



Science Magazine Podcast Transcript, 14 January 2011

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Music

Host – Robert Frederick

Hello and welcome to the *Science* Magazine Podcast for January 14th, 2011. I'm Robert Frederick. This week: genetically modifying chickens to cut down on the spread of influenza; boosting test performance in school by writing about anxieties; and how loneliness is hazardous to your health. All this, plus a wrap-up of some of the latest science news—including a story about a mysterious green blob in outer space—from our online daily news site, *ScienceNOW*.

Promo

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Host – Robert Frederick

In a proof-of-principle experiment, researchers have genetically modified chickens in such a way that flocks of the birds are resistant to the spread of all types of influenza virus A – the cause of influenza in birds, swine and other mammals, including us. The genetic modification is a small bit of RNA that is designed to help the chicken express another small bit of RNA called a “short-hairpin RNA.” Short-hairpin RNAs are typically used to silence gene expression. In this case, Laurence Tiley and colleagues report in a paper in this week’s *Science* that they developed a short-hairpin RNA that functions as a decoy for the normal influenza A virus polymerase – an enzyme that’s needed for influenza A virus replication and packaging. Technically, the researchers report, this kind of genetic modification could be done to prevent the spread of influenza in other domestic animals, too, including pigs, ducks, quail, and turkeys. I spoke with Tiley from his office at the University of Cambridge.

Interviewee – Laurence Tiley

We have produced genetically modified chickens that contain something that’s able to suppress the transmission of influenza virus, and the intention is to use that as a means of preventing avian influenza from spreading within flocks to protect the birds effectively from infection. And by preventing replication of the virus in birds and chickens we both reduce the consequences of that infection in the production birds and the death of those birds and loss of production, but also reduce the likelihood of transmission onto those people who are in contact with them, and therefore reduce the potential for avian flu strains to jump from birds into humans.

Host – Robert Frederick

What, if any, advantages does this technique of genetically modifying chickens have over vaccination?

Interviewee - Laurence Tiley

Well, obviously if you've got genetically modified chickens that are inherently resistant to the virus then, in theory, you don't need to bother with vaccination anymore. But the main drawbacks of vaccination for influenza virus is that the virus is often still able to replicate within those birds, even though they've been vaccinated, and their protected from clinical disease, but they're not actually prevented from replicating and shedding the virus, and therefore they can potentially transmit it onto other unvaccinated birds or again, if there are people exposed to those birds, they're also exposed to the virus. The vaccines that are well matched against the specific strain that you're concerned about do give very good protection, in general; however, there's an awful lot of flu strains that exist, avian flu strains that exist, and if your vaccine is not well matched to the strain that your birds happen to be exposed to, then that protection can be reduced and the likelihood of subclinical transmission within the flock is considered to be increased.

Host – Robert Frederick

So, what genetic modification did you and your team introduce into the chickens?

Interviewee – Laurence Tiley

We introduced a small RNA molecule – this is a piece of nucleic acid that contains the recognition sequence of the influenza virus polymerase. And that particular enzyme of the virus is crucial for the replication and packaging of the viral genome into new virus particles. And by producing this decoy in the cells, when an influenza virus infects the chicken and tries to replicate itself, it produces its polymerase enzyme and instead of working on the viral genome, it works on the decoys instead. So it sort of diverts the viral polymerase away from the job it's supposed to be doing.

Host – Robert Frederick

And how effective was this genetic modification for the chickens to either prevent them from replicating the virus and shedding it or keep them from contracting the virus in the first place?

Interviewee – Laurence Tiley

Well, we've shown that the decoys are quite good at suppressing the activity of the viral polymerase enzyme, and we were expecting to find that the birds would therefore shed less virus and be protected against infection. Actually, it wasn't until we then did the experiment in the chickens and tested them directly that we find that the birds themselves are not protected against flu infection. So, if you deliberately infect one of the transgenic birds, it will succumb to infection and ultimately die. The significant observation that we've found is that that bird will not go on to infect another bird that's in contact with it. So, we've done what we would call challenge studies and in-contact study, and the birds that are deliberately challenged do get infected, but they don't go on to infect the other birds that they're housed with. And that doesn't matter whether those birds that they're

housed with are transgenic or nontransgenic. And so, we interpret that as being that the transgenic birds that are infected are shedding virus that is defective in some way, and so unable to propagate infection into other birds.

Host – Robert Frederick

Were you able to find evidence of this defective virus coming from the chickens?

Interviewee – Laurence Tiley

Well, only the sort of indirect evidence that there's no one with transmission with birds that they're placed in contact with. We have been looking in cell culture to try and see whether we can determine a defect in the virus, and, at the moment, we can't show that there is a specific defect. But we are still looking at the virus that has actually been shed from the birds themselves rather than stuff that we've just grown in cell culture, because clearly, you know, how the virus propagates in a cell culture system may well be different from what's actually happening within the animal itself.

