Science Magazine Podcast

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Music

Host – Robert Frederick
Hello and welcome to the *Science* Magazine Podcast for May 6th, 2011. I'm Robert Frederick. This week: the effects of climate on crop production; re-appraising control strategies for acute infectious diseases; and using Darwin's ideas to study literature. All this, plus a wrap-up of some of the latest science news—including a story about altruistic robots—from our online daily news site, *Science*NOW.

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Host – Robert Frederick
Predicting the effect of climate change on future crop production and food security is really difficult. It involves climate change models, changes in agricultural practices and policies, pesticides, genetically modified foods, wars, and many other factors. But as David Lobell and colleagues report in a paper published online by *Science*, understanding the effects of climate trends and global crop production to date may help. And so, rather than *add* together multiple factors to try to predict the future, his team worked to *subtract* various factors to model how climate trends over the past thirty years have affected crop production in the past. Lobell researches food security and environmental earth system sciences at Stanford University, and I caught up with him here in Washington, D.C., where he was attending a conference of the National Academy of Sciences.

Interviewee – David Lobell
There are already clear changes going on in most agricultural regions, in terms of weather, and that they have affects on food production that are sizable and certainly bigger than zero.

Host – Robert Frederick
Where did the data come from for your team's analysis of climate change and global crop production since 1980?

Interviewee – David Lobell
We used publically available data in every part of the study. We used climate data that had been collected and analyzed by various public agencies and produced by the University of Delaware. We used information on where crops are grown and what times

of the year crops are grown, which are data generated by the U.N. and others. And then, finally, we used crop production data from the U.N. – the Food and Agricultural Organization of the U.N. And so, we, like I said, we use all publically available data, and then we process it ourselves and try to analyze the data in order to ask the questions that we wanted to ask.

Host – Robert Frederick
All crops?

Interviewee – David Lobell
We actually only looked at a handful of crops, in particular four main crops for this study. We looked at wheat, which is the most widely grown crop in the world; rice; maize, which is the largest production in the world; and then soybean, which is the fourth most produced crop. And so, we focused on those four crops because they make up the bulk of calories consumed today. And it was somewhat of an arbitrary choice because we certainly – since then, for example, we've looked at things like barley and sorghum, which are farther down on the list, and you could keep going, but we just decided for simplicity to focus on four to begin.

Host – Robert Frederick
First, then, what does the data say about how the global climate has changed since 1980?

Interviewee – David Lobell
When we look at the temperature and rainfall measurements that are made in the places where crops are grown and at the times of year where crops are grown, what we see is that there's actually quite significant trends in temperature for many of these places – not all, but many. And for average rainfall during the growing season there really are just as many areas that are getting wetter as there are getting dryer, and there's no obvious trend at the global scale. In terms of temperature, what we see is North America seems, oddly enough, to be exhibiting almost no trend at all over the last 30 years, whereas places like Europe, China, Brazil – pretty much the rest of the world, in terms of major agricultural producers – have seen remarkable warming.

Host – Robert Frederick
So, globally warmer, but the United States is an outlier?

Interviewee – David Lobell
It looks like the United States, Canada, and northern Mexico are an outlier, in terms of unusually stable weather over the last 30 years, temperature-wise, compared to the rest of the world, which has shown the same thing that global average temperatures have shown, which is a steady increase over the last 30 years.

Host – Robert Frederick
So, how does that global temperature climate data correlate with data on crop yields since 1980?

Interviewee – David Lobell
Well, what we don't do is, we don't directly compare the trends in climate to the trends in production because we do know that crop production has been influenced by lots of things over time. There are also big differences between countries and crop production that have nothing to do with weather at all. So, what we do is a large statistical analysis, which tries to isolate the effects of temperature and precipitation on crops, independent of all of the other factors like changes in technology and management. And when we do that, we can see how much these variables affect crops, and we can compare that to what we know from previous studies of whether these sensitivities make sense. And we do see that, for example, with a crop like wheat, that on the global average a degree of warming translates to about a 5% loss in production, and that's pretty consistent with a lot of other studies.

Host – Robert Frederick
Now, you said that a one-degree change in temperature leads to a 5% decrease in wheat, as an example. Is it possible to extrapolate further several degrees?

