

The Science Studio Interview With Susan Greenfield

Roger Bingham: My guest today in the Science Studio is Susan Greenfield, more properly Professor, Baroness Susan Greenfield, Professor of Synaptic Pharmacology at the University of Oxford, but, more importantly, the Director of the Royal Institution, which is one of England's premier institutions for getting out public understanding of science. Susan is in the United States, she has a new book out, called *The Quest for Identity in the 21st Century*, and it has caused a certain furore I must say.

I was watching some of the interviews on BBC *Newsnight*, and I've been reading some of the headlines about whether screen-based media changes our brains, screen culture and so on, people of the book versus people of the screen and so on. Why do you think this has had such a huge effect?

Susan Greenfield: I think a good analogy might be perhaps when people first started to suggest that smoking and lung cancer could be linked. The last thing you want, if on the one hand you're enjoying yourself doing something, and on the other hand you're making lots of money out of it, the last thing you want is someone to come along and say there might be a problem here. T

his furore that you allude to has often been based on a misunderstanding of what I actually said. The original speech, which was made at the House of Lords in the middle of February clearly just outlines a very simple syllogism, which is that we know the brain is very sensitive to the environment, unquestionably, the environment is changing, kids nowadays are spending six hours a day or more in front of a screen, and therefore, if the brain is sensitive to the environment and if the environment is changing in unprecedented ways then it follows that the brain might, and I stress might, be changing in unprecedented ways.

And the reason people felt so angry suggests that there may be perhaps an element of reality there for them, an element of truth. If I said to you, "the earth is flat," you wouldn't get angry, there wouldn't be a furore, you would just feel rather sorry for me. You would take me aside, you would explain where I was wrong. But the fact that people seem so hostile based on, may I say, the misunderstanding that I've said this bad in the first place, I think suggests to me that there is a debate to be had and experiments to be done. And, perhaps, regulation to be introduced.

Bingham: Well, now, you didn't say this bad. One of the talks you gave recently, which I was at, you showed something from a British newspaper which showed, and I'm going to get the figures approximately here, but between the tenth and eleventh birthday a child is in school for about 900 hours.

Greenfield: That's right.

Bingham: With the family for about 1300 hours, and watching a screen of some kind for almost 2000 hours.

Greenfield: That's right, that's right.

Bingham: Now, question is, is that just the way technology has gone, just the way things are, because one of your critics said "Well, you know, all we're talking about here," he said, after you gave your speech at the Royal Institution, "is that there's always been simulations, and fiction is simulation, Shakespeare is simulation and so on and so forth. This is just high-bandwidth simulation, nothing wrong with it". How do you like that? Who was that by the way?

Greenfield: Well, {unintelligible} I think in the Van Gogh we have this guy, Ben Goldacre, who, to the best of my knowledge, has based a lot of his criticism on the idea that I've said screen technologies are bad, and I've never said that. But we'll leave that to one side because why spoil a good story if you can actually enhance or exaggerate what you think someone said.

Bingham: The other thing, just to include that, the person also said, "What's the difference between now, and aren't we just being sort of technophobes? I mean what's the difference between now and somebody in the Victorian times or earlier saying 'Get your nose out of that book, go and do something worthy'?"

Greenfield: Okay, well, both those statements you've made aren't really related. One is saying that being engrossed in a book for a long period of time is as bad as playing computer games, and the other is saying that books and screens are the same type of experience.

Now, let's just think about that, because I don't think that ultimately really stacks up. When you read a book you go on a journey, and you go from the beginning usually, to the middle, to the end. You don't randomly access the book unless it's a dictionary or something like that. Most typically when you read a book the notion is that there is a narrative there, and you are led by the author, the authority, who takes you by the hand and therefore leads you through a sequence of steps. Logical steps, or quasi-logical steps. It is uni-directional, you can't go the opposite way because the sequence, the narrative is very important. Now, it might be a journey that you don't enjoy, or that you don't like, but it is a journey nonetheless, and intellectually you end up in a different place from where you started.

So, what happens is, the human brain being what it is, you then evaluate that journey in terms of previous journeys you've made and previous books you've read and experiences

you've had in the three-dimensional world, so that gradually, in this world in which you normally live where actions have consequences, where there is a certain sense of a single direction in which you're traveling. Then gradually you build up a conceptual framework in which you evaluate subsequent books and subsequent events so you can, if you like, check them off against the checks and balances of the adult mind.

Now, that is very different from being in a world that has no consequences, where the emphasis is on the experience, rather than by the logical sequence of a past, a present and a future. And what I've said {unintelligible} and nonetheless I think it captures the difference, is when you play a computer game to rescue the princess, you don't care about the princess. But when you read a book you do so because you care about the characters, you care about the princess. And when you say you care about someone it's because she or he means something to you, which is why you're following their fortunes in the book. The fact that they mean something to you is because you can actually place them in a context where they relate to other associations.