Host – Robert Frederick

So, the theoretical understanding of how this small RNA introduction into the birds is not necessarily what's going on in the birds themselves? Is that right?

Interviewee – Laurence Tiley

I think we would have to say, at this point, that the precise mechanism for how we get this phenotype, i.e. the prevention of transmission, we don't know exactly why that is occurring. The expectation, as I say, was that the polymerase would be inhibited, and therefore there would be a reduction in virus shedding. That doesn't appear to be the case, but often the sort of surprising result may lead to something particularly interesting and that's what we're investigating now is to try and figure out exactly what is going on.

Host – Robert Frederick

But at this point anyway it sounds like if transgenic birds came in contact with other birds that had influenza they wouldn't pass it onto others.

Interviewee – Laurence Tiley

That's the observation. If you expose transgenic birds to other birds that are infected with avian influenza, those transgenic birds can become infected, but then they don't transmit it onto other birds.

Host – Robert Frederick

Any concern that this genetic mutation may lead to the chickens being more susceptible to other diseases?

Interviewee – Laurence Tiley

Not really. The nature of the transgene that we've introduced is very specific in terms of its effect that it would have on influenza virus and we wouldn't expect it to disrupt any other functions within the chicken themselves. But clearly until such things have been

tested we can't say absolutely that there's no likelihood, but based on our understanding of the molecules involved that would be an extremely unlikely scenario.

Host – Robert Frederick

To the bigger picture then, is there something particular to influenza A that makes this particularly successful or do you suppose that this kind of genetic modification could be applied to other disease in chickens or other animals even?

Interviewee – Laurence Tiley

Well, the decoy is very specific to influenza A. It was designed to work against influenza A, which is this subtype of virus that is essentially exclusively the problem in chickens and to a large extent in humans, as well. So, all of the H5N1s and H1N1s that you hear about it's those are all influenza A. And so, the decoy has been designed essentially to take out all of those strains of virus. You could apply the same strategy to other viruses, if you can identify decoy targets. So, Newcastle disease virus, for example, could potentially be vulnerable to similar sort of decoy inhibition method. We are working on other inhibitory strategies that would perhaps have broader application against other pathogens, such as Marek's disease, for example.

Host – Robert Frederick

With the idea potentially of introducing at least this technique with influenza A to other livestock?

Interviewee – Laurence Tiley

Potentially. The chicken is a very useful testbed for looking at different inhibitory strategies because of the speed that you can read it up once you've made the transgenic and then do the assays. So, we're using that as a means of looking at different transgenes and deciding which ones are most effective and putting those in combination to get very robust resistance against the influenza virus. That's our long-term objective in chickens. But clearly there are other host species that once you've identified an effective combination of inhibitors it would be very tempting to introduce them into things like pigs, for example. Hopefully, what we will find is that by bringing the concept of disease resistance or GM aimed at disease resistance production in animals it will open a little bit more constructive debate about the potential of GM, because clearly in the U.K., in particular, there is a sense that there is an anti-GM sentiment. And I think disease resistance is one of those aspects of GM that holds huge potential within the livestock production, environment, and it's really unfortunate that it doesn't have a more positive perception, at least in the U.K. So, by showing what can be achieved – and hopefully starting some constructive debate – perhaps people will become a little bit more enthusiastic for it.

Host – Robert Frederick

This kind of disease resistance has been bred into crops for years using genetic modification. So, for chickens or for any other livestock it sounds like a natural next step. That's your team's thinking here?

Interviewee – Laurence Tiley

Yes, I think so. I think in the case of disease-resistant animals a lot of the concerns that have been raised over GM crops and fertility of seeds and cross-pollination, etc., really just don't apply, because clearly it's very much easier to contain the chicken than it is the pollen from Bt corn or something like that. So, I think many of the concerns regarding GM crops shouldn't really apply to the case of GM animals.

Host – Robert Frederick

Laurence Tiley, thank you very much.

Interviewee – Laurence Tiley

Thanks a lot.

Host – Robert Frederick

Laurence Tiley of the University of Cambridge is senior author of a paper in this week's *Science* on genetically modifying chickens in order to cut down on the spread of influenza.

Music

Host – Robert Frederick

If you have ever been anxious about taking a test, it might seem counter-intuitive to focus on your anxiety—especially right before the test itself—in order to improve your test performance. But that's what researchers found: in a paper in this week's *Science*, Sian Beilock and Gerardo Ramirez report that students who wrote about their thoughts and feelings about an upcoming test for ten minutes before taking their tests performed better than anxious students who did not. I spoke with Beilock from California where she was giving a talk. Beilock is a professor at The University of Chicago.