Interviewee – David Lobell
As we think about the future, it certainly is common to try to take historical relationships and in some sense extrapolate those going forward. You do have to make more assumptions when you do that, in particular, you have to assume something about how nonlinear the response is and how different the crops of tomorrow will be from the crops of today. But, in this particular study, we really focused on the past, and in that sense we have more confidence that the models we developed with the historical data would apply to these same systems that we're asking these questions on.

Host – Robert Frederick
You mentioned that you tried to eliminate the influence of other technological advances – farming methods, fertilizers, increased CO_2 – as something that would increase crop yields. Warmer temperatures meaning a longer growing season. With all of these other factors on global crop production can we say anything about the future, in terms of overall crops and food security?

Interviewee – David Lobell
I think the basic question of this study was, "How important is climate? How important has it been over the last 30 years?" And to be able to say how important you have to say compared to what. And I think it's very clear that climate is not the predominant driver of change over long periods of time, in crop production. There are pretty much, across the board you see crop yields going up over the last 30 years. The question is, "How much is climate modifying what would have otherwise happened if climate hadn't been changing?" And so, we look at this on a country-by-country basis. In some countries we see that the climate has really only affected things by a few percent. In other countries, we see that without the climate trends, yields might have been rising twice as fast as they were. On a global average, we say that for wheat, production today would be about 5% higher if we hadn't seen the warming since 1980. We see something similar for maize, or corn. But, with rice and soybean, we actually find that production today is about the

same as it would have been had climate not been trending. There just hasn't been the same obvious effects on those crops, as we in the other two.

Host – Robert Frederick
So, even with advances in farming techniques – fertilizers; new varieties, including genetically modified organisms; changes in temperature; precipitation – corn and wheat seem to be more susceptible to climate [change] than rice and soybeans. Do you have any predictions about what this means, in terms of future production – what areas of the world are cultivated and things like that?

Interviewee – David Lobell
One question I think we have is whether there'll be areas in high latitudes, which are not cultivated now, but will become cultivated as conditions warm. We don't necessarily see a whole lot of that historically, but we also haven't really looked very hard. And one of the things we're working on now is to really try to document what kind of conversions are taking place and whether they're what we would expect, given the amount of warming. Overall I think, though, it's important to realize that farmers are not necessarily the losers in this situation. There, in many cases, if farmers are, even if they're incurring some yield loss, the prices are going to rise to compensate for that. Demand for food is fairly inelastic. So, in a sense, the farmers have little incentive – or not as much incentive as you might think – to move. They're incurring higher prices; their profits may even stay the same or go up. But, it's the consumers that will end up paying a little bit more for food. Higher prices do provide an incentive to expand but not necessarily as strong of an incentive as some people think. And it's really an open question as to how fast that expansion might occur.

Host – Robert Frederick
David Lobell, thank you very much.

Interviewee – David Lobell
Thank you very much.

Host – Robert Frederick
David Lobell of Stanford University is lead author of a paper on climate trends and global crop production since 1980.

Music

Host – Robert Frederick
Controlling acute infectious diseases is often a matter of isolating and treating clinical cases and any others who may have been in contact with them. But with animals, perhaps the most important factor in controlling acute infectious diseases is early detection of them. That's because current control measures of diseases, such as foot-and-mouth disease in cattle, for example, include killing infected animals and animals that come in contact with them. And greater portions of herds might be saved with early detection. But as Bryan Charleston and colleagues report in a paper in this week's

Science, knowing the relationship between when an animal exhibits clinical symptoms and when it is infectious to other animals also has implications for control, particularly if there's a lag between when animals first exhibit signs of the disease and when they become infectious. I spoke with Charleston from his office at the Institute for Animal Health in the United Kingdom.

Interviewee – Bryan Charleston
We've studied the transmission of an important cattle disease – foot-and-mouth disease virus – between animals on a 1:1 basis to try and actually determine when transmission of viral infection occurs. For a number of diseases—acute viral diseases, including foot-and-mouth disease—conclusions have been drawn about when animals become infectious and for how long they're infectious based on measures of virus in various bodily fluids, such as blood, nasal swabs, or swabs from the back of the throat. And what we've actually done is, we've conducted a series of experiments where we've mixed animals on a 1:1 basis over time periods to show when actually transmission occurs. And we've shown that the transmission of viral infection is unlikely to occur before the onset of clinical signs, and also the period that the animals are infectious is much shorter than previously realized. This has important implications because the types of parameters we're describing, such as infectious period and incubation period and latent period, are used quite frequently to generate large-scale disease models. And so, a more accurate description of those parameters will give you more accurate disease models that can be used in control schemes.