Now, if you're in a world stripped of any cognitive contact, where the premium is on strong stimulation of the senses, that can be very nice. We all do it. We all go dancing, we like skiing some of us, I'm sure most people like sex and fine food and music and so on. So I'm not disparaging choosing that kind of experience, that hedonistic sensational experience from time to time. But we also counterbalance that with the cognitive experience of a world where we do think, hence the term, where thinking does entail a sequence of logical or quasi-logical steps. So I think it really doesn't get past first base to think that books and screens are the same thing. They serve different purposes, they provide different experiences, and they rehearse different mental abilities.

Bingham: Now, your critics are incensed by the fact that you take this a step further, or at least suggest the possibility of a step further. You are, actually, quite careful in your words, but nonetheless you do say, "Here's this stimulation coming at you, hours and hours a day, young brain, highly impressionable, is it any surprise, or is there a correlation between the fact that we have this huge increase in the number of people with ADHD, attention disorders, deficit disorders, and increasing prescriptions for Ritalin and so on and so forth? Does that have anything to do with screenlife?" And-

Greenfield: Well there's certainly a correlation, because that is what a correlation is, when there's two things happening. Whether they're related to each other, whether there's a cause or link, I am merely suggesting that we should perhaps explore that, because we do know that the human brain is very sensitive to the environment. And if that environment, especially for very young children, is one where the attention spans are very short, where screen experience mandates a very short attention span, where you press a button and something happens, you press a button something happens in rapid succession, that can actually be in itself very addictive and exciting, to have the instant feedback.

If you'll then place yourself in a world where you have to sit still for twenty minutes or half an hour it may just be that you would fidget a bit and people would say that you have an attention issue. So I think it's the kind of information we need to explore this, because heavens, is too important to be complacent, and what annoys me about some of the critics is that they don't know any better than I that something is or isn't the case. Assuming something is not the case just because it's convenient to do so is something I think the next generation {unintelligible}.

Bingham: Could you explain a little about something I saw in the British press, I don't know whether it's widespread here or not, but my understanding is that to keep up with technology it's now part of the curriculum in English schools, to actually keep up with these technologies. And there's a piece I read where you were complaining about the "twitter-iculum".

Greenfield: Yeah, well, the latest report suggests that young primary school children, kindergarten children, should learn Google. Now, what they omit is to actually suggest what they might be googling on. And I think we've got ourselves a bit back to front, and that to have people up to speed with technology begs the question of what you're going to use the technology for. I think that we shouldn't be saying this is a society with a certain technology, therefore we have to fit in with it. Surely we should say what do we want our young people to learn, what do we want them to be? And then harness that technology to deliver what we want rather than the other way around. We don't want the tail wagging the dog.

Bingham: People seem to survive, though, I mean, these transitions of new technologies coming in in the past, you're not content to just sort of say "Well, let's see what happens".

Greenfield: I think "let's see what happens" is a very dangerous attitude to take when it comes to the next generation and it comes to our whole society. I don't think people, when they were first worrying about smoking and lung cancer, or indeed about global warming, would have been very persuasive if they'd just said "let's see what happens" and shrugged. It's too important and expensive an experiment to make to just see what happens. In the past the technologies have driven and been part of the culture, they haven't been a culture all of their own.

So, for example, I'm old enough to remember the introduction of television, certainly in the U.K., which probably, inevitably, lagged behind the U.S. But we had one television in our home and, being my family, we talked all the time anyway while watching it, perhaps like many. But the television in a sense was the latest advance over and above the Victorian piano as something that actually was the center of attention. But it facilitated interaction and discussion and a family evening together rather than being a culture all on its own, whereas nowadays you have someone going up to their room alone, and sitting there communing with the screen alone.

Never before, never before have human beings, in the hundred thousand years we've stalked the planet, used the precious free time they have, and heavens we have more than any other generation because technology has given us a longer life and freed us up from drudgery. Never before, in any culture, to the best of my knowledge, has any human being chosen to spend their premium time alone, playing a game that means nothing and teaches them nothing, benefits them in no way whatsoever other than by delivering a here and now experience. Only very small children do this usually, and normally by the time you develop and grow and mature, yes you might play a game because it's a vehicle for social interaction, charades on a Christmas day, you might play games because you want to get fit, but it's all because there's some ulterior motive, team bonding, this kind of thing.