Interviewee – Sian Beilock

We show that having students write about their thoughts and feelings about an upcoming exam can really help boost exam scores, and especially help those students who are habitually anxious about taking tests, perform up to their full potential.

Host – Robert Frederick

What led you to the hypothesis that a student writing about his or her own testing anxiety – focusing on the anxiety itself before taking a test – would help that student's test performance?

Interviewee – Sian Beilock

There's work in clinical psychology showing that getting clinically depressed individuals to journal or write about emotional or traumatic experiences in their lives can help decrease rumination. And we have a lot of work in our lab showing that students worry in testing situations, and this is something that can really derail their ability to attend to and remember information they need for the test. So, we hypothesized that perhaps having students write about their thoughts and feelings about an upcoming test before

they took the exam might, in a sense, allow them to deal with some of these worries, such that when they were in the actual exam situation they were less likely to pop up.

Host – Robert Frederick

So, what high-pressure situation did you create in the lab in doing your study?

Interviewee – Sian Beilock

So, in our laboratory we actually have a testing room where we try and mimic the types of stressors students might feel when they go to take a standardized test. So we essentially what I call it is “throw the kitchen sink of stressors” at them. We offer them money to perform well, which could be seen as a stand-in for scholarships that students might earn as a function of doing well on a test. We also tell them that other people might be depending on them, so it’s a team effort – that they have to improve and someone else who might be their partner has to improve, as well. And finally, we videotape them and tell them that math teachers will be looking at the tapes to see how they performed on this math test. So, we have social evaluation, peer pressure, monetary incentives – and together these really serve to create a stressful situation for our students.

Host – Robert Frederick

And what was the benefit to those who did this writing about their testing anxiety?

Interviewee – Sian Beilock

Well, when students don’t write about their feelings about the test or even write about a mundane event – say, what they did the day before – we show that they choke under pressure; in essence they perform worse because of the perceived pressure of the situation than when they’re just performing for practice. So, there are no stakes on the line. And we show that they perform worse by maybe 10 to 15%, so it’s a pretty substantial drop. But for students who were given the opportunity to expressively write before they took this pressure test, we actually showed they didn’t choke, and in fact, they improved slightly on their performance in this exam.

Host – Robert Frederick

“Expressively writing” – not necessarily writing then about testing anxieties?

Interviewee – Sian Beilock

Well, we asked students to write about their thoughts and feelings about the upcoming test. And students tended to write about their worries about the exam – maybe what they were fearful of losing or how they were fearful of looking. But in doing that writing they also tended to maybe reassess the situation, reexamine how they would perform, shed new light on their ability possibly to excel in the situation. And we showed that those worries together with this reappraisal of the situation helped students excel when they needed to the most.

Host – Robert Frederick

As I understand from the scientific literature on this topic, there are several studies that suggest that writing about one's values before taking an exam improves test performance. Is this writing about anxieties just a flip side of the same coin?

Interviewee – Sian Beilock

Well, it's interesting because that work often is done where students might write about their values at the beginning of the school year and it's shown to improve performance by the end of the semester, for example. So, students gradually improve their test scores or their exam grades. And our work shows that one bout of writing for 10 minutes just right before you take the test can do a lot to boost scores. And it's not writing about what you feel positive about it's almost as if you're emptying out all of those negative thoughts and feelings that might be likely to pop up and distract you during the test. So, I think all of this work shows that there's pretty simple psychological interventions that can be done to help all students perform at their best. But, there're some counterintuitive findings, like our own I would suggest, it's not just about self affirming or writing about positive things, sometimes it's beneficial to get that negative out too.

Host – Robert Frederick

So, I imagine, if I'm in this situation, I might write about my testing anxiety but conclude with value statements like, "This test isn't so important, I don't live to make money, I don't even know this other partner, and my friends and family will still love me no matter how I do on this test." Did you analyze what the students were writing then?

Interviewee – Sian Beilock

Yeah, we did actually. And we showed that it was worries together with this essentially reexamining of the situation – maybe that, "Oh, I studied, I'm going to do well," or, "I have the tools to succeed," or maybe, "Nothing's riding or my life isn't riding on this one performance" – those sorts of writings together really accounted for our effect.

Host – Robert Frederick

And how did you extend your study and test this "writing to improve test performance hypothesis in a high pressure situation" in the classroom?

