John Trueswell:
We are going to take questions, if you want to call people, that would be great, and I think that there is a microphone that is going to be sent around because we are recording this. I don’t know if...yes. So, raise your hand and the microphone will get to you. Right here.

Question 1:
Hi, you mentioned in your slide on what do we know about consciousness that self-consciousness is not necessary for consciousness. Can you elaborate on that?

CK:
Yeah, most of the time, so I think that the idea that self-consciousness is essential is promulgated by literary people who like to brag, who like to sit and agonize and think about themselves. But when you observe yourself, the vast majority of the time, you are not self-conscious at all, like when you were listening here, when I was really engaging, you were probably caught up with what I said. When you are out there running, you know, when you run or climb you are certainly not self-conscious because you have to be out there, because otherwise you are going to get badly injured. Also, fMRI imaging evidence also suggests that you can get vivid perceptual states basically by having very strong activity in the back of the brain rather than frontal lobe activity. It’s a hypothesis. It may be wrong, but it’s a hypothesis, that self-consciousness is just one particular aspect of consciousness when we turn consciousness onto ourselves and think about ourselves. But, when you are out there driving or when you are watching a really engaging movie, you don’t think “hmm, here I am watching a movie,” you are in there, you are loving and hating with the actors.
Q1:
OK, but that loving and hating with the actors, presumably, depends on also having those same kind of feelings yourself and being reminded...

CK:
Yes, just like an animal, but that doesn’t mean, I don’t see why it should depend on me reflecting upon those feelings. Self-consciousness is not the fact that I love and hate; it’s the fact that I can reflect upon that I love and hate, and that I think is unique to us, but I think that that is a late evolutionary elaboration of a much more basic mechanism.

Q1:
OK, so, another question I have is, in your experiment with the naked people where you show that people paid more attention without being able to say what they saw, you basically said, well they were unconscious because they were unable to tell you which side they were on, but it clearly affected the behavior, so, in this sense, you seem to be defining consciousness by what people are able to tell you with language. Is that...

CK:
Well, no, two ways, the way you design an experiment, you first try it on yourself, you don’t talk, you just do the experiment. I’ll bring you to the lab, you’ll see, you just don’t see it. I can also be quote “more objective,” I can give you a button and say, “Every time you see a naked person, push a button,” and then I see they don’t push the button. It’s purely behavior, there’s no language, just pushing a button, they don’t push the button that they have seen a naked person, yet, I can show you using this, well, Jiang He showing you the potential after-effect. He paid attention to the side with the naked woman was on if he were a straight guy.

Q1:
Right, but, so, in this case...

CK:
So, it depends on some behavior at this point to measure it, yes.

Q1:
But, you also have a discrepancy between two dependent measures, and you are basically defining one as annexing consciousness and the other one as not annexing...

CK:
No, there is no discrepancy, both talking about and pushing a button you don’t have access to that information.

Q1:
Right, but I am talking about pushing the button or talking about and this intentional measure.

CK:
Yeah, so, it tells us - but, we know this – that many things go on in your mind that you have no idea go on, right? If I tell you how does your kidney work? You have no idea how your kidneys work, right? You don’t have access to your kidneys; it’s a complicated biochemical process. So, just likewise, in this case, you don’t have access to gender-specific information in your brain, yet, something in your brain does, but not the conscious you.

Q1:
Thank you.
Question 2:
Yeah, I was also really interested in this new disassociation between attention and consciousness, so, if I followed it correctly, you can show that you can shift attention, or you can measure some shift in attention, in the absence of consciousness, but can you disassociate the other way? Can you show that there is consciousness in the absence of a certain amount of attention?