But very rare to play a game all alone and the game means nothing. When you finish the game guess what – you can just play it again. And again and again. And it has no consequences at all. And you just start from zero again and play the game again. It's meaningless. You've spent your hour or your two hours in an activity that has had no forward narrative, had no consequences to it. Now, it may be that we choose that, but I think, given the impressive cultural explosions that we've seen over the centuries that human beings are capable of, what a waste if, ironically, technology is delivering all this free time and leisure and a longer life, and at the same time really limiting us to just being small children.

Bingham: So you think, I mean, this is new, I can see the irony of this, it would upset you.

Greenfield: I think, it irritates, you know? It's more, I think it's rather tragic actually.

Bingham: So, there's an infantilization of the mind, if that's a good word. There's this mental masturbation going on, essentially, and instead of Second Life you're saying get a life.

Greenfield: Well, let's be clear about the screen activities that we are referring to. Although there's certain overlap, I think one can nonetheless think and talk in separate breaths about Second Life and I'm sure everyone watching this knows what Second Life is, although surprisingly, when I've given talks recently there are people within the audience, a majority, who still don't know quite what it is. But, as everyone knows, Second Life is not a computer game. It is, as its name suggests, a cyber-life where you can be a {unintelligible} I don't know, dragon slayer, or something like this, or even have whole economies in a virtual world.

So there's that, offering experience offers you a second identity as opposed to a game as opposed to social networking sites. I think the three activities clearly have different issues or different emphasis one would want to explore and discuss, so on the one hand you can do a little bit of an umbrella overview of all three, it may be some of the issues that one of these activities raises does not apply so forcefully to the other.

Bingham: So, do you, I checked, you actually did try a Twitter account at one point.

Greenfield: I didn't.

Bingham: Was there somebody who faked it on your behalf?

Greenfield: I never had one. Now, you see that's scary, isn't that, what people do.

Bingham: Today's, here's one small possible counterargument. Today's Guardian, in the U.K. The editorial actually says "*Twitter: tweet nothings* - You want to know what happened over the weekend? Well, Barack Obama reportedly wants direct pre-election talks with Iran, Microsoft is about to launch a new search engine and Elizabeth Taylor tried to smuggle a new puppy into hospital". There are a lot of these things here and their basic argument is that actually "a space is emerging in which people can communicate with each other based on mutual interests," so there's almost an {unintelligible} endorsement of this in the global village. And about 140 characters can be made to have some effective force. I mean, do you buy that?

Greenfield: No. Let's just think about that. How sad that a species that previously wrote novels and expressed themselves in 1000 word letters are now having to encapsulate important or interesting ideas in 150 characters. And that's the first issue. And if you are used to doing that you are going to start living your life in windows of 150 characters. And I do find that rather sad. Secondly, there's many ways in which you can have debates and discussions. You can go to the pub, you can go out on the street, you can go to universities, you can come to the Royal Institution in London.

There's many many places and ways in which you can discuss ideas with each other. You can go and sit in the piazza, what a lot of people have done for generation after generation, it's three dimensions, and discuss and explore topics. So to say that this is the only vehicle for debate and discussion of people who are ordinary human beings, who aren't in positions of power, who don't have platforms that politicians have. I find that a bit disingenuous here.

Secondly, if you just have a readout of information like this, out of context, then one does question the value of it. So, information is not knowledge and we shouldn't confuse the two. The fact you can access information from even in 150 characters is only the first step. If you don't have a conceptual framework in which to place it, or if you have no other facts to which it should relate, then actually I would question how it's going to help you or give you any insights into anything. Are you just going to say, "Wow, Elizabeth Taylor smuggled a puppy in, far out" and then press on? Is this really very valuable? Truly?

I think, I don't want to throw the baby out with the bathwater. Look at MIT who put all their courses on the web, wonderfully, for anyone to access, even though they can't register. Of course, it can be a very powerful and useful and fantastic way of disseminating

information, but you can't assume that the passive receiver is already up and ready with their conceptual framework in their Renaissance mind to then appreciate what the fact is. And more, that they can then in a limited space actually discuss and debate it.

So, I think that on the one hand, yes, the technologies are very valuable, and I'm never saying that they should be abolished, any more than you should abolish chocolate, but you wouldn't recommend doing nothing else other than eating chocolate. You would recommend a healthy balanced diet of which chocolate was a very small but interesting and fun part. So I'm not saying they shouldn't do Twitter, but to just do that, to rely on that for your social interaction, for your sources of information, for your way of thinking about the world, I find totally inadequate.

Bingham: Let's just cut to a couple of other things for the time being. One of things that I keep on getting asked is how do you get to be a baroness? What does that mean? Do she have lots of land?

Greenfield: Oh I wish.

Bingham: Would you just mind unpacking that?