Interviewee – Sian Beilock

Right. So, we did two studies initially in the laboratory where we could really control how much knowledge students came to the table with. They were taking a math test and we made sure no students had seen the types of problems we used before. So, we could really pinpoint this impact of writing for helping performance under stress. But, of course, your results are only as good as being able to show that they extend to the real world situations. So, we also did two studies in high school classrooms where we had students 10 minutes before they took the first final science exam of their high school career – it was a biology test – either write about their thoughts and feelings about the upcoming test or just think about something that might not be on the test. So, some students wrote and some students essentially didn't write. And then we looked at their

exam performance as a function of whether they'd had the opportunity to express their thoughts and concerns about the test.

Host – Robert Frederick

Who then, if any, were helped by this intervention?

Interviewee – Sian Beilock

So, immediately before the test they did their writing. But about six weeks before we'd gone into the students' homeroom classes and given each student a measure of test anxiety – a typical measure, a paper and pencil measure that students fill out designed to assess how worried they get in testing situations. So, students filled out questions like "In exams I tend to worry a lot," and they rated how much this applied to them. And what we showed is that for students who were just asked to sit and think about the upcoming test and what might not be on it – so for students who didn't write – there was a strong relationship between a student's test anxiety and how they performed on the test, meaning that those students who had higher test anxiety performed worse. And this was true, even when we took into account previous grades across the school year. So, test anxiety over and above what students bring to the table seemed to be having a negative impact on performance. But for that group that was given the opportunity to write, we essentially showed that this relationship between test anxiety and performance was abolished. Now, those students higher in test anxiety were performing just as well as their low test-anxious classmates and, in fact, we showed a three-quarters of a grade point boost almost for students higher in test anxiety who were given the opportunity to write about their worries.

Host – Robert Frederick

Did the students know why they were given a short writing assignment right before this school test?

Interviewee – Sian Beilock

They had no idea. In fact, they didn't know what they were doing relative to their classmates or how the writing was hypothesized to impact their performance. The teachers also didn't know what conditions students had been assigned to. So, the idea was to keep the students and the teachers in the dark somewhat about the hypotheses to see if our effects would come out, even if no one had any idea about why they might be doing the things they were doing.

Host – Robert Frederick

Is this then a strategy students could implement themselves to reduce testing anxiety or could knowledge of this intervention change the result?

Interviewee – Sian Beilock

Well, I think that what this suggests is that students on their own they don't need a teacher on-board to show some of these benefits – that writing about worries can be very beneficial for one's performance, and you can do this on your own or when you get into the test. But, you don't need a teacher's orchestration to make it work.

Host – Robert Frederick

So, you've extended this further than in testing people who know and people who don't know about the effects of this intervention.

Interviewee – Sian Beilock

So, we haven't done that specifically. One of the issues when you know that something is supposed to have a particular effect it might have that effect, even if it's not doing it through the mechanism that we would hypothesize, right? A placebo effect. So, I think it's a stronger test to keep people blind, in a sense, to the impact of the intervention, because it suggests it works without any expectation.

Host – Robert Frederick

Sian Beilock, thank you very much.

Interviewee – Sian Beilock

Thank you.

Host – Robert Frederick

Sian Beilock of The University of Chicago is senior author of a paper in this week's *Science* on how writing about testing worries boosts exam performance in the classroom.

Music

News Writer – Greg Miller

So this is an article about loneliness and some research suggesting that it might actually be bad for your health.

Host – Robert Frederick

Science's Greg Miller reports in this week's issue on the correlation between chronic loneliness and changes in the cardiovascular, immune, and nervous systems.

News Writer – Greg Miller

I think everybody probably gets lonely from time to time, you know, when a relationship breaks up or we move to another city or something like that. But, what the research is suggesting is that people who experience chronic loneliness – over, you know, many months or years – they exhibit a bunch of different physiological changes throughout the body and in the brain that might actually be harmful to their health over the long run. There is some indication that up to 20% of the population at any time is in a long-term state of loneliness. And if that's true and if all of these connections to poorer health outcomes are true, then that makes it a considerable public health risk. And so, the goal is to understand that and understand what we can do to alleviate it.

Host – Robert Frederick

Are there cases where people have lots of social contacts and suffer from this chronic loneliness?

News Writer – Greg Miller

Yeah, that's an interesting point, because one of the things that this research – and this mainly the work of a guy named John Cacioppo at the University of Chicago – his work has really tried to distinguish between objective measures of someone's social network, like just counting up how many friends they have or something like that, and the subjective feeling of loneliness. And it turns out to be that subjective experience of loneliness that seems to really be what's important. So, there are some people, like you say might have a large social network, seemingly have a lot of contacts, but still feel lonely, and on the other hand, some people might seem to have not too many social contacts and lead a kind of isolated life, but actually they're okay with it. And it actually does seem to be the perception that really matters in terms of health.

Host – Robert Frederick

At what point does loneliness become chronic?

