Jill: Thank you everyone for standing by, and welcome to our webinar, entitled why we don't believe science - a perspective from decision psychology. These webinars are an initiative of the Ohio State University Climate Change Outreach Team. A multi-departmental effort within the University. Led by Ohio Sea Grant Office of Research. Ohio Super Computer OSU extension, and several OSU departments. To help localize the climate change issue for Ohio and Great Lakes residents.

I am Jill Jentes Banicki from Ohio Sea Grant and Stone Laboratory. And joining me today is Doctor Ellen Peters, of the Ohio State University. Doctor Ellen Peters is a Professor of Psychology, and director of the Decision Scientist Collaborative at Ohio State. Her research focuses on understanding the basic building blocks of human judgement and decision making. Including how critical information can be communicated to facilitate better decisions and help financial and environmental context. She is a former President of the Society of Judgement and Decision Making. Former Chair of FDA's Rush Communication Advisory Committee. And is the current member of the National Academy Committee on the Science of Science Communication. We are delighted to have her here today to talk to us about decision psychology.

But before we get started, a few logistical issues. During our presentation, all participants will be in a listen only mode. Afterwards, I will conduct a question and answer session. If you would like to ask a question during the presentation, feel free to ask using the chat feature - located on the right hand side of your screen. And I will collect and pose your questions out to Doctor Peters at the end of her presentation. We have nearly 500 participants so far on this webinar. A great, diverse group representing governmental agencies, academia, and non profit groups from the Great Lakes and around the country. Please keep those questions coming throughout the presentation, and we should have a great Q and A session.

As a reminder, this webinar is being recorded, and will be posted onto our website for later viewing. Also, we will post a webinar survey in the chat feature, toward the end of the hour. Please take a few minutes after the webinar to fill out that survey. It will help us continue to bring you better webinars. So without any further delay, I would like to introduce Doctor Ellen Peters. Doctor Peters, I am going to unmute you. And I'm going to hand you the ball here.

Ellen: That's perfect, thank you Jill.

Jill: Actually, hold on sorry. Let me have the ball back again for one second.

Ellen: Okay.

Jill: So I can give you your PowerPoint presentation.

Ellen: Oh, 'cause I'm going to do it from (3:20?).

Jill: Alright.

Ellen: Okay are we ready?

Jill: You are in good shape, thank you.

Ellen: Perfect, thank you so much for the introduction, Jill, and especially for inviting me to give this talk. And thanks to the many of you out there who are listening. I hope I'm able to teach you something, and something that's interesting even. What we're going to talk about today is a perspective from decision psychology on why we don't tend to believe science. And I wanted to start off with a few facts, a few scientific facts.

First of all, a recent report from the Pugh (3:59?) Research Center, found that about 79% of Americans think that science has made life easier for most people. According to the National Science Foundation, science indicators from 2016 - Americans are often more likely to have a great deal of confidence in leaders of the scientific community. Better than leaders of any other group, except for the military. At the same time though, we don't always believe in science.

So for example, 88% of scientists believe that genetically modified foods are generally safe to eat. Compared to the public, where only 37% of them believe the same thing. Among scientists, 86% believe that vaccines should be required in childhood, compared to only 68% of the public. 94% of scientists believe that climate change is a very serious problem, or a somewhat serious problem. Compared to only 65% of the public.

So Americans seem to believe in science, but not to always believe in scientists. And what we're going to do today, is we're going to - if I can get this to work. There we go. What we're going to do today, is we're going to focus in particular on how we judge risks and make decisions. We're going to start off with some of the things that come from my field of decision psychology. And that'll lead up into some of the work that's been done about beliefs, and beliefs about risks in particular.

We're going to examine some of the many ways in which human judgement can be biased. And when I say biased, I simply mean where judgement can be influenced by factors that ideally shouldn't be involved. And in the end, what we're going to look at is this idea that beliefs can be constructed, every position of belief. That belief - persistence can be rational in some cases, and perhaps not as rational if you look at it from a different one (5:47?). But that - how we present information to people should end up mattering to beliefs and beliefs persistence.

Let's go ahead and get started. And I have to remember how to switch these slides,

'cause it's not my usual way. But to look at - starting first with 4 general themes in the psychology of judgement and decision making. The first is something that you're probably all aware of. It's the idea that every day, we're bombarded with a vast number of decisions and an overwhelming quantity of information. And it's all this stuff that we have to deal with each and every day.

So for example today, there's probably a whole bunch of minor decisions you've already made. What to have for breakfast. Whether to attend this webinar? What clothes to wear? There's all kinds of decisions that we make every day. Some of the - we think through, some of them are more habitual. But we often bargain with an almost overwhelming quantity of decisions and information. They're are also much more important, the major decisions. You might have recently decided whether to get married, whether to change career? Those are even more important decisions.

But again, there's a vast number of them that we have to make. And the problem with that, is that we have limited resources. Human beings are capable of these absolutely tremendous feats of (7:06?). But we're what's called boundly rational. We can't possibly attend to and process all of the information and all of the options with which we're faced. Because of our bounded rationality and our inability to be able to take everything into account, we end up taking a lot of mental shortcuts.