Greenfield: Okay, well we have to go back in history a little bit. The way the government of the U.K. is organized is into two chambers, like other countries now, where we have the House of Commons, the elected, democratic chamber, and the House of Lords, which up until 1958 was composed of so-called hereditary peers. That is to say, for want of a better word, nobles, who traditionally would have owned land although that's not a prerequisite, some don't anymore. But you do inherit a title of one sort or another, whether it's baron or earl or duke, from their father. And up till 1958 because it was shown that the majority of these folk, perhaps not surprisingly, were Tories, were rather right wing.

The government brought in a system whereby you could have much more balanced representation of the House of Lords, by a system called life peerages. And these were traditionally emeritus politicians who had served with great distinction who were nominated by their party to serve in the House of Lords. Therefore one could actually restore the balance a little bit of our right and left wing parties, our Labour and Tory parties.

When Blair came to power in 1997 he promised reform of the House of Lords, which is still going on. It was in 2001 that he introduced this notion, which the press called People's Peers, which is actually misleading and led to a great outcry because it suggests that one is randomly selected from people walking in the street, folk that could actually come and actually talk in Parliament. Rather, the idea was to select people who would serve on the cross benches, that is to say, who would be neither Tory nor Labour, but who would serve sitting in the middle, who would be apolitical, who would be able to vote

either way. That is to say they wouldn't, rather strange phrase, take the whip. The whip is where, within a political party you are told how to vote, so if you don't take the whip it means you can vote as you choose.

So, the system of these new types of peerages were for people to be for life only, rather like their counterparts from 1958, but at the same time not political, but to be there to represent certain areas of expertise. In my case it is science, but there's diplomats, there's military people, and so on, there's educators, there's physicians. So, we have a rather wide representation now on the crossbenches of we nonpolitical peers. And the way we were selected was from nominations and then following that an interview with a cross party group who grilled us.

And then in my case I was very, very surprised, because there were thousands of people, as you might imagine, up for this, to be one of the first 15 to be selected.

Bingham: Okay, so you were in the first batch.

Greenfield: I was in the first batch, yes.

Bingham: And in fact a lot of people do come from science. There's in a fact a considerable representation, a reasonable representation. I mean, I'm thinking of in total.

Greenfield: Yeah.

Bingham: In contradiction to here where there's very few scientists in politics.

Greenfield: Well, this is something, when people sneer at our House of Lords, when they say that it's not democratic, we say it depends what element you wish to have in the Upper House. If you want it to be a pale imitation of the House of Commons, if the most important thing is that it's elected, then you're going to have to put up with the fact that you might elect people who don't have wide sweep of expertise. Yes it would be elected, it would be democratic, but you will get the same kind of composition of expertise as you get in the House of Commons. Whereas if it is selected, and it has to be completely fair the selection process, then you can ensure, and I'm very proud to be part of, an institution where there's a very high representation of scientists, for example.

So we've had debates on stem cells and anyone who wished could {unintelligible}. And there I spoke on the neuroscience of stem cells, other people spoke on regulation, others on the ethics, others on the economics of it. It's been fantastic to have that.

I see you've also got a report that has arisen from an old party group I started on neuroscience and education. And so, these are ways that one can use the House of Lords as a platform. And indeed, the debate that you've referred to which caused a furore was a

speech that I made in the Lords. And that's what started it, I used that as a platform to express my thinking on that.

Bingham: There's a consistent theme here, brain science in the classroom. And that's something that as you know we are very concerned with here, with the Temporal Dynamics of Learning Center. And it comes under the egis of the Institute for the Future of the Mind, which is part of the thing that you're associated with at the University of Oxford as well.

Greenfield: That's right.

Bingham: So, you're packaging together, you're utilizing your science to inform your policy, positions.

Greenfield: That's right, that's right. Well, my own view is that the 21st century science, sorry, the 21st century scientist has a duty to the taxpayer and a duty to society to look beyond the ivory tower and look beyond the main concern of most scientists, which is getting a grant. Because although that is important in order to do your own research, at the same time science is not the heart of society. As Carl Sagan said, it is suicide to live in a society dependent on science and technology, where no one knows anything about science and technology.

So what we have to do, whether we like it or not, to the best of our abilities we scientists, we have to talk to politicians and the press and the general public, because only in that way can the public have a view and be empowered, and that's something I feel very strongly about. It's very sad when within the scientific community, as indeed this guy Ben Goldacre has said, you know one shouldn't do this, one should just stick with what you know. And I think that that is again a very narrow interpretation of what scientists know. What one should do is one should apply what one knows.

Bingham: Now, you've just, for clarification, Ben Goldacre is an M.D. who writes a book, wrote a book called *Bad Science*, in which he lambasts a lot of the fluff that gets out under the name of science. So, there's often, I mean, criticism of people in positions, public positions is almost a sport in the media.