News Writer – Greg Miller

Yeah, that's an interesting question. I don't know that there's an easy answer. I think what they're trying to distinguish is between the periodic bouts of loneliness that people would have just due changing life circumstances, you know, like I mentioned a breakup or moving away that might a few weeks or a couple of months or something like that, and people who take a really lonely view life over the long run, over many months or years or maybe even their entire lifetime, feeling like they have no one that they can turn to, no one they can talk to, no one there to sort of support them.

Host – Robert Frederick

And it's at that chronic loneliness state that loneliness becomes bad for your physical health. Is that right?

News Writer – Greg Miller

Yeah, that's the thinking – that when people experience this emotional state over a long period of time it comes to be harmful for your health. Just like being, you know, stressed when you have a busy day at work or a busy week at work is kind of an unpleasant feeling maybe, but it's not going to kill you, in a short period of time. But, if you go through week after week, year after year, of being stressed that takes a toll on your health over time.

Host – Robert Frederick

So, what physical conditions are loneliness, or chronic loneliness, correlated with then?

News Writer – Greg Miller

Well, it's interesting because a lot of the studies that have been done – the epidemiological studies that have been done – haven't looked at loneliness per se. They've looked at social isolation, so more objective measures of how many social contacts a person has. And, in general, it's probably true that people with fewer social contacts tend to be more lonely, but it's not necessarily exactly the same thing, as we talked about. And so, anyway, with social isolation people are more prone to all sorts of

different illnesses. They're more prone to some kinds of infections; studies have found they're more prone to heart disease, to depression. In fact, there was one recent study last year that looked at a whole bunch of these studies together and reanalyzed the data and found that being socially isolated gives you about the same risk, health risk, as being a smoker in terms of your longevity.

Host – Robert Frederick

Is there some evolutionary advantage to this physiological response to being lonely?

News Writer – Greg Miller

So, this researcher that I mentioned at the University of Chicago, John Cacioppo, thinks there is. Actually, he thinks loneliness is adaptive in the short term, because it gives us a signal, an unpleasant signal, that our social connections have become stretched too thin, that we need to reconnect with a group, because our ancestors, by living in groups, they were better able to survive and reproduce. And so, he thinks loneliness is a signal that evolved to keep us in groups and let us know when we're getting too far out of the loop.

Host – Robert Frederick

What's the connection then? What's the mechanism for poor health as a result of chronic loneliness?

News Writer – Greg Miller

Well, that's exactly what Cacioppo at the University of Chicago is trying to investigate. Because all of these epidemiological studies have suggested for many years that there might be a connection between social isolation or loneliness and poor health, but they didn't really say much at all about the mechanisms. And so, he's being doing all sorts of physiological and psychological testing and teaming up with researchers around the world with other kinds of expertise in neurobiology and genetics. And so, they're finding some interesting things in people who seem to be chronically lonely. They find changes in stress hormone levels, like they have elevated stress hormone levels; they have changes in the way their brain responds to social stimuli. Lonely people tend to react more negatively to other people and rate their interactions with people more negatively, and they're seeing some correlations of that with some brain imaging work. One of the really interesting things that they found in the last few years – they've been collaborating with a group at UCLA using DNA microarrays to look at gene expression in immune cells in the blood of people who are lonely and comparing that with people who aren't lonely. And they see some changes there in genes that are involved in the inflammatory responses, so they see elevated inflammatory responses in lonely people and they see decreased responses in immune system genes that are involved in fighting off viruses. And that actually kind of fits with some of the epidemiological studies where they found that people who are socially isolated are more susceptible to viral infections – anything from the common cold to HIV – and are also, at the same time, more susceptible to heart disease, and inflammation is thought to be a contributor to heart disease. So, these kinds of immunological changes that they see could begin to hint at some of the mechanisms for why people are more susceptible to certain kinds of conditions.

Host – Robert Frederick

So, could these observed differences in hormone levels, how the brain responds to stimuli and gene expression of immune cells be a cause of loneliness and not just a symptom of it?

News Writer – Greg Miller

I think they would say it is loneliness – it's neither the cause nor the effect, it is loneliness. When you're lonely it puts your body and your brain into this state and that's what they're describing.

Host – Robert Frederick

So, is loneliness then a product of your environment or is there a genetic component to it, too?

News Writer – Greg Miller

There's probably both. Certainly someone's environment influences whether they feel lonely or not. There are some studies that suggest that college freshmen are actually among the loneliest people that have been studied because, even though they're surrounded by people their own age, they've left all of their high school friends and their parents and their family behind. So, that's an example of how your environment can affect it. But there's also a series of studies that this researcher in Chicago has done with a group in the Netherlands that has a large registry of twins that suggests that there's a heritable component to loneliness, as well. That people inherit, the way John Cacioppo, this researcher, characterizes it as a sort of "genetic thermostat," where each person might have slightly different set point and what this determines is how painful it feels to be alone. So, for some people when they're socially disconnected maybe they don't feel so bad; other people take it a little harder and feel a lot more pain, social pain, as a result. You know, so there's environmental influences, there's genetic influences. The other environmental factor might be a sort of almost "contagious effect," where there's one study that these researchers published a couple of years ago looking at how loneliness spreads through social networks. Looking at a large study of people and finding that loneliness tends to cluster in groups, suggesting that when you're around a lot of lonely people you might be more likely to become lonely yourself.