Host – Robert Frederick
Current disease models and current control measures work. The idea is to reappraise, in order to save more livestock?

Interviewee – Bryan Charleston
Yes, that's right. Ultimately, our results need to be translated into policy by people who have responsibility for implementing those control procedures, and there are real practical challenges of implementing or monitoring animals in an outbreak situation on a large scale, such as the outbreak of FMDV we had in 2001. But, this work does show that there are opportunities to identify animals that are showing signs of viral infection before they're showing signs of clinical disease, and so you could remove those animals from the population or treat them – even thinking further forward in terms of treatments – and so stop transmission throughout the herds.

Host – Robert Frederick
How did you and your team determine this characteristic of foot-and-mouth disease – that the onset of symptoms [of] the viral infection typically occurs before the infected [animal] is contagious?

Interviewee – Bryan Charleston
So, this study is one of the first to be carried out in such a way. By that I mean we're using a pathogen and its host species, and we're actually doing 1:1 mixing studies between those animals. We're not relying on proxy measures of infectiousness, such as

blood samples or other bodily fluids, to predict when the animals will actually transmit disease. We actually perform the transmission experiments, and, as far as we're aware, this is the first of these types of experiments that have been performed and show that there will be value in carrying out similar sort of experiments for other acute infectious diseases to determine these parameters – these transmission parameters – as well.

Host – Robert Frederick
So, you infected cows and then saw what would happen when they were put near other cows.

Interviewee – Bryan Charleston
Yes, that's correct. So, we infected the so-called source animals – and these are the animals that are studied in great detail looking at a variety of virological/immunological parameters and monitoring clinical signs in detail. So, these animals are allowed to undergo the natural course of disease. But, at time points post the initiation of infection in those source animals, other naïve animals were mixed with those animals, the source animals, for an eight-hour period in close contact in conditions we know are highly conducive to transmission. And then we determined whether those naïve animals became infected, so we're measuring actual transmission rates.

Host – Robert Frederick
Now, you said that the results suggest policy changes. Is there some suggestion, then, as to what this policy might be or what it might look like?

Interviewee – Bryan Charleston
It think the importance, in terms of changes in policy that could potentially happen as a result of this work, is that clearly we'd have to do more research in research and development. The development of sensitive diagnostic tests to detect virus in animals – in large groups of animals – without using invasive techniques could be developed. We're already looking—we and others throughout the world—are already looking at air sampling devices. And air-sampling devices combined with sensitive assays to detect viral genome could be used to detect animals that are positive before the onset of clinical signs. And also, more importantly, could protect animals that were negative, that remain negative. So, animals that you would describe as potentially would become infected because of their proximity to an infected premises by a repeated monitoring system, such as air sampling, for example, it might be possible to, if those animals remain negative, those animals not to be culled, so you'd limit the number of animals that would be culled during an outbreak. And it's interesting that in the 2007 outbreak in the U.K., which was a small outbreak in a confined geographical area, the authorities actually sampled herds in close proximity to infected premises on a regular basis. And those samples were taken to laboratory and tested for viral genome by PCR. And as long as those samples remain negative, the animals remained alive. And so, during that outbreak, the number of animals that were culled was reduced than would have otherwise have occurred. Now, clearly the system I've just described is not going to be applicable on a wide scale outbreak throughout a country. It's that the process of blood sampling and shipping samples back to laboratory would be too time consuming and too labor intensive. But,

with sufficient development of improved economically viable diagnostic tests, then that may become a reality. And I think an important part of this work is that it would give us greater impetus to develop those diagnostic tests. Also, there's a number of strategies being developed by groups around the world in terms of antiviral products, notably the group in Plum Island in North America producing an adenovirus driving interferon, as a way of preemptively treating animals to prevent FMDV infection. FMDV is very sensitive to interferon therapy, and those encouraging published results from that group suggest that this may be a strategy that could be effective. And what our results show is that by delivering such a product to animals that are not showing clinical signs, you would have greater confidence that those animals would not have transmitted at the time point of administration of those antiviral products. So, again, I think this work indicates where we should focus our research efforts to improve control measures.

Host – Robert Frederick
What, if any, other diseases are there in which the onset of symptoms typically occurs before the infected animal, or person, is contagious? The idea that you and your team have learned something about controlling foot-and-mouth disease – could that be applied to other diseases?