We use mental shortcuts when judging risks and then making decisions about them. (7:33?) Simon once said, "We satisfice. We make decisions and form judgements that are good enough. They may not be ideal, they may not be the absolutely best, but they're pretty good - we satisfice." And this process can be incredibly adaptive. It's very efficient. Because we, otherwise that bombardment of information and options can (7:52?). And it's also adaptive, because what we end up with really is frequently good enough. It can though end up, with worst decision. So it can be maladaptive in some ways.

These mental shortcuts, we often call heuristics and we use heuristics to judge and to decide. Some examples of heuristics, just sort of every day heuristics are things like - we might conclude that a person is closed or defensive because they have their arms crossed. Or we might decide to eat at restaurant B rather than A. Because B has more cars in it's parking lot. So probably the food is better when (8:27?) heuristics. A great risk perception one is people deciding not to swim in the ocean, because you just saw the movie Jaws.

The first theme from the psychology of judgement and decision making, is the idea that we frequently don't know our own true value for an object or a situation. So we don't for example know exactly how much a house is worth. Or how much risk is really posed by climate change or some disease. And because we don't know our true values for objects and situations, we often end up constructing our values and our preferences

and our beliefs based on (9:07?) in the situation, but also based on who we are as decision makers. And so later on in the talk, we're going to look a different Liberal versus Conservative leanings, and how they've helped us to construct values and preferences and beliefs.

But, so let's take a look first at some of the psychology. So beliefs and judgements should arise from an intentional process in which we gather all the relevant information, we discount irrelevant information. We weight relevant information objectively and thereby we come to a decision. But ideally we're objective when we think and decide that that's really what we'd like to do. But that is not how the human mind works. Instead of that objective process, what ends up happening instead is that we actually are influenced by a huge number of systematic heuristics and biases. And we study many of these in my field.

We're influenced by irrelevant cues, in ways that affect judgements - risk perceptions and judgements and decisions outside of our awareness. We're also influenced by our own moods and emotions.

What we're going to focus on more today though, is the idea that we actually seek out, interpret and weigh information according to our preconceived opinions. According to what we thought ahead of time. Beliefs end up shaping how we judge and (10:27?). And they (10:28?) can be constructed. They persist. They're had to give up if they're our own beliefs. Even (10:34?) perhaps is trying to change somebody else's beliefs. These beliefs can color our perceptions of reality. They can color our perceptions of exactly what's out there. And this isn't just try for laypeople, it's also true for experts.

I want to tell you briefly about one study. 57 wine experts were asked to taste 2 glasses of wine. 1 red wine and 1 white wine. But unbeknownst to these wine experts, the wines were actually the same white wine. One of which is then tinted red with food coloring. That red tinting though, and the fact that they were actually the same white wine, didn't stop the experts from describing the red wine in language that's typically used to describe red wine. One expert praised it's jamminess, while another enjoyed it's crushed red fruit. Not a single one noticed that it was actually a white wine.

This is an example of what we would call belief persistence. The tendency to maintain beliefs without sufficient regard to the evidence against them, or the lack of evidence in their favor. So the simple color of the wine, the redness of the wine led people to believe it was going to be a red wine. And then they maintained that belief with sufficient regard to the evidence, the taste of the wine itself.

Some other examples of that, perhaps in our own life. We tend to persist in beliefs like the safety of the 5 second rule with food. I hate to tell all of you, but it's actually not true. We tend to persist in beliefs about the idea that getting a base tan will protect you

against sunburn. This kind of belief persistence can be quite rational. It can inspire us to try - inspire us with the confidence to try more. To pursue lofty goals - to go onto graduate school, to initiate a new relationship.

But it can also be irrational, and it can cause us to make worse decisions, potentially. So for example, you might continue to pursue someone romantically, who really just isn't interested. Or a person with clinical anxiety might continue with a debilitating fear of death. That can have large negative consequences on the life that they would like to lead. But it is a gray area, whether belief persistence is rational or irrational. So Thomas Edison, who invented the light bulb once said, "I have not failed, I've just found 10 000 ways that it won't work. Rational or irrational? It's not always clear.

So why do we persist in our beliefs? We persist in our beliefs, because it's 2 general prophecies that lead to a particular bias. We tend to selectively perceive information. We see and believe what we want to see. We also don't selectively expose ourselves to information. We search for what we want to see. And these 2 prophecies of selected perception of information and (13:23?) authoritative exposure to information - lead to what we call confirmation biases.

But let’s look at some of the research. And let's start off with selective perception. So again, this is the idea that we see what we want to see, and we believe what we want to believe. And one of the first studies on selective perception, it was done by Lord, Ross & Lepper. And what they did, is they had subjects - half of whom favored capital punishment. And half whom opposed capital punishment. And they took all of those (13:49?), both groups. And everybody read the same 2 studies. One of which confirmed beliefs that capital - one of which confirmed beliefs about capital punishment. There was pro capital punishment. And one that just confirmed beliefs.

So everybody read the same thing. The subjects however, selectively perceived the 2 reports. It turns out that the report that agreed with their own A priority attitude was more convincing. Where the other reports had more flaws. So people actually, even though they all got the same information, they actually saw different information. They perceived the information differently, and they perceived it in ways that were consistent with their A priority beliefs.