CK:
Yeah, so that is a little more controversial because it depends on the exact definition of attention. And some people, like Ken [Yakanama] will say, “Well, every time you are conscious, by definition, you are attending to it.” So that is very difficult to prove. So, for example, [McEnroe] did these experiments where he flashed up—it’s a very simple experiment—I flash up a card and I ask you (I only do it eight times per subject, so I need very large pools of subjects), I ask you “is the vertical arm longer than the horizontal one or not?” And on the third or fourth trial, totally unexpectedly, so you do it once, second, third time, fourth time, I flash up a triangle or something. Many times, people don’t see it at all, so, this is called inattentional blindness, because you don’t expect it, you’ve never been told. Yet, you can still show even under those conditions when you don’t expect things, if I, for example, flash an entire scene, you can be perfectly conscious of the entire scene; you get what is called “disperception,” you can say “oh yah, there were two people sitting around a table,” although I’ve only given you ten milliseconds to do that, and totally unexpectedly. So, under in those conditions, there doesn’t seem to be a lot of attention around.

Also, I don’t really see computationally, if I put this single piece of paper on a screen, like you would do in a monkey experiment, I don’t see why you need attention, because attention is to select information, but there’s no other competing stimulus there. Furthermore, you can really do demanding experiments when you really have to
tend to some stimulus like in dual task, but you can show there are a lot of things that you can process outside your focus of attention. It’s not, if you really attended, everything becomes black. If it’s really true that you can only see the things you are attending to, then, if I am really attending to your face, every thing else should disappear into black and nothingness, but that is not the case. You still see something. What you see outside of the attention is low bandwidth, but you still see something. Attention is an amplifying step, and, under many conditions, there is no need to do the amplification. But, it’s more difficult to establish. I think more people now accept that you can get attention without consciousness, the other one is more controversial. Yes?

Question 3:
Do you think of conscious states as being all or none or graded? And would that change the way you think about it?

CK:
It’s a very interesting question. So, I think, any one attribute, there is some evidence that suggests that, for example, we talked about the yellow; either you see the yellow or you don’t see the yellow. There can be greater states of consciousness. You know this, when you get up, you’ve only slept three hours, and you are barely awake. You are clearly less conscious, like right now, you’ve had your cup of coffee. So, it is clearly both a graded property due to the graded enabling system in the brain stem, you know, if you are not wake up yet, you are still in your sleep cycle, they aren’t firing as vividly, so you are probably not going to get as large a coalition of neurons, but, then, it may well be that any one conscious attribute itself, whether you see the horizontal line or the vertical line, or it’s a male face or a female face, those are all or none. If that is true, that would give rise to a simple prediction, at the neuronal level you should see these all or none transitions between a group of neurons that fires, let’s say, high or low, or fires in an oscillatory manner or in a non-oscillatory manner. So, we don’t know. People have different opinions on this.
Question 4:
I have a question. Many people believe that there is little causal relationship between consciousness and behavior. You touched on this; would you care to give us your viewpoint?

CK:

Yes, as you mentioned, there is the epiphenomenal point of view, that consciousness is there, so, there are several philosophical reactions. Some people, like Dan Dennett, of course, claim that consciousness is just a big illusion—you are just totally confused about it, and it doesn’t exist. I just don’t buy that, because consciousness is such a simple part of my existence. Then, there are people who say, like John Searle, that it certainly exists, but I am at a loss to explain what the function is. I find this also very difficult to believe, because it is so highly structured, so consistent throughout my life, it would be very strange, very unlikely event for evolution to have evolved this consciousness without it having any function.

So, essentially, because we are a product of seven hundred million years of evolution in multicellular organisms, it would boggle the mind if this just were purely epiphenomenal without any function. The test, of course, would be...I mean, the shoe is on the other foot, they have to show me a case, these people who claim that it is epiphenomenal, where you get all the behavior without consciousness, and I claim that you are not. Every time you get a loss of consciousness, you will get a loss of some sort of behavior. I claim that there will not be any case where you get full panoply of behavior without having consciousness. I don’t think that will ever be the case.

Question 5:
Testing...you somewhat avoided defining consciousness, cleverly, and I am trying to understand what it is, perhaps, beyond awareness. And I thought one way to ask that question is, if I look at your experiment with Poggio of the machine vision, that system then recognizes and can say I see a “car” as it were, is that system conscious, and, if not, what is it missing?