Greenfield: Well, can you think of anyone, can you think of anyone in a public position who has never been criticized, ever? I mean it doesn't exist. I mean, even the queen is criticized. Everyone, if you are in public life, if you have a public profile {unintelligible}, of course you are there because you've said something that is different from what other people have said. And not everyone is going to like or agree with what you said. So I mean, to me it's a no-brainer. It follows, obviously, that if you say something different or interesting then it's going to be challenged and it's good that it is.

What saddens me is when it gets personal. When people, they say in Australia, play the boar, which you should do, rather than the man. It's when it gets personal or vindictive and spiteful, that's when, and I'm afraid the British press sometimes do that. But so long as you stay on the message and discuss the issue being raised I'm very happy to look people in the eye and defend what I've said. What saddens me is when the criticisms are anonymous or ill-defined, and therefore you can't defend them or talk about them. But it is a healthy society that discusses and debates issues rather than assumes that everything is the case or sneers at people or attacks them or, say it does so anonymously I find that rather cowardly.

Bingham: Again, a little background question just for an American audience particularly. The press made, has spent a lot of time looking at your, what they would call your humble origins. Not aristocracy at all, could you just tell us about your parents? Stuff like that, scientists? No.

Greenfield: Well, the press do this because, as you know, everyone loves a good story and it makes a story. But my own view is that fine, yes, my mother was a dancer and my father was an electrician, didn't have much money, but they brought me up in a way that I think I was very privileged compared to a lot of rich people who didn't have the support and the warmth and the encouragement and the confidence-building that my parents gave me. And also the values my parents gave me.

My parents brought me up to be honest, be open about things, to say what you think and to look people in the eye, to always own up to things, you know. These values I think are more precious and important than merely having money or having, owning things. So I do find it rather strange if people think I've done well despite my background. I've done well because of my background.

I've had the best education in the U.K., I went to one of the top girls schools in the country, and then to Oxford. All for free, of course.

Bingham: {unintelligible}

Greenfield: Yeah, all for free. So I can't pretend that I lived in a cardboard box and you know have fought my way up against all odds, that's not the case. So I just have to reiterate, yes, I come from poor people, but then a lot of people do. But in a sense that has been a benefit rather than a disadvantage.

Bingham: Right, but when did you get interested, why science? When did science come in?

Greenfield: Science came in late, actually, because no one pointed out to me why it was interesting when I first learned about distilling water or the reproductive cycle of the amoeba. No one said why this was relevant or interesting to one's life. No one told me

what distilled water was, why it was useful. We just had to stencil conical flows to show how it was done. Whereas in history and literature you actually could have ideas of your own, you could have insights, it made you realize and interpret the world around you.

And in particular, I actually chose to do the ancient history and literature, I did classics: Latin and Greek and ancient history. And I did do maths, that was kind of fun on the side, but my main A-levels, the subjects I did advanced level 16-18 was Latin and Greek, ancient history and pure maths. All of which really gave you a discipline, but not just a discipline in terms of the way you think, but also a context, and that's why I'm very sensitive to this notion of process versus context.

So just doing maths was process, whereas comparing ideas of empires, say in ancient Greece and ancient Rome was content. You had to see one thing in terms of something else. And that's why comparison is always very interesting, because you have to compare one thing in terms of something else. And I find that very rewarding and providing great insights, and even though I therefore came to science much later, through philosophy then psychology and then neuroscience, which actually has a logical step to it, I don't regret ever having done classics because that gives you a confidence intellectually that really enables you to engage with new ways of thinking and new ideas and new terms without being scared of them, and to just challenge them all the time.

So it was really great doing that. Certainly it says a lot also for Oxford, where they put a premium on your enthusiasm rather than what you knew already. I mean, nowadays, sadly, you have to fit into certain boxes and check certain boxes to qualify for certain things whereas there was a certain {unintelligible} to Oxford in the seventies when I was there, which, well you just gave it a go. And you pushed yourself to your limits. I thought it was great.

Bingham: So you went to Oxford to read classics?

Greenfield: I came, okay, so the way Oxford entrance used to work, rather like Cambridge, is that after your exams, so-called A-levels when you were 18, you then had to do further exams, entrance exams afterwards. Then you went up the following year. So I offered, as they say, classics and I think I must have made a mistake because at the interview they said would I consider doing classics, but for me I already had enough, I thought in my arrogance, to read Homer in the evenings, not that I've ever done that of course.

But I was very interested in philosophy, what Greek had done had given me an interest in philosophy and asking these very big questions. So I did philosophy, and at Oxford you had to do something else, so I did it with psychology, a subject I knew nothing about. It was a very fledgling subject at the time. And actually in philosophy, which was very abstract and comprised, at that time, formal logic, which for me wasn't very interesting because I had done maths, so I found psychology new and interesting.