So you might recall that - for these subjects, in terms of their average attitude before, half of them opposed capital punishment, and half of them favored it. And logically, both sides should then become more neutral, or they should at least stay the same. Because everybody read the information that was balanced. Half for capital punishment, and half opposed to it. However, after reading the reports, attitudes actually polarized further. People seemed to weight consistent information quite a lot, and inconsistent information very little. (15:07?) results, those attitudes polarized. They became extreme than what they started out as.

We not only selectively perceive what's in front of us, but we do also selectively expose ourselves to information that's consistent with our own beliefs. We've searched for what we want to see. So Liberals will tend to watch - if they want to watch news, they watch CNN. Conservatives, on the other hand, will tend to watch Fox news or other conservative outlets.

An interesting example of this from the 1970's had to do with Richard Nixon. It turned out that interest in Nixon's demise, depended upon whether you voted for Nixon. You were not interested in finding out about his demise. Or, you voted for McGovern. And if you voted for McGovern, you are very interested in finding out what happened to Nixon.

In another experimental example, conducted by Lowin. Subjects in this study could order free brochures about their own political candidate or the opposing political candidate. But Lowin found that the brochure orders depended on how well the brochure helped to maintain their belief. So what they did is, they had - they did an experiment on manipulation. So half of their subjects were randomized to conditions, where they were given strong arguments - both for the individual's own candidate, and for the other candidates. The other half of the participants were given brochures that had weak arguments. Both for their own candidate, and the other brochure had weak arguments for the other candidate.

And people were simply asked, "Would you like to order brochures for your own candidate, or would you like to order brochures for the other candidate? And what they found is that if there was strong arguments for both candidates, people were much more likely to order their own brochure - order brochures for their own candidate. And much less likely to order brochures for the other candidate.

Because the strong arguments - if you ordered it for your own candidate, helps you maintain your belief, your A priority beliefs. But if you've got strong arguments for the other candidate, it wouldn't. It would actually undermine your A priority belief. On the other hand, when the participants got weak arguments - the brochures that had weak arguments about your own candidate and the other candidates. Well if you don't want to hear weak arguments about your own candidate, then what happens is that people tended to be much more likely to order the brochures about the other candidates. Because the weak arguments could further undermine beliefs that the other - interest in the other candidate. And that's helped you to maintain your own belief.

Beliefs are surprisingly stable. Because we're often closed to challenges to those beliefs. Selective perception and selective exposure to information, tend to lead us to confirm our hypotheses and beliefs. Rather than testing against information that might disconfirm them, we tend to not want to do that. Yeah, there's a question about whether this is rational, whether it's good for us? And in some ways it is rational. It's rational in the sense that it's efficient. It takes us far less effort, and it's often good enough in most

circumstances. But it's not rational in the sense that it allows us to maintain beliefs. That's simply untrue.

It may also leave us worse off as a society, and what I'd like to do now is look at a couple of examples of risk perceptions in environmental domains. This is work that I've done with Dan Kahan and others. And - but what we look at in these 2 examples, is the idea that experts believe that the public often doesn't perceive enough risk - in at least some domains. For example, like climate change. And we're going to use climate change as an example.

Experts also believe that the public perceive too much risk other times. An example there is nuclear power. What we looked at in this study, is we first considered what I'm going to call the public irrationality thesis. So PIT. Experts essentially think that the public is irrational, and for a few reasons. First they think that the public tends to be scientifically illiterate and innumerate. Not everybody, but for the fairly large proportion of the population. They also believe that the public is boundedly rational. And the public is boundedly rational. And uses (19:25?) in place of knowing the science and knowing the numbers. They often use other, the experts also believe that the public uses other non numeric sources of information. Like their fear of new technology, or their political leanings. Now we're going to focus on political leanings today.

And so, we decided to test this public irrationality thesis in the domain of climate change as well as nuclear power. And what we did was a study of the US population. We had a sample of about 15 000 subjects. Knowledge Networks is the company that collected the data for us. And what we asked people was how much risk do you believe climate change poses to human health, safety, or prosperity? So what I'm showing you in the graph that you have in front of you, is risk perception on the Y axis. The greater risk perceptions are higher, lower risk perceptions are lower. And I'll explain what the X axis is in a moment.

The X axis itself is numeracy and scientific literacy. So people who are less numerate and scientifically literate on the left. And on the right are people who are more numerate and more scientifically literate. And the prediction comes from a public irrationality thesis, is the idea that innumeracy and scientific illiteracy lead to bounded rationality in climate change perceptions. And what that should end up people, is that people who know less about numbers and about science, they're simply going to perceive less risk about climate change. Compared to individuals who are higher in numeracy and scientific literacy. Who are going to understand the facts, and they're going to realize that the experts do, that it poses more risk.

And so this is the PIT prediction. Again, so people who are higher in numeracy and scientific literacy should perceive more risk, compared to those individuals who are lower in numeracy and scientific literacy. So let's look at what actually happens. This is

the actual variance. What actually happens in this data, is that people who know more about numbers and about science and about (21:23?) science - they actually perceive a little less risk from climate change, from those individuals who are lower in numeracy and lower in scientific literacy. And that's inconsistent, as you can see with the PIT predictions. The negative correlation, that's the negative correlation between numeracy and scientific literacy were both risk perception to climate change. But there's small negative correlation, but it's nonetheless the opposite of the PIT prediction.