CK:
I can tell it in one state that it is missing. One hallmark of consciousness is the integrated nature. You can show me any scene, things I’ve never seen before, and I can very quickly describe you what it is, and I can make all sorts of connections. This machine right now knows about four things; it knows pedestrians, cars, trucks, and cyclists, I think. It doesn’t know anything. It doesn’t know whether the truck is upside down, or whether the truck is in the sky—it doesn’t have any other knowledge. There is no integrated information. Key hallmark of conscious information—it’s integrated information. So, I do believe in the fullness of time these guys, you know, computers, ultimately will be conscious, but you have to think about this measure that Tononi for instance calls “integrated information,” which is different just from Shannon’s information, and that is missing. This system is still a very, very primitive system compared to anything. It knows so little and it is so brittle compared to anything, us, or a fly—even a fly has a much more sophisticated visual system. So, that I think is ultimately what’s missing. So, I do believe, ultimately, we’ll be able to build artifacts that have consciousness, maybe even more consciousness than we do.

Question 6:
I just wanted to talk a little more about the ethical implications here. So, is there is a danger if we operationalize consciousness into something that can be measured, that we’ll suddenly come to conclusions that rats and insects should be treated better than anencephalic infants, and that, on a social level, we will prioritize our ethics differently
and not give protection to individuals that may not be as conscious, or conscious at all, but maybe deserve the most moral protections by our society?

CK:
Well, today, we are making decisions every day, right? In abortion, like Terri Schiavo or other cases, when we deny care, so, all I am saying is, the more we know about these cases, the better, the more educated a decision we’ll be able to make. We have to make them as a society. I am just one member of society. We have to make them. The particular thing with technology, you see, until thirty years ago, death was easy; you stop breathing, you were dead, right? People like Terri Schiavo couldn’t exist. Now, today, with technology, they do exist, and there will be more harrowing cases like that, where we can keep people alive indefinitely. We are going to be more and more confronted with these cases. We will be confronted with cases of machines and people merging where we don’t know is a machine or is this a person? And so, we have to think about these problems—are they sentient? Once a machine is sentient, can we just turn it off at will? Yah, so we have to confront these problems, so, in closing, not doing the research I don’t see why that would be better. Yes, it’s going to violate our cherished traditions that possibly violate the simple stories that we grew up with over the last three hundred thousand years, but we have to understand where we are in this universe and how we find ourselves in it and then act accordingly. I don’t see any alternative.

Question 7:
There is a very close relationship between attention and memory and consciousness. So, how do you comment on memory’s role to produce consciousness? And is it possible to produce consciousness without memory?

CK:
We know from patients that you don’t need long-term memory. If I lose all my memory and I don’t know that today is March 28th and, in fact, I think I’m back in 1972 and I think it’s summer and in California, the patient is still perfectly conscious. So, you don’t need long-term memories. Also, working memory, you probably don’t even need working memory. All the evidence suggests that probably only need a very short form of memory, like anaconic memory, a memory on the order of a few seconds in order to be conscious. The other memory you need, of course, in order to be intelligent or in order to survive, but you probably don’t need it for consciousness.

Question 8:
Hi, thinking back to the example with the machine learning, the classifier. What would you comment about, say, infants or someone who can’t really identify these objects anyways? So, maybe they can only identify four objects as well, so, are they unconscious in that case?

CK:
This is the danger with machine consciousness because just because you can get a machine to do one particular thing that a human can do doesn’t imply... I think at this point, machines and biological organisms are so far apart that I’m not sure how useful it is to directly compare them, because, you are right, an infant doesn’t know what a pedestrian is. Now, it’s also a legitimate question - to what extent is an infant conscious? People ask this question in the context of, for example, premature birth? If you have somebody who is born at seven months or eight months, are they conscious? Of course, emotionally sentimental, we, of course, we immediately say yes, but we don’t really know. So, one way you can test this, for example, is to do imitation learning. If you do something, you make a face, you wiggle at them, and they can, for example, delay that and, two or three seconds later, respond. So, the operational tests like this that tells you that, probably, an infant, even born, let’s say, after eight months, is probably already conscious. It’s a simple measure right now and it’s just a practical
operation measure because we don’t really have a science yet of consciousness, we
don’t really know for sure whether it’s conscious or not.