I suddenly realized that with science you could actually ask questions and test them, and so I did the more physiological options and gradually got more into it. Then my tutor said I think it would be a laugh if you were a scientist. See, that was the attitude of the time – it would be a laugh, be a hoot. Dispatched me to talk to the then head of pharmacology, and he said do you know what {unintelligible} solution is? Now that, in case people, nonscientists, are watching, that's the equivalent of saying "Have you heard of Shakespeare?" or "Can you read?". And I said, "Well, frankly, no". And he said, "Well, never mind, you can tell us about Homer on the coffee breaks", and so I say the whole thing was done rather like I'd been brought up, with a sense of having fun, being an individual, not judging people or yourself by what is known or by sanitized desiccated facts.

So it was a much more dynamic and fluid way of approaching knowledge and information. And for me I personally thrive on that, and I've enjoyed it hugely, and I find it very sad when people come along in this sort of way of trying to impose constraints and pigeon hole people in things.

Bingham: We try and knock down {unintelligible} on The Science Network.

Greenfield: That's right.

Bingham: It occurs to me and now I think about it, that one of the books that I enjoyed is a collection of essays called *Mindwaves*, which has in there essays by Horace Barlow -

Greenfield: {interposing, unintelligible}

Bingham: {unintelligible} But you put that book together as I recall.

Greenfield: I did.

Bingham: Colin Blakemore, who's obviously Professor of Physiology at University of Oxford, or was at one point. And Susan Hurley who is a philosopher.

Greenfield: Sadly, now, she now died, yes.

Bingham: Sadly. So that's again –

Greenfield: Yes, that's an example. So Susan is a philosopher and I was having dinner with her one evening and we were just discussing, we found that although we came at it from different angles we were both interested in certain things like pain or memory, for example. And so between us we organized this series, and it was very revolutionary at the time in Oxford, this was in the eighties, between a philosopher and a scientist. And the place was packed every evening, every time we did this. Then the book *Mindwaves* arose,

edited by myself and Colin, as a result of that. And that's what gave me a first taste, actually, for consciousness and interest in consciousness, I think.

Bingham: You mention consciousness, we're in Francis Crick's old study, this is the double helix window here. Francis, obviously, when he came to the Salk from the U.K. shifted from doing DNA work to consciousness, became his new thing. He loved that. A lot of it her partnered with a young scientist called Christoff Koch, with whom you have debated quite frequently.

Greenfield: Yes.

Bingham: Christoff and Itzhak Fried and Quiroga have done some work recently on trying to find out, as the cover of *Discover* magazine for June says, "Can a single neuron recognize Jennifer Aniston?". This is the issue that I raised with Horace Barlow a couple of weeks ago. This issue of where in the brain is information stored, can a single neuron actually do this kind of thing, you have a different view of the brain, I think, from Christoff. Would you like to ...

Greenfield: I, yes, the work to which you refer, and it's always hazardous to talk about other people's work when they're not in the room, so with that health warning done I may not be as eloquent or as accurate as they themselves would be. But the idea is that you can record from a single brain cell the electrical discharge, that is to say the activity, of a single brain cell in an awake human being, and it shows a certain selectivity, that is to say it is active only under specific conditions when, for example Jennifer Aniston or Halle Berry or whoever is presented.

Now, like much of science, it is not the actual finding that one finds fault with, that's fine, I don't doubt that that is what they saw. The issue lies with the interpretation of that. If the interpretation is that that cell and only that cell will respond in that way, you can only make that claim if you've exhaustively recorded from every single other cell in the brain, and that would be impossible to do. So you can't claim an exclusivity of that cell for that particular stimulation.

Moreover, you can't claim that there's necessarily a monopoly of that particular image for that particular cell unless you present to that cell every single possible image ever in the world, again impossible. Though you could show variations and so on, which I know they do, you can't say for sure that this cell will only be active to that stimulus and it is the only cell in the brain that will be active to that stimulus. So, both those claims can't be made. If you can't make those claims you have to weaken it a little bit and actually probe as to what it is actually telling you.

A lot of neuroscience, and I would include brain imaging in this, as opposed to just looking at the isolated brain cells, they're very esthetic and they're very interesting in and of themselves, and they're formidable in terms of the technology behind them and they're

skill required, but what they actually tell us. Well, what does it actually tell you? If you have a brain cell that is more active when you present a certain image, what question are you asking there? What is it actually telling you about a particular issue such as consciousness? So although it can claim the front cover and it can be impressive in terms of the technology for doing it, all I do is say well, what does it actually mean?

Bingham: So, you have written books on consciousness, I think we're almost going to have to say because of time constraints, that your position is out there in a number of books. But it's a distributed processing kind of thing.