So the other thing of course you might recall, that experts think the public does. Is they rely on cultural cognition to worldviews. And this is very consistent with the literature. We know that these worldviews guide the evaluation of information about societal risks. The ways where - individuals who are more hierarchical, compared to (22:11?). They tend to believe that societal classifications, like age and gender and family lineage. Those should be the basis for status and resources and opportunities. Those individuals who are more individualistic, tend to agree that people should fight for them self. Or those who are more communitarian believe that people should interact and cooperate. And these ideological worldviews are associated with risk perceptions in environmental domains. Perhaps because those who are higher in hierarchy and individualism, don't believe in heavy regulation of industries.

So that what ends up happening, is that individuals who are more hierarchical and individualistic, they tend to be skeptical of environmental risks. Where those who are egalitarian, more communitarian - they tend to be more concerned about environmental risks. And we can look at our data for that. What I'm showing you here is the (45:35?) graph about risk perception on the Y axis. I have - and then we're going to leave the X axis alone for now.

'Cause first I want to show you how numeracy makes a difference to risk perceptions, just the way I showed you before. But then look to see what happens with the cultural cognitions or worldviews. There's a much greater relationship there. Those individuals who are more egalitarian and communitarian, they perceive far greater risks for climate change than individuals who are hierarchial and individualistic. And (46:04?) is much stronger than that for numeracy and scientific literacy.

And so there is a lot of prediction though. So the PIT prediction's closer (46:12?) to their cultural cognitions with that or the risk perceptions. And that is the case. Cultural cognition's seem to be used, perhaps as a heuristic substitute. But there's a PIT prediction that goes further than that. And that's the cultural cognition's should be used more by people who are lower in numeracy, and lower in scientific literacy. Because those individuals who are higher, it might not come together on the right facts, but they should come together on the facts. Maybe they've been presented wrong, so there's

people higher in numeracy and scientific literacy didn't quite get to where the experts thought they should. But they should at least come together on facts, and they should be influenced less by a heuristic substitute like cultural cognition.

So this the PIT predicted. That predicted interaction from the public irrationality thesis, with numeracy and scientific literacy. The black line that you can see is the data I showed you before. People who are more numerate tend to perceive a little less risk, and therefore (47:06?). But at least according to the PIT, to the public irrationality thesis, if people are going to be using these cultural cognition's, they should be used more by people who understand less. So people who have lower numeracy, and (47:19?) trying to get literacy, should show a greater divide between egalitarian and communitarian. So you can see, perceive a lot of risk. And individuals who are higher go on individualistic - who perceive a lot less risk.
But among, as you go to the right among those individuals who are higher in numeracy and scientific literacy. You should see these cultural cognition's being used less. They should be used as less of a heuristic substitute. As these individuals, whatever it is they understand, they come together on those thoughts. So that's a PIT prediction. Let's take a look at what actually happens .So again, I have risk perception in my Y axis, my numeracy and scientific literacy scores are on my X axis. This is what happens with the egalitarian and communitarian's. And look what happens. We actually get a greater political divide among people who are highly numerate and highly scientifically literate.

So this is the actual interaction of cultural - of culture, cultural cognition's in numeracy and scientific literacy. Among those individuals who are low in numeracy and scientific literacy, cultural cognition's do play a big role. But, among those individuals who are high in numeracy and scientific literacy, there's an even bigger
divide. Polarization increases and numeracy and scientific literacy increase. You see similar polarization effects for both climate change - I've shown you the same data that I showed you a second ago on the right hand side for climate change - excuse me, on the left hand side for climate change.

But you also see a similar polarization of that for nuclear power on the right hand side. Where greater polarization exists, and on those individuals who know more about numbers. And who know more about science. So why might this happen? Why might polarization increase with more knowledge about numbers and science? It doesn't make sense in a lot of ways. And it particularly doesn't make sense when we think about the goal - the goal that people should have in these situations. Is to learn the facts, and allow them to influence our beliefs.

But instead, what we're seeing is something else. And instead what we seem to be seeing is that people want to remain part of their group. If I'm a hierarch, I want to belong. And I might not belong as much if I disagree with things that people who are higher up don't believe. If I'm an egalitarian, I want to remain part of my egalitarian

group. And with my egalitarian friends. And if I disagree, I may end up not belonging as much. And we have these very, very strong goals to belong. And as a result, one way to think about the least persistence, is that it may be quite rational for the individual, who also lived with their family. Had to live with their friends who are part of these groups, and get that strong goal to belong to those groups.

And those individuals who have more skills, whether with with numbers or with science, they may actually be better at it. They may be better at recognizing and working towards this strong goal for group belonging. And an individual's kind of rationality. Even though society is worse off, because we can't agree on the facts. But at least, it should be the case that we could agree on the answer to a math problem. 'Cause 2 + 2 is always 4, right? Unless subjective perception matters when it comes to objective facts.