Interviewee – Bryan Charleston
Well, we believe so. We believe that there's possibility to carry out similar types of studies with other acute viral disease[s]. I think it's quite important that we're talking about acute diseases here – that's the nature of the study that we've performed. It's tempting to speculate that similar studies could be performed with influenza virus. That may not be possible in human subjects but in an appropriate animal model, such as swine and so a swine influenza model, it may be possible to carry out similar sorts of experiments to determine the incubation periods and latent periods and the period of infectiousness for important disease, such as flu, and determine whether actually preclinical transmission occurs in such viruses.

Host – Robert Frederick
Bryan Charleston, thank you very much.

Interviewee – Bryan Charleston
Okay, thank you.

Host – Robert Frederick
Bryan Charleston of the Institute for Animal Health is lead author of a paper in this week's *Science* on the relationship between clinical symptoms and transmission of an infectious disease and implications for control.

Music

Host – Robert Frederick
Literary scholars apply many fields of thought to their criticism of literature – Marxism, postcolonialism, Freudianism, the list goes on and on. But, Darwinism? As freelancer

Sam Kean reports in this week's *Science*, there's a group of literary scholars who, Sam writes, are "convinced not only that evolutionary thought can improve literary research, but also that literature can teach scientists a thing or two about human evolution." I spoke with Kean via telephone.

Freelance News Writer – Sam Kean
The article is about some literary critics who are trying to take a new approach – a different approach – to literary criticism. They're trying to get away from some ideas in the humanities that human nature is completely determined by our environments, and they're trying to take more of a Darwinian look at human behavior, human nature and see how that would apply to literature specifically and how it might have influenced not only the literature that we have today but the reasons that we would have evolved literature in human societies.

Host – Robert Frederick
What's been the impression of the literary societies to this?

Freelance News Writer – Sam Kean
It hasn't been all that popular. There is a lot of skepticism in the humanities generally about the idea that human beings have a fixed human nature, especially when you get talking about human behavior. And so, there is a lot of skepticism that not only that they'll be able to learn a lot about where literature came from and why it means so much to people, but also that they'll be able to understand anything about individual literary works – that it'll really help people, you know, understand *Hamlet* or *The Iliad* or something like that.

Host – Robert Frederick
To what, if any, extent are scientists getting involved in literature studies – collaborating with these literary scholars?

Freelance News Writer – Sam Kean
There has been some collaboration. I think more of the scientists who get involved are more interested in the idea of where literature might have come from and how it might have given human beings an advantage if they were doing things like telling stories or using narratives in their daily lives. So, it hasn't been so much focusing on individual works again as much as just figuring out what literature specifically adds to human societies.

Host – Robert Frederick
And so, what's an example using a scientific lens on, if not a literary work, then literary works in general?

Freelance News Writer – Sam Kean
One example is a book called *The Rape of Troy* by Jonathan Gottschall. And what he does is, he analyzes the sources of the conflicts in *The Iliad* – a little bit in *The Odyssey* too, but mostly in *The Iliad* – and he tries to look at it from the point of view of the

number of available young women for men in the society, and he finds that there's a lot of conflict. And most of the major conflicts in *The Iliad* are based on trying to find young women for the men to marry. That's a little bit of a simplification, of course, but that's the basic conflict in the book – over and over again they're fighting about having women to marry. And it sort of gets at that they're really fighting – even if they talk about honor or wealth or other things – in some fundamental sense, they're really fighting for their evolutionary legacy.

Host – Robert Frederick
Is this influence one-way using a scientific lens such as evolution on studying literature, or are there any scientists who are using literary lenses, if you will, in studying science?

Freelance News Writer – Sam Kean
There are a few people. Some of the literary critics who have taken a Darwinian approach really feel that they can kind of illuminate some things about the human mind and human nature that they feel that scientists miss sometimes. They especially criticize what they call "narrow evolutionary psychology" because they think that these scientists don't take into account how much imagination really drives human beings. There was one part that I mentioned in the story: There was this study that humans spend something like an average of four hours per day producing, discussing, talking about stories and just four minutes per day, on average, having sex, which from a, you know, strictly Darwinian point of view, doesn't really make sense. And so these critics just want to point out that if you want to talk about human beings and human nature, you really have to take into account how much imagination and how much the mind really drives us.

Host – Robert Frederick
So, story telling or imagination as evolutionarily advantageous?