Host – Robert Frederick

That sounds rather counterintuitive to me.

News Writer – Greg Miller

Because why are you around lonely people?

Host – Robert Frederick

Right.

News Writer – Greg Miller

Yeah, well because you can be around people and not, I guess, be fulfilled by your interactions with them.

Host – Robert Frederick

So, what then are the treatments or interventions for loneliness?

News Writer – Greg Miller

Yeah, so, it is a treatable condition, as you might imagine. And I think for most people, a lot of people, you can just sort of be more engaged with the contacts that you already have. But, this group is looking at interventions for people who might have, you know, harder cases to shake and they've found that there are some treatments that are not so effective and others that are. So, just having a mixer basically, where you get together a bunch of lonely people and do a "meet and greet" sort of thing doesn't really work that well. What seems to work better, for people who are really chronically lonely and have a hard time shaking it, are types of therapy, therapeutic methods, borrowed from something called cognitive behavioral therapy that's used to try to change the way people perceive social situations and perceive themselves and their interactions with others.

Host – Robert Frederick

And prevention?

News Writer – Greg Miller

So, I think, in terms of preventing loneliness, what Professor Cacioppo recommends is just to remain open and available to the people around you. And it's something that sounds really simple, but it's not always easy.

Host – Robert Frederick

Greg Miller, thank you very much.

News Writer – Greg Miller

Thank you.

Host – Robert Frederick

Science's Greg Miller reports in this week's issue on the correlation between chronic loneliness and changes in the cardiovascular, immune, and nervous systems.

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, *ScienceNOW*, including a story about a mysterious green blob in outer space. Welcome back, Dave! Happy New Year!

Online News Editor – David Grimm

Happy New Year, Rob!

Host – Robert Frederick

So what is this mysterious green blob in outer space? Sounds like a movie title or something?

Online News Editor – David Grimm

Well, this mysterious green blob is also known as Hanny's Voorwerp, if I'm getting my Dutch pronunciation correct and I'm probably not. But, "voorwerp" means "object" in Dutch and the Hanny is a Dutch schoolteacher, who in 2007 was combing through a database of celestial objects and came across this glowing green smudge of light that's approximately 650 million light-years away. And for a while astronomers were really perplexed by this object. What is this? Is this just an artifact? Is this something we've never seen before? And so, they trained a bunch of telescopes on the object. And what they concluded initially was that the object appeared to be a giant cloud of hot gas. And the reason they thought it was glowing green is because it was located not too far from a galaxy known as IC 2497. And in the center of this galaxy is what's called a quasar, which is a black hole that was gobbling up stars, and as this black hole gobbled up stars it was emitting these tremendous highly energetic jets of hot gas and high-energy radiation. And the astronomers thought that this radiation was striking this cloud of gas and the radiation was exciting oxygen atoms in the gas and that was causing it to turn green. But that was just preliminary speculation. Up until now there have really been no way to confirm this hypothesis.

Host – Robert Frederick

So, now, what's happened?

Online News Editor – David Grimm

So, now scientists have very detailed Hubble space telescope images of this object and also new x-ray observations, so they have a lot more data than they had before. And the good news is the data pretty much confirms these other hypotheses – that Hanny's Voorwerp is this giant cloud of hot gas and indeed was being excited by these massive radiation jets from this quasar in a nearby galaxy. And I say was being excited, because what the astronomers discovered with this new data set is that the nearby galaxy the quasar is actually shut off, it's no longer emitting these tremendous jets of radiation. But, the Voorwerp is still glowing green, and that's because these objects – the Voorwerp and the galaxy – even though they're relatively close together, are really not that close together in our terms. And it actually takes tens of thousands of years for light from the galaxy or the light from the quasar to reach this Voorwerp and excite the atoms in it. So, even though the quasar is shut off, the light is still traveling to the Voorwerp, exciting it, and it's causing it to glow green. What that tells us not only is that the quasar was indeed responsible but also that, by their calculations, the astronomers have found the quasar probably shut off about 200,000 years ago, which is a lot faster of a shutdown than researchers thought possible. So, we're not only learning more about this mysterious green blob, but also more about how quasars work, as well.

Host – Robert Frederick

Are there any more mysteries then to this previously mysterious green blob?