Greenfield: For those who are interested, especially in my views versus Christoff Koch's, in *Scientific American* in 2007 in October we have a jointly published debate, so that's perhaps a very straightforward way of finding out more detail of what I'm saying.

But my own view is that consciousness is like a dimmer switch, that is to say you don't have all or none but it grows as brains grow, and that you as an adult human being. So it's not just an evolutionary issue, but as an adult human being you will have more or less consciousness sometimes rather than other times.

And why I find this idea attractive is that one can actually approach consciousness as something that you measure, which is what scientists like to do. Because if you just have it as a qualitative, ineffable, ill-defined thing it's very, some people just explain it away or say that it's not there. Others really just sidestep the issue as, in my own view, people like Christoff do when they look at changes in something while the person is persistently conscious, because you're not exploring the difference between consciousness and unconsciousness there, you're looking at changes in consciousness, which I would call attention. Which is a very laudable, very worthy thing to do, but it ain't consciousness.

So my own view is that whilst at the moment we're still at the foothills of developing this idea that consciousness comes in degrees, that you can have more or less of it, that it is something you can measure, what you're measuring and how you measure it and under what conditions we're only now starting to develop and that's what we do in my lab and that's what I explore in the books.

Bingham: So given your family background, the way you grew up, the education that you had, given your view of consciousness and what the brain does, given your view of education, it's hardly surprising that I would suggest that you're not totally enamored of the Twitterverse then.

Greenfield: Well, I find it rather sad that we are limiting ourselves to a constant readout of the most banal of activities. Why do we do this? Well, as a scientist you always say, "Well, why? Why do people do something?" I would say, "Well, why do people get angry?" for example. Usually people get angry when they feel threatened or undermined or insecure, that's when you get angry.

So people that get angry at my position on Twitter, why are they getting angry? Why, what am I saying that, it might be that they feel in some way threatened, because what I feel with people that seem to need to give a constant online monitoring of the most banal of their activities is that suggests to me a shaky sense of identity.

When children are very small they are constantly demanding attention, they constantly need feedback from the outside world that they're there, that you're actually existing, whereas normally adult human beings up till now hadn't needed to do that. You had a strong sense, internally generated, of your own continuity, your own life story, your own narrative through the world. But to have this constantly read out to some anonymous audience, I find that actually perhaps might suggest that people are feeling less secure about who they are and where they're going. Perhaps they're going nowhere.

Bingham: I want to ask you about a couple of more substantive things. There's a couple questions I always ask people. One of them would be, if you hadn't been a scientist what else would you have liked to have been?

Greenfield: Well, my mom wanted to be a dancer because she wanted me to follow in her footsteps.

Bingham: Literally.

Greenfield: Yes, dancing. I myself, I loved riding horses, when I was smaller I wanted to be a horse riding instructor, I thought that was the pinnacle of achievement. When I lived in France and I got quite good at French I thought it would be very useful to be a simultaneous translator, because whilst one wouldn't necessarily want to do that all the time in the pervasive way that one does science, I mean brain science is all the time, it struck me as intellectually stimulating and a job where once you finished, a bit like flying a plane, you didn't have to worry anymore, you just sold your services in a very intense full-on focused way, and then you stopped and did something else.

So, that in a sense had a certain appeal, but to be honest I've never really thought about anything other than doing what I do. But again, I don't see myself as just a scientist, I see myself as me, and I do a whole range of things. Ranging from being a trustee of the Alexandria Library in Egypt, through to being the Director of the Royal Institution, through to promoting a new charity called Science for Humanity with NGOs and the developing world and scientists, through to being on the Lords, giving the occasional speech, through to the work in my lab, through to making a T.V. series. So, I don't see myself as a this or that, I'm myself and I think the ideal in life would be to have these portfolios of what different things that one does, for everyone.

You know, you do a whole range of different things that interest you that actually complement each other in a way that I find couldn't be served by just one activity. So, for

example, high end science, where you're dealing with difficult concepts that will play out to society decades and decades later, but not immediately, contrasts with engaging in concepts like refurbishing the Royal Institution, which is not intellectually demanding to understand what that involves, but is very difficult to actually raise the funds, persuade people and get it all working.

So, there's various aspects in one's life where they complement. On the one hand you have intellectual stimulation, on the other hand you have the reward of seeing something physical change in the outside world. So, I think portfolio activities are very attractive and I would like to carry on doing that. I don't see myself as just doing one thing.

Bingham: If you had a chance to have dinner with anybody, in history as well, who would you like to sit down with?

Greenfield: Anybody? Well, in history, it would be Elizabeth I, my role model and heroine. I think nowadays it would be, I think perhaps this is very unoriginal, I'm sure there would be a long queue for Obama. I'll join the queue.