Freelance News Writer – Sam Kean
There are some people out there that definitely think there are advantages to it. One person in this story talks about the idea that human beings seem to cooperate a lot more than other species do. And one of the things that would help you cooperate is being able to tell stories about lives – about your own life, about other peoples' lives – because it helps you keep track of whether the person is generally a good person – someone that you should cooperate with – or that he's a rogue – someone that you don't want to cooperate with. And so, if you had the ability to keep track of people's histories and lives and sort of encode those in stories that are easily remembered, you can evolve a society that's more egalitarian and where you're going to have more cooperation. And so, that's one example of a way that early human societies especially might have benefitted from having some sort of story telling function, especially if the mind was sort of tuned to be able to create and understand narratives.

Host – Robert Frederick
So, using this literary lens to study science, it sounds as if it's another method of coming up with conjectures, hypotheses. Is that right?

Freelance News Writer – Sam Kean
Yeah, it's definitely a way to, you know, put ideas out there and say, "If this is true about human societies, then how might that be reflected in the literature that we have today?" And one example in this story that I mentioned is a couple authors did a look at Victorian novels, and they found that, even though there were some variations for individuals, most people really found that the protagonists were selfless people – they tried to help others – whereas the antagonists were very selfish people who were trying to dominate others. And to them it showed that the preferences that we evolved very long ago have sort of stuck with us over time, and they influence and shape the kind of literature today that we really respond to. So, yeah, it's a way of figuring out not only how our old preferences – our old, evolved preferences in early society – might influence literature, but we can also look at literature and say that it explains a little bit about where our preferences might have come from.

Host – Robert Frederick
On the science side of things – using literary lenses to study science – is all this conjecture—reasoned or statistical conjecture—or are there any experiments to test these conjectures?

Freelance News Writer – Sam Kean
There is a movement that's sort of parallel with the other movements to be a little more empirical and to try to bring in more data and data analysis into the study of literature. One of the people in the story even mentioned explicitly that, you know, literary scholars sometimes need help from scientists, from experimentalists, just because it's expertise that they don't have dealing with numbers and statistics. So, there are people who – in addition to just thinking about things in a Darwinian way – want to go out there and start to take numbers and look at literature in a little different way.

Host – Robert Frederick
Sam Kean, thank you very much.

Freelance News Writer – Sam Kean
Well, thanks for having me.

Host – Robert Frederick
Freelance news writer Sam Kean reports in this week's issue on Darwinian literary criticism and bringing science to bear on the study of literature.

Music

Host – Robert Frederick
Finally today, David Grimm, *Science*'s Online News Editor, is here with a wrap-up of some of the latest science news from our online daily news site, *Science*NOW, including a story about altruistic robots. Dave, I'm really skeptical.

Online News Editor – David Grimm
Well, Rob, let me first say that mainly what this study dealt with was not actual robots but computer simulations of robots.

Host – Robert Frederick
And now I'm even more skeptical.

Online News Editor – David Grimm
Well, maybe you should be. This story is all about how and why altruism evolved. And when scientists usually talk about altruism, they talk about it in ways that being altruistic tends to have costs for the person that's altruistic. So, in other words, a lot of times in the animal kingdom, if you're an altruistic ant and you decide that you're going to go out and protect your colony, even though you know you're probably going to get killed, there are negative consequences to being altruistic – namely that you're dead – sometimes that also you could be maimed, but evolutionarily-wise, the biggest cost of being altruistic is that you often don't get to pass down your genes to the next generation, which introduces a bit of a conflict. Because ostensibly the whole point to life – if you can ascribe a scientific point to life – is to pass your genes down to the next generation. But, if you're being altruistic, you're in conflict with that goal. So, scientists have debated for decades why did altruism evolve if it sometimes prevents us from passing our genes down to the next generation?

Host – Robert Frederick
So, what do robots have to do with this?

Online News Editor – David Grimm
Well, one of the going theories about why altruism evolved is because altruism is effective because, say, Rob, say you and I are brothers. And you're about to get hit by a bus. And I run out there, and I save you from getting hit by the bus, but in the process I'm the one that ends up getting hit by the bus, and I die. So, I've just performed a very altruistic behavior, but it hasn't been completely in conflict with my desire to pass my genes down to the next generation because we're siblings – we actually share a lot of our genes in common. So, as long as you survive, I've still been somewhat effective in getting my genes passed down to the next generation. And that's what this scientist, W.D. Hamilton, proposed, but that's sort of really controversial. There's been evidence for that, evidence against that. As you can imagine, this is very hard to test in the real world – why exactly are animals being altruistic, and that's where robots come in.