Online News Editor – David Grimm

Well, one other thing that the astronomers discovered was this cluster of young stars in the Voorwerp. And they say that actually adds more evidence to this whole quasar hypothesis, because if a very energetic beam of radiation is hitting the Voorwerp it's not only causing it to glow green, but it can actually compress the gas, and when gas is compressed it can form stars, so more evidence of this quasar hypothesis.

Host – Robert Frederick

Okay, thanks, Dave. So, what other stories have you brought with you this week?

Online News Editor – David Grimm

Well, Rob, this next story is also about studying a tricky object, but instead of a mysterious green blob the tricky object here is the penguin. And the reason penguins are very tricky to study is because, at least to you and I, they all kind of look alike. And in the past researchers have surmounted this problem by putting metal bands around the penguin's wings and these bands have numbers on them and that allows the researchers to tell one penguin from another; it allows them to track their movements and figure out, you know, where they're migrating and learn more about their behavior. But for a few decades now researchers have been worrying that these bands could have deleterious effects on the penguins. In fact, in the 1970s, a study at a zoo showed that the bands actually hurt the penguins because when the penguins have their annual molt their flippers swell and the bands can interfere with that. And there's been a lot of studies since then to try to figure out whether these bands are actually harmful and whether researchers should stop using them in the wild. And the studies have really come to mixed conclusions – some have said that the bands are fine and some have said the bands are a bad idea.

Host – Robert Frederick

So, is there any growing consensus or is it still just two different sides – they're bad or they're good?

Online News Editor – David Grimm

Well, in an effort to try to lay the controversy to rest, a French research team decided to do a very comprehensive study. And this was actually a 10-year study on a colony of king penguins that live on Possession Island, which is this 150-square-kilometer patch of land that's roughly 1,000 kilometers off the coast of Antarctica. And what the researchers did was from 1998 to 2008 they had taken 100 of these birds and they put bands on half of them and didn't put bands on the others. Now, these researchers had another way of tracking the birds – something called RFID chips. And these are chips that are injected under the penguin's skin and when they're excited by a radio signal, they reflect an altered signal, which the researchers can use to track the penguins. And what the researchers found was, over this 10-year study period, the penguins that were banded did a lot worse than the penguins that weren't banded. Two big things stuck out. First of all, the penguins that were banded had a lower survival rate, about a 16% lower survival rate than those that weren't banded. They also arrived a lot later to their breeding grounds and took longer trips to forage for food, and both of these resulted in them

producing fewer chicks, about 39% fewer chicks, on average, than the penguins that weren't banded.

Host – Robert Frederick

Sounds like more is at issue than just the bands getting in the way of molting.

Online News Editor – David Grimm

Well, these researchers think that the bands can actually interfere with the penguins swimming, potentially creating drag while the penguins are swimming, that would cause them to have to exert a lot more energy while they're swimming, which could make them more susceptible to starvation or disease or other problems.

Host – Robert Frederick

Seems pretty conclusive – get rid of the bands.

Online News Editor – David Grimm

Well, it sounds pretty conclusive from this study. And what the researchers say is that the reasons past studies may have achieved mixed results is that penguins with the bands did fine in years where there was plenty of food. If there was a lot of food around, it didn't matter whether the penguin had a band or didn't have a band. It was really affecting them most when it was "normal" amounts of food around or very scarce amount of food around. So, what the researchers say, if somebody was studying the effects of banding during say just over a one- or a two-year period, where their penguins had a lot of access to food, they may have concluded that, "Hey, there's no problem with bands." But, it was only by studying these penguins over a 10-year period, where there's years with more food than others, the researchers were able to find that, "Yes, over the long term these bands are bad." Now, getting back to your question, Rob, not all researchers agree with this conclusion. One of the experts in this story says that it may depend on the species of penguin. She studies Magellanic penguins in Argentina and she says her team hasn't observed any deleterious effects. So, although this study may be the best evidence yet, it may not be enough to sway all the researchers that are currently using these bands on penguins.

Host – Robert Frederick

Well, if these RFID tags are available, why aren't everyone just using those?

Online News Editor – David Grimm

Well, the problem with the RFID tags is that they require a lot more equipment, as it were. With a band around a penguin's arm all you have to do is be able to visualize the penguin, you can jot down the number on the penguin and follow it around. But, with the RFID tags the only way to track them is to place antennas anywhere the animal might move, so you're talking about a lot more of an infrastructure set up than you would with just with a simple metallic band.

Host – Robert Frederick

So, potential expense but clearly a difference in the ease of use.

Online News Editor – David Grimm

Exactly.

Host – Robert Frederick

Okay. So, last story. What's this last one about?