And so, we were curious about that, so we did an experiment. What we did in this experiment, there are actually 2 different parts to the experiment. I'm only going to talk about the first part right now. I'm going to talk about the skin cream experiment, which is only half of the experiment. And in this experiment, we essentially have people do maths. What we do is we tell them that medical researchers have developed a new cream for treating skin rashes. And these new treatments often work, but sometimes they make rashes worse. And even when treatments don't work, skin rashes sometimes get better and they sometimes get worse on their own. Just like every other medicine.

As a result, it's necessary to test any new treatment with an experiment, to see whether it makes the skin condition of those who use it better or worse, than if they had not used it at all. So researches have conducted an experiment on patients with skin rashes. In the experiment, 1 group of patients used the new skin cream for 2 weeks. That's the row on the top in the table below. Where the other - where another group of patients did not use the new skin cream. That's the row on the bottom.

And then what you can see in the table below, is that among those patients, for some of them, the rash got better. And for others, the rash got worse. And in the end, what we ended up asking people is just what result does the study support? It indicates the people who used the skin cream were more likely to get better than those who didn't. Or, were more likely to get worse than those who didn't. Let me blow that up just a little bit, so you can see it a little bit better.

So again, this is the table that I showed you with the question just beneath it. And let me show you the right answer, first, (52:10?). So the proportion of people who got better among those patients who did use the new skin cream, were 74.8%. Among those patients who didn't use the new skin cream though, more of them got better. So the correct answer in this stage, is that people who use the skin cream, were more likely to get worse than those who didn't.

In this particular experiment, we actually varied whether the skin cream made the rash increase or decrease. What I'm showing you right now is the table that I showed you a moment ago. But notice the - I'm going to click again, and the column labels are going to change. So in the first half of the skin cream experiment, the column on the left is labeled - the rash got better. In the other half of the participants, the rash got worse. So the correct answer depends upon which of those 2 tables you got. The numbers however, remain the same. We just changed what the column labels were.

And what you find, is that people who are more numerate are better able to flag (53:09?) this problem. What I'm showing you on the graph are the proportion of people who actually correctly interpret the data. They get the right answer. On the X axis are numeracy scores. We measured people's numeracy with 9 items. So they can get anywhere from 0 correct up to 9 correct. And what you can see is that, the (53:25?) the right answer, is that the skin cream decreases rashes or increases rashes - people who are more numerate are simply better at locating that answer, and figuring out what that answer is. And that makes sense. That should be the way it is. Scores on a math test should produce more correct - is what should be associated with more correct answers.

However, we have another half of the experiment also. For half of the experiment, we used a skin (53:52?) problem. In the other half, we used a more politically divisive topic. And we had people do math in a (53:59?) experiment. So in this case, a city government is trying to decide whether to pass a law banning target citizens from carrying concealed hand guns in public. The government officials are unsure whether the law will be more likely to decrease calm, or reducing the number of people carrying weapons. Or whether it will increase crime, by making harder for law abiding citizens and the government (54:19?) from violent criminals.

Researches completed a study of 2 groups of cities to answer that question. And one group of the cities did ban carrying concealed handguns in public. That's the first row in the table below. The other group of cities did not ban carried, concealed handguns in public. That's the second row of the table below. And then what you can see in that table below is that in some of the cities, crime decreased. And in some of the cities, crime increased. Once again, we're simply asking people what's the correct answer to this problem? Is it the case that cities (54:54?) of (54:56?) carrying concealed handguns were likely to have a decrease in crime? Or an increase in crime?

It is the same math problem. I don't know if you noticed, but the tables were identical between this and the skin cream problem. The actual math was the same. And the question is, what ends up happening? Is it the case that in this more politically divisive domain, the people who are higher in numeracy will still be able to get - will still be more likely to get the problem correct? Once again, like before, we actually put half the people in the gun ban part of this experiment. The correct answer is crime decreases. But the other half, crime increases. Look to see what happens.

So this again is, this is the skin cream problem again. And what you can see, once again is that with greater numeracy on the X axis, people are more likely to get the skin cream problem correct. But what about gun control? Here what you can see is that it's not quite as obvious. It's not quite as obvious as the people who are highly numerate are going to be more likely to get this correct. There's something a little strange going on in the data. And what we thought was that maybe understanding of the facts, maybe driven in part by political beliefs. And what you thought to believe is happening.

And so here, once again - and so what we did is we divided people up by their political leanings. The Liberal Democrats are in blue. And Conservative Republicans are in red. And then you can see all the different conditions - the 2 positions that are the rash increases or the rash decreases. And it turns out that political leanings don't matter for the skin cream problem. And that's kind of what you would expect, it's not a politically divisive problem. But what about political leanings when it comes to gun control.

Here what you can see is that it makes a difference. And (56:42?) lets unpack the story little by little. But it turns out the political leanings matter for correct interpretation of the data here. Let's start with the Conservative Republicans in red. They want to believe that gun control will increase crime. And in fact, when someone's a Conservative Republican - and the correct answer is that crime increases. Individuals who are more - Conservative Republicans who are more numerate are more likely to get the answer correct. Compared to Conservative Republicans who are less numerate.