Host – Robert Frederick
Especially virtual ones, it sounds like.

Online News Editor – David Grimm
Exactly. Well, the researchers started with real robots, and you can actually see a picture of these robots on the site. They're really small. They're only a couple centimeters tall, and they have little wheels, and they have a camera sort of for an eye, and they have a few sensors on them that allow them to sense objects or sense these little discs that the

researchers created, which are sort of a stand-in for food. And with these real robots, what the researchers did was they put about eight of them in an arena and sort of let them loose. And what the robots do is they use their cameras and their sensors, which are sort of like a, you can think of it as a like a very rudimentary nervous system. And they all run around this arena trying to gather as many food discs as they can. And the robots that got the most discs won and were able to sort of exist in the next "generation." And the researchers wanted to see, "What if we repeat this hundreds of times – will something like altruism evolve?" But, you can imagine in the real world it's very difficult to run an experiment, even if these aren't living things, these are robots, they have to be designed. Hundreds and hundreds of trials could take forever. That's where the computer simulation comes in. So, what the researchers did was, they created this virtual simulation, and what they did to sort of mimic what happens in evolution – a lot of the time the real major basis behind creatures evolving is mutations. We acquire mutations in our lifetime, sometimes mutations spontaneously appear in our DNA, and sometimes these mutations are very bad – they can cause cancer – but, over the course of millions of years, these mutations can sometimes be beneficial – they can cause animals to evolve new adaptations that help them better cope with their environment. And the researchers wanted to mimic this with the virtual robots. And, like I said before, these robots have sort of this rudimentary nervous system. And so, what the researchers did in the virtual simulation is, they mucked around with this nervous system. They made a little change here, a little change there in different robots. And they kept on running this competitive simulation over and over again where the robots would be trying to get the most food, and they found that sometimes mutations made the robots much better able to get food. They sensed the food a lot better, they grabbed it a lot better, whatever, than the other robots. And again, the robots that win are the ones that get passed down to the next generation. So, they ran this a couple of hundred times, and they ended up with these robots that were really, really good at getting food. And then, to see whether altruism would evolve in these robots, they started to make some of these robots more related to each other. So, they made some clones of the robots – so some robots had the exact same mutations as other robots, and these mutations are kind of a stand-in for our genes. And some robots were not very well related. And again, the robots that acquired the most food were the ones that were able to be repurposed for the next generation, almost like they're passing their genes down to the next generation. And what the researchers found was that when they kept on running this simulation the robots that were highly related to each other were more likely to share food with each other than the robots that weren't.

Host – Robert Frederick
Wait a minute. So, what prompts a robot to share its food in the first place?

Online News Editor – David Grimm
Well, the reason that the robots would share food – say, for example, (and I'm just making up these numbers) but just say, for example, that a robot needs 10 pieces of food to sort of win the game and be passed on to the next generation. Say you've got two robots that are highly related to each other, and maybe one has seven pieces of food, and one has three pieces of food. Well, they're both going to get cut. So, if they don't cooperate, neither of them is going to make it to the next generation. But, if they pool

their food – so as if the robot with three pieces of food gives the other robot its food, then this robot now has 10 pieces of food; it gets to go onto the next generation. And, even though the robot with the three pieces of food had sort of altruistically given up its life to do that, by giving its comrade the extra food – and its comrade is highly related – the comrade is actually passing down, essentially passing down, that other robot's genes down to the next generation. So, it really confirms this hypothesis of W.D. Hamilton that highly related creatures are more likely to be altruistic towards each other.

Host – Robert Frederick
So, people were able to program the robots to give one another food and so create a scenario where the robots mimicked what we think happened evolutionarily.

Online News Editor – David Grimm
Well, it's important to say that the researchers didn't program the robots to share food. The researchers programmed the robots to be "capable" of sharing food. So, it was the robot's "decision" – these robots could have completely elected not to share food with each other, and that would have gone against Hamilton's hypothesis, because it would have said, "Well, these guys are highly related to each other, and yet they're still not helping each out, and therefore Hamilton's hypothesis doesn't work, at least for this simulation." But, what the researchers found is they gave these robots – even though it's a very simplistic representation – they gave these robots the same sort of "choice" and "free will" that animals have out in the wild. And with that free will, the robots that were more related to each other were more likely to share with each other.