Online News Editor – David Grimm

Well, Rob, from penguins that live off the coast of Antarctica to Antarctica itself. This last story is about the West Antarctic Ice Sheet and how it may melt, no matter what we do in terms of curbing greenhouse gas emissions, and that could be very bad news for the coastal cities of the world.

Host – Robert Frederick

No matter what we do – is that because we've already emitted the greenhouse gases that are going to lead to this disruption?

Online News Editor – David Grimm

That's the basic idea. This new study has to do with climate modeling – this is where researchers plug a bunch of factors into a computer and try to predict the effect on climate over the next few years, hundred years, in this case over the next thousand years. And what they found is they considered a very rosy scenario with greenhouse gas emissions.

Host – Robert Frederick

Rosy in terms of?

Online News Editor – David Grimm

Rosy in terms of that we would completely stop emitting greenhouse gases by the end of this century, which is very optimistic. And the idea would be by the year 2100 we've stopped emitting all greenhouse gases, or at least from manmade activities, and have completely switched to green sources of energy. Now, that's a very optimistic scenario, but even under that optimistic scenario the researchers found that carbon dioxide levels, which is one of the main greenhouse gases, remain elevated in the atmosphere. And that's because, even when we stop emitting, the oceans are very slow to absorb this carbon dioxide, it takes a really long time. And also, right now we're relying on ecosystems, terrestrial ecosystems, to soak up a lot of the CO₂, but they can't soak up all of it. And in fact, according to the model, after about the year 2200, they're going to start releasing some of these gases that they've soaked up. All of this together means that carbon dioxide levels are going to remain very elevated for the next nine centuries, so we're talking about, you know, almost to the year 3000. Now, the big question is, "What is that going to do to rising sea levels?" We worry about rising sea levels because of coastal cities, obviously flooding cities like New York and Hong Kong and Sydney. And the reason sea levels have been rising up until now, because land-based masses of ice, like glaciers, are melting and that water flows into the ocean rising sea levels. Also, heat itself causes water to expand and that can also raise water levels. But one thing that scientists have thought was maybe not immune to this process but weren't as concerned

about were these giant ice sheets, like the West Antarctic Ice Sheet. And this is a, you know, enormous mass of ice that covers a large portion of Antarctica. But the scientists say that because of this elevated carbon dioxide in the atmosphere and because it's going to persist for so long it's going to warm the waters for a very long time, and not only warm the surface waters, but actually warm the waters at depth. And that could cause even something like the West Antarctica Ice Sheet to begin melting, which could have huge impacts on the oceans – water levels could rise as much as four meters, which would completely swamp many coastal cities.

Host – Robert Frederick

So, are these modelers just pointing this out as a kind of, “Okay, we need to do something now,” or do they have another objective in mind, say an argument for geoengineering?

Online News Editor – David Grimm

Well, it's not a very hopeful study, is it? You know, it basically is saying that no matter what we do the oceans are really going to suffer. And they don't really propose a solution, but obviously geoengineering has been bandied about as a way to potentially slow or even reverse the effects of global warming. But studies like this just show how bad it's gotten. That, you know, in many ways we've sort of passed the turning point of being able to effectively deal with the impact of all of the manmade pollution over the last few centuries. And in some respects, it may be too late for things that we're concerned about and in this case especially, rising sea levels.

Host – Robert Frederick

At least according to this team's model.

Online News Editor – David Grimm

Exactly.

Host – Robert Frederick

Are other modelers convinced by this study?

Online News Editor – David Grimm

Well, at least one expert – the expert that's quoted in this article – thinks it's a strong study and says it's just more evidence that, you know, long after we stop burning fossil fuels Earth is still going to feel the effects.

Host – Robert Frederick

Okay, well thanks, Dave.

Online News Editor – David Grimm

Thanks, Rob.

Host – Robert Frederick

What other stories are you looking into for the site?

Online News Editor – David Grimm

Well, Rob, speaking of climate change we've got a story about how climate variations may have been linked to seminal events in European history, including the rise and fall of the Roman Empire; also a story about a new way to distinguish cancer cells from non-cancerous cells and what implications that may have for cancer therapy. And for *ScienceInsider*, *Science's* policy blog, we've got a story about a new report that's come out about the oil spill, the giant oil spill, that occurred in the Gulf of Mexico last year. And how the report writers are arguing for a larger role for scientists in shaping U.S. Environment Policy decisions. And also a story about the search for the elusive God particle – this is Higgs boson – the particle that's supposed to solve many riddles of physics. It turns out that U.S. efforts to find this may be ending very soon, leaving it to the Europeans to pick up the slack. So, be sure to check out 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, *ScienceInsider*, at news.sciencemag.org.

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Host – Robert Frederick

And that wraps up the January 14th, 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.

Music ends