Bingham: Royal Institution? Importance in, I mean hugely important to the British public.

Greenfield: The Royal Institution is very important because it's a unique place that has diffused science for common purposes of life, I use the words of our charter, for over 200 years. It's proud to be an independent organization, and therefore I think we get the respect of various sectors, not the least the media, because we can host free and fair debates that are not in anyone's pocket, that follow no one's agenda. Not least I'm very proud that we've had the last few years a science media center that is starting to help scientists and journalists speak to each other without pea-shooting each other. So we do many things there, public outreach, young persons' programs, a media center, a history of science department, and now we have a bar/restaurant, café, so we have a salon type environment there.

And I'm hoping, as we get further funds, to be able to web-stream and webcast everything. So it could be truly global and every event we have there, and we have three or four events a week for adults, discussions and debates, could actually be downloaded by anyone anywhere in the world. And I think that would be a wonderful facility. Eventually I would like it to be online, where we could have globalization, not just democratization of science.

Bingham: Women in science? You have to be, one reads Susan Greenfield the first woman this, the first woman that, and so on. Women in science, is that still, that still appears to be a major issue. I saw a report that came out in an editorial in *Nature* only last week.

Greenfield: Yes, this is a really serious issue, because as you get more senior in science then it gets harder and the representation of women gets lower. Part of the problem is that

when you get to the child-bearing age in public sector science, you're on soft-money, so called two or three year contracts. And this means that what happens is you'll have time off to have a child, but then it's very hard to come back again at the same level, having the same publication record as the men against whom you're competing.

So either you postpone having children or you don't have children or you come back having had children but at a much more junior level that's very hard to catch up on. So clearly something has to be done, and I work a lot with L'oréal, I'm part of the jury, so-called, for the Unesco-L'oréal prizes that are international recognition of women on five continents, of senior women plus rising stars. But more intimately I'm involved with the Royal Institution with L'oréal and we're now in the third year of fellowships that give a relatively modest sum, but it's a very helpful sum of fifteen thousands pounds, to women to enable them to spend this money on either childcare or equipment or lab assistance or whatever they choose that will help them get back up the greasy pole again.

But it's a drop in the ocean, and I can say this year, because we do do the judging quite soon, for four or five finishers we had over 200 applications. So that tells you something, that tells you that there is a need there, and it's a need that can be addressed. This is not something like black holes, this could be addressed by, for once, throwing money at something, by creating fellowship schemes where anyone who has had primary child care can compete in a ring-fence way, like for like, with let's say a twenty or thirty percent chance for being successful, so it's not like winning the lottery, to get funds for let's say two years where you can build up your research career again and develop your ideas again and start to publish again and compete again in the open arena.

And I do stress, anyone who has primary childcare so you could be a widower or a guy who has had custody of children in a divorce or something like that, so this is not a sexist issue. It's an issue of people who just at the accelerating point of their science careers are taken out of the frame to do something else. I think we need to, society cannot afford to lose that amount of talent. We just can't afford it.

Bingham: Just in passing, since you were on the point, you decided not to have, do you miss having, not having children?

Greenfield: That's a strange question because you don't wake up one morning and say right, today I'm not going to do something.

Bingham: Right.

Greenfield: Your life takes certain paths, it evolves in certain ways, and it's not something I really give a lot of thought to anymore than I give thought to becoming an airline pilot, say. Yes, from time to time I think it would have been interesting, I wonder. So you go on your own path.

Bingham: What's the biggest mistake you ever made, and what did you learn from it?

Greenfield: Someone said experience is what you get when you don't get what you want. So I don't think I've ever made a mistake as such. Perhaps, I suppose talking too freely to the press in my younger days was, when I thought that they were all open and honest and I believed them when they said they wouldn't make a mess, and they did. No, I'm being glib.

But I don't sound too much like Edith Piaf, to say I don't regret anything, but there is no point in regrets and yes, negative things have happened, perhaps I haven't made the best choice in retrospect in certain things, but then that's all part of life. If you met someone who had always made the correct choices, had never put a foot wrong, they wouldn't be very interesting. I don't think they'd be a human person. So yeah, I have made mistakes, but nothing that I obsess about or would reverse.

Bingham: Okay, final question. What are you optimistic about?

Greenfield: I'm optimistic about the future in the sense that if we get it right, finally we will have the chance en masse to develop our individuality, as opposed to being preoccupied with killing each other or being warm or just surviving. I think that technology is giving us life spans and hours in the day in an unprecedented way to all of us, not just for to a privileged few, and I think that it would be a great shame if we trash that and don't make the most of it and don't appreciate it to become as individual as we can be.

Bingham: Susan Greenfield, thank you very much.

Greenfield: Thank you.