Host – Robert Frederick
What does an evolutionary biologist say about this? Any outside comment here?

Online News Editor – David Grimm
There is outside comment. One evolutionary biologist really liked it, thought it was a very original way to test this hypothesis. Another one had sort of the same skepticism that you have, Rob, which is basically that this is a very artificial system. Not only is it artificial, but we're not even dealing with life forms or even tangible objects here – we're dealing with a virtual computer simulation. But, again, going back to what I said earlier on, this is extremely hard to test in the wild, so this may be the closest we can get for now into really trying to test this hypothesis in the laboratory.

Host – Robert Frederick
Okay, well thanks, Dave.

Online News Editor – David Grimm
Thanks, Rob.

Host – Robert Frederick
So, what other stories have you brought with you this week?

Online News Editor – David Grimm
This next story deals with a bit of a battle of the sexes in canines.

Host – Robert Frederick
What are they battling over?

Online News Editor – David Grimm
Well, you know, when researchers do studies on animals – and even people a lot of times – they don't really differentiate between male and female subjects. You hear like, you now, scientists recruited 10,000 people for this study to see if drinking lemon juice cures cancer or whatever. And, of course, this study is not with people – it's with dogs – but this study really started out with these researchers they were testing this idea called "size constancy." And it's this idea whether basically you recognize that an object shouldn't change size if it disappears. So, for example, Rob, if I were to hold a tennis ball out in front of you, maybe put a black cloth over it, then suddenly remove that cloth and all of a sudden it was a basketball you would know something was different. You have just displayed that you are good at size constancy – you know when an object suddenly changes size for seemingly no reason. So, researchers wanted to test this in dogs. That was the basic setup – are dogs capable of size constancy? But, the twist here was one of the researchers said, "You know what I wonder, is there a difference between male and female dogs?" And so, what they did was they recruited 25 female and 25 male dogs, and they had them sit in a room, and there was sort of a barrier that the dog couldn't see behind. And on one side of the barrier was a ball about the size of a tennis ball. So, the dog would watch this ball for a second, see the ball, and then the ball would be dragged behind the barrier so the dog couldn't see the ball anymore. And then, a ball would emerge on the other side of the barrier, but this time it would sometimes be the size of a cantaloupe.

Host – Robert Frederick
Much bigger.

Online News Editor – David Grimm
Much bigger, exactly.

Host – Robert Frederick
And no humans were involved in these balls moving around?

Online News Editor – David Grimm
Well, there was a human that was behind the barrier pulling the ball from one side of the barrier to the other with a string – there was a string attached to the ball. But, these balls were otherwise identical, except for their size – same color, same shape, everything like that. And when they did this test on the 50 dogs, they noticed that the dogs spent a little bit more time looking at the ball when it magically got bigger. And this behavior of looking at a ball for more time is an indication of surprise or confusion. You know, if the dog didn't sense the size difference, he or she would just sort of not have any reaction at all, would, you know, maybe look at something else. So, the experimenter said, "Well,

that's kind of interesting, but it's not really clear whether they're exhibiting size constancy or not." But then, just for the heck of it the researchers said, "You know, I wonder if there was a difference between the male dogs and the female dogs?" And so, they reanalyzed the data, and what they found was that there was as big difference between the male dogs and the female dogs. The female dogs stared at the magically increased ball size twice as long, about 36 seconds on average, versus the male dogs. And when the male dogs were just analyzed by themselves overall they didn't actually exhibit much of a difference in staring at these balls.

Host – Robert Frederick
So, in a battle of the sexes between male and female dogs, in terms of size constancy awareness, the females win.

Online News Editor – David Grimm
The females win; the females win by a big margin.

Host – Robert Frederick
Did the researchers have any idea why?

Online News Editor – David Grimm
Well, the researchers weren't really willing to speculate on why there would be this difference. One thing they do say is that the findings really reinforce the fact that scientists should very much pay attention to gender when it comes to a lot of the studies that are done, whether they are psychology studies or even drug efficacy studies. But, experts have some interesting theories about why the females were better than the males. One theory is, is that females have to keep track of sometimes very large litters of puppies, and all puppies kind of smell the same, but they may look a little bit different. So, for females, vision may be more important than smell. Also, previous studies have shown that male dogs actually tend to be a bit better at smell than vision. When researchers are picking dogs for things like drug sniffing, they often pick males over females just because male dogs are known to have better tracking abilities. And so, it may be that there's a bit of a disparity in the senses, and females are better at vision, and males are better at scent. And if you can imagine if females are better at vision – or at least vision is more important to them – they're going to be much more likely to notice something that's visually interesting versus males, maybe they're much more likely to notice something that's got an interesting odor.

