trash can. Generally, they prefer to give a reward, but it depends on who you are. If you are unfamiliar to me, I'm a little bit less prosocial, a little less likely to reward you.

Jan Witkowski: You've also been pursuing the neural circuitry involved in these processes. What have you found?

Dr. Platt: In particular, we've been comparing neuronal activity in two areas that have been implicated very strongly in higher-order social behavior in humans. One is the anterior cingulate gyrus, which is an area that has been identified with empathy and learning from other individuals: what they've experienced, or their states. So,

something like empathy, like recognizing another individual got a reward or did not get a reward. Then another area which is rather mysterious is the middle superior temporal sulcus, which we now think is the homolog of the human temporoparietal junction, which is an area that's defined functionally: It's active in people when they think about the mental states of other individuals. Like, if I was thinking about what you are paying attention to, or if you know that when you walked out of the room I actually replaced your coffee with vodka, or something like that. It's an area that really is involved in this recursive thinking about another individual's mind.

We didn't know if monkeys really had that brain area or not, but this was a candidate. When we recorded from neurons there in this task, we found that neurons carried information that was unexpected because they signal things that were not just about the social perceptual context, like "Oh, there is a face of another monkey there," but signaled things like "Did I get a reward or not? How much information did I have about what the other animal was intending to do?" In particular, we found these neurons—that have never been described before—were selective for cooperating, and cooperating with a live monkey but not for cooperating with a computer or cooperating with a decoy monkey.

Jan Witkowski: The monkey can distinguish between a computer playing...

Dr. Platt: Or even, what's most surprising, a decoy monkey. One of our most important comparisons is when a monkey plays with another monkey sitting there, but the computer is actually playing. And the computer is playing a strategy that's not directly yoked to the player monkey. In that case, our monkeys identify that very rapidly and they're more likely to cooperate with a real monkey who is really playing with them versus a computer with a decoy monkey sitting there.

Jan Witkowski: The monkey that is playing can distinguish the playing patterns?

Dr. Platt: The playing patterns, plus we think they are also paying attention to other cues that are coming from the other monkey, other gestures and what that other monkey might be looking at and that there is some disconnect between the normal predicted patterns of what, if I'm playing with you I might look where I am going to go, and so that disconnect allows the monkey to make that distinction.

Jan Witkowski: Does the playing differ if you have the two monkeys but you shield them from viewing each other?

Dr. Platt: This is a great question. We haven't done that in that experiment yet. But in another experiment, we had monkeys playing soccer against each other. One monkey is kicking the ball, he's guiding the ball and the other monkey is the goalie, he's trying to block him. And monkeys play exactly the same way people do, down to every movement of their eyes and every dilation of their pupils.

It's really quite remarkable. In that case, the monkey plays the same if he's playing a live monkey here or that live monkey is in another room. They can pick up on the patterns of behavior that indicate that there's a real intelligent agent who's guiding things. Whereas, if he's playing against a decoy monkey who is just sitting there but the computer is playing, they play a very different game. It's quite clear that they distinguish those two conditions.

We have to be a little careful here, depending on the complexity of the computer program, the software, the AI [artificial intelligence]. I believe that if we made an AI that completely mimicked the behavior of a monkey online—a "Turing monkey"—it will be indistinguishable to a real monkey.

Jan Witkowski: You said that human beings play these games in a similar fashion?

Dr. Platt: In our human players and our monkey players we measure their gaze position, we measure the dynamics of their pupils because that's an indicator of arousal and engagement. We look at the number of redirections they make. We look at the trajectories. Everything about those factors is identical in monkeys and humans. Monkeys are a little slower in the game play. Their response time is a little bit slower, but that's the only difference. All of the factors that predict winning, we see in both species. Both monkeys and humans make a brief glance to the place where they will eventually take the ball to try to win. Even though between the moment that they look and then they start playing they're responding to the goalie and trying to outmaneuver him, but they eventually go to that spot, so they both have a plan well in advance, which is quite remarkable. The thing that is really interesting is that neither our monkeys nor humans have discovered this tell. Like, a good poker player would actually be able to figure that out.

Jan Witkowski: So you should be an advisor to a soccer team and coach the guys not to do this.

Dr. Platt: Well, I'd be very interested to know, and I'm sure the data are out there, how people really play soccer. Or hockey, which is actually the exact same thing as well.

Jan Witkowski: Thinking of human soccer players, you've mentioned that a striker coming in will make some gesture to fool the goalkeeper. Have you ever seen anything like that in your monkeys?

Dr. Platt: We call those "feints," and monkeys and humans both perform them but only when they are playing against a live individual. What they do is they try to get the goalie going one direction and then they rapidly change direction. They try to do it at the very last moment; that is basically the optimal strategy in this game. And the optimal strategy for the goalie is to wait as long as possible for commitment, and then shift. So it's kind of a showdown as they get close to the goal.

Jan Witkowski: And both the monkeys and the humans haven't picked up on this.

Dr. Platt: Not to our knowledge, but I think we need to look into that in a little more detail.

Jan Witkowski: What are going to be your next steps in this work?

Dr. Platt: We have some brain imaging work going on in humans to try to verify and validate that we get very similar patterns of brain areas actually activated. So far, that looks to be the case. We are going in many directions with this and they all involve really taking the reins off and allowing things to become much more complicated.

One thing that is pretty new is the incorporation of a third individual. We know that for animals, just like people, even just having an observer, an audience, changes the way that people interact. If somebody sees us playing a game that involves trust, my reputation is at stake if there is another individual there and so I might act very differently, especially if that individual could punish me. We know that that has a big impact, even on very simple interactions between individuals.

So we brought in a third monkey in the soccer game, and he is "passive." What we do is we cue the kicker monkey that occasionally he is playing for the benefit of that other monkey. When we did that, it was quite remarkable: Our kicker monkey started playing much harder. They made more fakes, their pupils dilated more indicating they are more aroused and more engaged, and they won more frequently—they beat the goalie more often. And when we looked in their brains we basically found that the signals we had already identified that were predictive of the strategy that the monkey was going to use became amplified. It was basically turning up the volume on this circuit, just the presence of that other monkey. The presence, and the fact that you're working harder for him.

Jan Witkowski: This is an example, I presume, of altruism. You're making an effort that you're not going to be personally rewarded for in a material sense; you're not going to get a treat or whatever.

Dr. Platt: That monkey who's kicking gets a reward. Irrespective, he gets a reward no matter what, whenever he wins. But when he is also working for the benefit of another monkey, then he plays much harder. He actually wins more frequently.

Jan Witkowski: That's altruism.

Dr. Platt: Altruism is a sticky concept, as you are probably aware. Economists think about it a little bit differently than, say, evolutionary biologists might think about it, versus philosophers. I take a pretty broad view: Working harder for the benefit of somebody else is altruism. Absolutely.

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