But what about when the correct answer doesn't agree with what they want? What about when crime decreases? That's the solid red line down at the bottom. And all of a sudden, it's not as clear - the people who are fighting (57:25?) are more likely to get the problem correct. They look an awful lot like people who are emotional (57:29?). Although you do see a small effect. And this effect is not limited to Conservative Republicans. Liberal Democrats would like to believe that increased gun control laws will decrease crime. And in fact, those who are more numerate are more likely to get that problem correct. But when it comes to a belief that they don't hold - when the correct answer is that gun control will actually increase crime, it's almost as if people's math abilities are turned off. It's very interesting.

There are patterns and differences in what's the right answer. And it's a maths problem. The highly numerate were more likely to get the right answer overall. But there is this huge political polarization of what was considered a fact. And that political polarization was stronger among the people who are highly numerate, and not as strong among the individuals who were less numerate.

Getting it right seems to depend on the correct answer, but it also depends on whether the correct answer agrees with what you want to see, and especially if you're more

numerate. And so, there are a variety of reasons why we might not believe in some scientific facts. Some of it does have to do with numeracy and science literacy. The public, the American public is not as numerate and as scientifically literate as perhaps we should all be. At the same time, we do tend to be boundedly rational. We do (58:56?). But on top of that, we showed these confirmation biases, that seem to be driven by selective exposure to information - and selective perception of information.

This is Leon (59:08?), a famous psychologist. And he once said, "A man with a conviction is a hard man to change. Tell him you disagree, and he turns away. Show him facts or figures, and he questions your sources. (59:18?) the logic, and he fails to see your point." That doesn't mean it's hopeless though. It turns out that how you present information matters. Let me share some of the tongue in cheek examples. A little boy being told by his mom to get his sister a cookie. And you ask her, "Do you want the one I licked or the one I spat on?" And he concludes by saying, with both cookies in hand, "It's all in how you present them."

There are these evidenced based strategies for communicating information that work. It's important to provide numeric information, as opposed to not providing it. It's important to - another evidence based strategy, and there a whole bunch of different techniques for doing this. But it's important to reduce the cognitive effort that someone requires to be able to understand the information. There are a whole bunch of different techniques for doing this.

Number 2 is particularly important for people who are less numerate. We need to be able to provide evaluative meaning, particularly when information is unfamiliar. Because sometimes someone can know that it is a 9% risk, but they may not know the good or bad meaning of that 9% risk for the judgement that they're trying to form, or the decision that they're trying to make. And when that information is unfamiliar, by providing value and meaning, you can help them use that information more.

And then the 4th type of strategy that comes with evidence, for which we have a good evidence base. Is that we can draw attention to important information. And again, there are a variety of strategies that can be used there. And still, in the end, careful choices of how information is presented - in conjunction with knowing what the goals of your communication are - will increase comprehension, and will increase use of important information.

Of course, sometimes motivated information processing is just going to occur. When it comes to climate change, the evidence based at about 97% of climate scientists have concluded that human caused climate change is happening. But according to Nicholas Kristoph (61:19?) in the New York Times, only 44% of American's believe humans are causing climate change. Versus 77%, who believe that aliens have visited earth.

And so what can we do when (61:30?) are motivated? One of the best ways to change or give up beliefs are first to ask others to critique their own judgement. You should do it too. Try and assume the logical opposite of your belief. And see how well the data fits - the opposite of your belief. That's one of the best ways to change beliefs. To give up what (61:51?) saying doesn't help. Instead replace it with a plausible alternative belief or hypothesis.

So in conclusion, cognitive and beliefs in scientific data should be independent. They're not independent. People don't always believe science. And for a variety of reasons, some of which are motivated. But communication is not an easy task. Communicators often over estimate what others know. They over estimate how well they've (62:23?) to communicate. Because of that, they lose opportunities to improve their communication.

Also, the public is not adept at using the complex and often numeric information that's important to good climate decisions and other kinds of decisions. Evidence based communication techniques do exist. They should be used strategically. Communicators should decide what the goals of the communication are. And then carefully choose how to present information, in order to maximize attaining that goal. But we also need more research into how to communicate best in areas where beliefs are motivated.

Thank you very much, I appreciate your attention and your time. Are you interested in OSU's decisions sciences collaborative? I've included my email there, as well as the website. But thank you very much.

Jill: Hi, sorry everyone, we had a little bit of an audio problem there. One of the questions that we had was-- for Doctor Peters is - if you noticed that these tendency's to believe what you want to believe, see what you want to see in yourself - how do you counter them?

Ellen: Well that's kind of what we were looking at before. Jill, am I still able to control the slides for people? Changing the slides?

Jill: Yes.

Ellen: So there's a couple of things that you can do. Part of the problem is being that we're standing there in our own shoes, and we don't try to walk in someone else's shoes. We see things from our own perspective, and if you can kind of pick yourself up and put yourself in someone else's shoes - that's one way of changing your beliefs. It's one way of seeing someone else's data. And looking to see whether it is consistent-- Sorry, seeing someone else's beliefs, and looking to see whether it's consistent with what the data are (42:21?). And so, critiquing your own judgement, assuming the logical opposite is some of the things that can help quite a bit.

Jill: Thank you Doctor Peters. Another question that we got was - I've read studies by organizations that suggest that the average American has a 4 to 6th grade level in terms of science knowledge. So should we be thinking like elementary school counselors to get the answer to be at least considered?