Host – Robert Frederick
Are the researchers planning on testing these hypotheses of the experts, as to why the females seem to have better size constancy awareness?

Online News Editor – David Grimm
No, they're actually really not interested in exploring this question further. It's not the question they set out to find, it's just sort of an interesting finding. But, that doesn't mean other researchers can't.

Host – Robert Frederick
Okay. So, last story, what's this last one about?

Online News Editor – David Grimm
Well, Rob, from dogs to armadillos. This last study is about whether you can get leprosy from an armadillo.

Host – Robert Frederick
I don't want to try, Dave.

Online News Editor – David Grimm
And you shouldn't. This is an idea that's actually been around for a long time. Believe it or not, there's actually only a very, very few animals that can be infected with the leprosy bacterium – this is a bacterium called *Mycobacterium leprae*. As far as we know, it only infects humans, armadillos, and, if you genetically modify mice, it can actually grow on the feet of genetically modified mice – so not a whole lot of creatures out there that are harboring leprosy. And there have been some anecdotal reports of people coming into contact with armadillos – they can be found in people's yards, or sometimes you'll run over them on the road, and you pick them up, and you're getting armadillo blood on you – that have later come down with leprosy. And so, there's been this sort anecdotal report that you can get leprosy from an armadillo, but there's never been very strong evidence that this is the case. And so in this new study, researchers analyzed a bunch of people that had contracted leprosy in the U.S., and they also took DNA samples from a bunch of armadillos that also lived in the U.S. They already knew that the strains of *Mycobacterium leprae* varied from various regions of the world, so there's a strain in the U.S. that doesn't exist in any other parts of the world where leprosy is also a big problem. And what they found was that the strain seen in U.S. patients was the exact same strain that's seen in U.S. armadillos. And this isn't something you would expect if people were getting leprosy by traveling abroad or getting if from some other source – there's not really that many sources out there, except for other people, really. And so, this is the strongest indication yet that armadillos can transmit leprosy to people.

Host – Robert Frederick
So, does this suggest some way of eradicating leprosy by culling armadillos [that are] infected or treating them with antibiotics?

Online News Editor – David Grimm
Well, the researchers actually suggest a much more simple solution. And that basically is avoid armadillos – don't pick them up; if you run over one don't get your hands full of armadillo blood; don't dig in soil that has armadillo excrement, a little harder to avoid. But, if we just avoid them and they avoid us, we can probably cut down on the cases of leprosy in the U.S., which aren't that many, but we could cut down on them.

Host – Robert Frederick
Thanks for the warning, Dave. So, what else are you looking into for the site?

Online News Editor – David Grimm
Well Rob, for *Science*NOW we've got a story about the only insect in 300 million years to have sp[r]outed a third pair of wings, also a story about recovering waste heat from electronics and other machinery and using that heat to produce even more energy. For *Science*Insider, *Science's* policy blog, we are following the scientific angles of the capture and killing of Osama bin Laden, including the DNA testing that was done and also some estimates that were made by some geography students that came pretty close to predicting where bin Laden was actually found. And finally, *Science*Live, our weekly online chat on the hottest topics in science, this week we are unraveling the mysteries of dark matter, and next week we've got a chat on new progress towards curing AIDS. So, be sure to check all of these stories on the site.

Host – Robert Frederick
David Grimm is the online news editor of *Science*. You can check out the latest science news, plus all the stories on the *Science* policy blog, *Science*Insider, and join a live chat, *Science*Live – on the hottest science topics every Thursday at 3 p.m. U.S. Eastern time – find it all at news.sciencemag.org.

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Host – Robert Frederick
And that wraps up the May 6th, 2011, *Science* Magazine Podcast. If you have any comments or suggestions for the show, please write us at sciencepodcast@aaas.org. The show is a production of *Science* Magazine. Jeffrey Cook composed the music, and I'm Robert Frederick. On behalf of *Science* Magazine and its publisher, AAAS, thanks for joining us.

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