Question 9:
Is it possible to build an ethical machine?

CK:
Yeah, read Asimov’s “Three Laws of Robotics.” Yeah, I think that it is possible to build an ethical machine. We haven’t done so, but I don’t see...

Q9:
There is a philosophical problem with ethics, which is called relativism. Whose ethics?

CK:
OK, but you asked the question “can you build an ethical machine?” Yeah, you can build a machine that follows certain ethical precepts. I think that’s possible, but that is really very different from consciousness. I think you can build a conscious machine.

Question 10:
Do you ever think there will be a widely accepted definition of consciousness?

CK:
Probably, yeah; it’s like in any other science. You look at genes, you look at planets, people will redefine it. Last year, we redefined what a planet was. Pluto is not a planet anymore, I don’t know if you’ve heard. So, we redefine these things, yeah. Once, in the fullness of time, I think there will be a general, accepted definition of consciousness, just like there is for all the other objects of scientific study.

Question 11:
So, in the example of the yellow dots and blue spheres, one thing that often happens, that I wonder with these illusions, you are conscious of something, you’re conscious of the absence of the stimulus, you’re conscious of it disappearing. So is that going to affect how these sorts of data are interpreted? Because it’s not the case that you really are unconscious, unaware, of something going on, you’ve just made a decision about reality...

CK:
Well, whether you made the decision, and who the “you” is, is another question.

Q11:
I’m not saying that, I’m just saying that the phenomenon is...it appears that there is some kind of decision about presence versus absence, and an awareness of that.

CK:
So, I think that you are right; it’s a subtle process. It’s a complicated thing; there are subsidiary processes, like absence. You know you should see something, but you don’t see it, and I think it’s another conscious attribute, and the attribute of appearance and disappearance are also other conscious attributes. So I think most conscious perception is the sum of very different things, and each one of them will have a neural correlate that we can, probably, at some point target specifically. So, we should be able to, for example, make that you don’t have this disappearance feeling anymore, that we can manipulate it specifically as we get better at understanding the brain and have better, more sophisticated psychophysical techniques. So, I think that we can begin to interfere in a more and more specific way, but, you are right, it’s not as simple as I made it out to be. It’s a complicated thing, but, just like in genetics, the power of the genetic approach in the 30s’ and 40’s and 50’s was that people said, “Let’s not worry about human genetics, because that is probably going to be very complicated, let’s study it in bacteria or in some simple animals, in phages (you know, viruses that appear in bacteria),” and,
turned out, in that case, spectacular, that everybody uses the same mechanism. And so, here, rather than studying...most people when you talk to them about self-consciousness, they want to study the body image or what I think about myself. Those things are very difficult to study in the lab, but things disappearing and appearing that’s easy. We can do it in a monkey, we can do it in a mouse, and, yes, it’s simplified compared to real life, but, just like in any other science, once we understand how this works, I think it will be a huge step forward to understanding, in general, how consciousness works.

Question 12:
Well, my question is, perhaps, a little similar. You started out by talking about the fact that we used to think the question, “What is life?” was mysterious. And now, partly, because of the discoveries of Watson and Crick, we feel that we understand something very fundamental about “What is life?” so it’s no longer mysterious. So, I’m wondering if you would speculate if there will be a fundamental discovery of “DNA” in the realm of consciousness, what that might look like? What would that be?