Ellen: So there's a couple of ways to think about it. There are short term ways and there are long term ways. So one term is better education of science, and working at teaching science perhaps - starting of course with the lower levels, but continuing on into middle school and high school. Shorter term though, there are ways to communicate science. In ways that are more sort of psychologically appropriate.

So a lot of the work that I do is with number prophesying - how do you communicate numbers, which are often part of science communication. How do you communicate numbers so that people are better able to understand them and to use them? And sometimes that understanding of numbers and use of numbers is different. But one of the things you can do short term is the communicating. And this is part of what I was talking about towards the end too.

Communicators need to identify what the goal of their communication is. So sometimes the goal of communication is help people understand all of the inspiration. And that can be more or less realistic, depending upon what it-- Depending upon how much information there is, how much time that people have to understand the information. But (44:20?) even the stats is that - even when the stat is your goal. Even if you can't take a subset of the information to try to teach them, there are other things - there are ways that you can present that information. And that is part of science. There are ways that you can present that information so that people are better able to understand and use it. It's just that you need to decide what the goal is first, and then choose an evidence based technique for communicating information, that's going to best accomplish the goal.

Jill: Thank you Doctor Peters. Another question that we had was - could you talk a little bit about-- We had quite a few people asking about the - slide 20 and citing the source of slide 20. And I'm sorry, I was going to go back to see what slide 20 was. We had quite a few people asking about - in like the polarization slides, which I think is part of the slide 20. How did they assess people's numeracy/scientific literacy?

Ellen: That's a great question. There are a variety of ways that you can assess either one. The science literacy test that we use comes from the National Science Foundation. It's their scientific literacy scale. It includes things like a - true/false questions. Actually, I guess it's a multiple choice. Does the earth go around-- Let's see? I think it's - does the earth go around the sun, or does the sun go around the earth? It might be the moon instead of the sun, I forget. But they're sort of basic science literacy questions. Maybe about 8 of them or so.

For the numeracy skill - again, there are a variety of ways to assess it. The numeracy items that we used are things like - they come originally from a paper by Schwartz (46:24?) and then from Isaac (46:26?) Liptus and some of his colleagues. They include things - items like - which of the following represents the biggest risk of getting a disease? 1 in 1000, 1 in 10 or 1 in 100. And they simply have to pick out the right response. And we happen to use a scale, I think in this case that has 9 items.

Jill: Thank you Doctor Peters. Another question that we had was - why was a political affiliation measured instead of the measures of opinions about gun control specifically?

Ellen: Oh, so why did we use kind of a more general politcal leans, rather than specifically how you feel - what is your attitude towards gun control?

Jill: Yes.

Ellen: It could have been done either way. I suspect the results would have been even stronger perhaps if we used those specific A priority attitudes about gun control. The reason we chose to do it the other way, simply has to do with the idea that we carry around with us the predispositions that may end up influencing across a wide variety of different topics. How we perceive information, and how we use that information. And we were interested - we were more interested in that general tendency, rather than the more specific belief.
The (47:54?) belief probably would have shown stronger results, but we didn't actually measure that. But also very interesting question to look at. It's not consistent. That way of doing it would be more consistent with a study by Lord (48:07?) Ruffard and Ross that I showed earlier in the talk.

Jill: Thank you Doctor Peters. Another question that we had was - systematic desensitization is used to gradually decrease people's fears of things and get more comfortable with them. Is there something from that approach that would be - that could be used to gradually bring a group around to a different opinion?

Ellen: So those types of desensitization techniques are used for things like acute anxiety, like a fear of spiders. A fear of heights. And in those kind of cases, the person doesn't want to be afraid of spiders. The person doesn't want to fear heights. And having the fears that they have - they recognize it's irrational, and they want to do something about them. In these cases, these are not irrational beliefs.

Some people believe in gun control, other people believe that gun control is going to increase crime. And some people believe that gun control is going to decrease crime. And they have preferences in that way - for it to be one way or another. Those are not irrational beliefs. And so I would argue that desensitization is simply not the right

process here. It's not the right technique to use here. What we want to be doing, is we want people to be allowed their own values. And to bring their values to bear on decisions that ultimately impact them and impact society. But we want them to come together more on the facts themselves.

And the question is, how you get people to come together on the facts while still maintaining their own values and preferences. In my opinions, systematic desensitization simply isn't the right approach in this case.

Jill: Thank you Doctor Peters. Another question that we had was - you have mentioned 4 evidence based strategies. Can you give a few more examples of how to do this using all 4 (50:22?) - seems to be a challenge for a short term interaction.

Ellen: Yeah, so I didn't go into those too much, only for lack of time. (50:30?) if I can find them. Don't you have a slide number on that?

Jill: I don't.

Ellen: Okay (50:36?). Here it is. So the first - the first one's pretty obvious. Provides the number as opposed to not providing it. And essentially providing the numbers helps people to be more informed. If you're in a context of like prescription drugs, and you provide the likelihood - you provide the numeric likelihood, some side effects versus you don't provide them. So for example, here in the United States, we often do not provide the numerical likelihood for side effects. We give people kind of a laundry list. We sometimes tell them, if one of them is particularly unlikely, but mostly we just give them a list. If you actually do provide the numeric likelihood, so there's a 10% chance of this. That there's .1% chance of that.