CK:
I can make a personal and a general remark. The personal remark is that Francis Crick, of course, was driven - early on at least, he got a little more skeptical in his last few years - but early on was the belief that, just like he had the “eureka!” moment with DNA in March 1953, that there will be a similar moment with consciousness. I don’t think so and he didn’t think so either, because the brain is much more complicated than genetic operators. Just stepping back to answer it a little bit more general, I think there are two approaches you can do. One is you see consciousness as an emerging property. It has something to do with brains that have ten to the twelve components or twelve to the fifteen components. It’s an emerging thing and we don’t need any new laws. No new laws of physics or quantum mechanics or of information theory.
The other approach you can say is so radically different, because it has this feeling, first-person perspective, of anything else in the known universe, that, probably, I have to, just like people were confronted with in the seventeenth century or in the eighteenth century and early nineteenth century, when they realized they couldn’t describe the universe without introducing this new thing called “magnetism.” In the twentieth century people realized we need to assign a property called “spin up or spin down” to electrons, to small particles. So, it may likewise be, that in the fullness of time, we realize we just have to introduce something fundamentally new into the universe to charm us into an only thing that relates to information, in particular to integrated information. That’s one approach to the dual aspects of information theory. Or maybe it is something else that we have no idea right now what we are just totally missing. He in this book very nicely talks about that, that we may just be missing something totally. We need a fundamental new insight, and, once we have that insight, then maybe afterwards we’ll say, “Of course! How can it be anything but?” We don’t know. You often don’t know how the final solution looks like unless you stumble on it.

Question 13:
So, would you say that we are at the “Mendel” level?

CK:
So, I’m a physicist. I think a lot with respect to where the science is. We are probably at the stage of Galileo. We are beginning, just like He at the telescope, we have the microscope, the microelectrode, and the imaging scanner. So, we are now beginning to have the simple tools that we can use to peer inside the brain, dissect it. So, I think that we are at the level of Galileo. We don’t have a Newton yet and we are far from an Einstein. What I mean, we don’t have quantitative theories of Newton or of Einstein.

Question 14:
I have two questions. I may have missed something, but, back on the blue sphere, has anyone done tests to check for differences in the activity—the synaptic activity—if the yellow squares actually are made to go away without telling the subject? And the second question is how many times did they pass the basketball?

CK:

How much what? Oh, fourteen. Nobody has looked at synaptic levels, in fact, that is a good question. When the things appear and disappear, is it neuronal population or is it synapses? For similar illusions, we know that it’s neuronal population that fire and don’t fire in monkey experiments. People have done similar experiments in monkeys in a high-level part of the brain called the inferotemporal cortex. There you can see neurons being silent when the monkey doesn’t report the one percept and firing strongly when the monkey does see it. So, there, it seems to be really switching of neuronal populations that go on or off in a binary manner that really nicely mimics their behavior. There, you have a very nice relationship between the percept of the monkey, the inferred percept of the monkey, and the underlying neural hardware. Whether that ultimately reflects synaptic properties, we don’t know.

Question 15:

I’m curious with the ethical implications, whether you often encounter resistance when you discuss the ideas of consciousness in animals, specifically, as you are obviously doing some animal research yourself, and in presenting this research to a lot of animal researchers? And, also, as you’ve mentioned here, in terms of the atrocious conditions under which animals are raised to feed us, as well, if we were to remove the atrocious conditions, and just have the statement, “Should we just raise conscious creatures to eat them?” would you be ok with that, then?

CK:
Well, if you’ve ever been to a slaughterhouse or see movies about it, it’s pretty bad, actually.

Q15:
I’m asking that if you would remove that component of the sentence?

CK:
So, they are very different audiences that object. A lot of people, particularly in this country, object to the idea of science taking on consciousness, because they are afraid it’s going to leach out any remaining meaning that the universe may have, and that, ultimately, we scientists, love to take out the meaning and pull the rug out of people, so they’re left in this empty void, a voidless universe that has no meaning. So, there are a lot of people who object against science studying consciousness at all. Then there are different audiences, yeah, so when I mainly talk, of course, to neuroscientists, and some people get uncomfortable, and, myself, I’m conflicted because of animal experiments. So, there, my answer is, like anything else, any other moral question, there are shades of it. One of my daughters died of Sudden Infant Death Syndrome, my friend died of schizophrenia, my father died of Alzheimer’s compounded by Parkinson’s, so, if we want to eliminate those curses, we have to do animal experiments, with care and with passion. So, that’s how I think about it. Yeah, there are different people. Thank you very much.