That actually informs people, it reduces over estimates of risk. If you don't give them the numbers, people tend to over estimate the likelihoods of the side effects quite a bit. And it also makes - by reducing over estimates of risk, it is also - people also end up being more willing to take the drug. So that's - that's the first one, it's fairly simple. In terms of reducing cognitive effort, there's a variety of things you can do.

But the simplest things would be - if you have a lot of options, let's say you have 12 options that you want someone to be considering. If you can, if you can reduce the number of options, it will increase comprehension of the information that remains and increase use of that important information. So if you can reduce the number of options, that's one way of doing it. Reducing the number of pieces of information for each option can also help quite a bit.

Let's see, other ways of reducing cognitive effort - sometimes in medicine, and I can work in health kinds of contexts. You might - sometimes it's like a genetic (52:31?) for

example. We'll inform somebody that they have 1 in 200 risk of something happening. And then, later on - well if this happens, if your genetic test comes out in this way, then you have a 1 in 400 risk of that thing happening. The problem in that case is that they change the denominator from 1 in 200 to 1 in 400. And people are actually really unclear about what that means. Is it bigger risk or smaller risk? And so one way of reducing cognitive effort, 'cause they have to go to the effort of figuring out which one is bigger and which one is smaller. You can simply put - you can keep the denominator (53:09?). You can say 2 in 400. Whereas there was 1 in 400.

I forget which direction I did it. But that's another way of reducing cognitive effort. Keep denominators constant. In terms of providing evaluative meaning, there's a variety of ways this can be done. You can think about this in a consumer reports kind of sense. Consumer reports often uses a series of symbols that indicate whether something is above average, average or below average for the group of things under consideration. And that provides just little bit of a value (53:43?) meaning to information. When the people don't have to dredge themselves through the numbers, figuring out which one is bigger and which one is smaller - and how does it compare to the others?

Another way of doing it that we tested a little bit, is we actually provide value to people. We're doing a study on quality of care indicators. When it came to choosing a hospital, and what we found is that if we use evaluative labels for what is really unfamiliar information for people. We tell people whether the quality of care that (54:14?) they're shown was poor or fair or good or excellent. People were just as able to remember the numbers, but they were better able to use them in the presence of the evaluative label. And again, that's particularly important when information is unfamiliar. We might recognize what a number is, but we don't know what it means all the time. And you need to understand, and feel that good or bad meaning, before you're able to use the information. Otherwise, it's just another 9 (54:43?) it's just a symbol.

And the fourth strategy is to draw attention to important information. That can be done with larger fonts, colored fonts, movement on a screen. (54:57?) kinds of ways that we use, there's a variety of different ways that can be used there too. The idea is to draw attention to important information. You can even do it simply by ordering information from most important to least. They're going to pay attention to that first information. You could even put the most important information first as well as last, to remind them. That is important, you want to make sure you consider it. That's another way of doing it. Just in general, if you choose carefully how that information is presented, it actually will increase comprehension and use of the information.

Jill: Thank you Doctor Peters. Another question that we had was - I'm sorry, I'm trying to make sure that I'm not repeating anything. Did you - we had a couple of people asking about whether or not these studies included questions about the desire to belong to a

group? Or whether there were complementary studies that assessed people's motivation to accept or not to accept climate change based on their desires to fit in?

Ellen: Well I don't know of any specific studies that have measured that directly. We are interpreting our data in that way. There's lot of evidence to suggest that people have a very strong desire to belong. And we're really making assumptions about that and the explanation for our data. The data that I showed you are actually the data that we have. And it's the idea that our risk perceptions tend to be consistent with our cultural cognition's, and even more so, if you're higher of (56:46?) ability. And we made the interpretation that that probably means - that's probably linked to our need to belong. But I don't know of any specific studies, no.

Jill: Thank you Doctor Peters. One other question that we had gotten was - did you consider running a within subject design to see if individuals who do the maths correctly with skin cream, also do correctly with gun control and vice versa? This person was wondering if people in the political treatment just didn't do the math.

Ellen: So - let me try to rephrase it. So the question is - did you have people do the skin cream problem and the gun control problem. Where the same people did it, correct?

Jill: I think so.

Ellen: So the short answer to that is - that certainly not all of the same people would get it correct. Because we're getting a lower proportion of people getting it correct in the gun control experiment than in the skin cream. And if it disagrees with what they believed A priority. We actually did one (58:09?) of this (58:08?) within subject. I don't have the data with me here today, but what we did was we randomly assigned people to either do the skin cream problem first or the gun control problem first. And then the other problem came after.

And what we actually expected to see was that if they got the skin cream problem first, and then like 2 seconds later, they got the gun control problem - that, having drawn them down that path of correctly solving the problem - particularly for the highly numerate people, that they would then be able to correctly solve the gun control problem. We totally accepted that, and we didn't find it. So in that condition where they did skin cream first, and then gun control - people in the skin cream problem, if they were highly numerate, they were much more likely to solve it correctly than people who were less numerate. 'Cause (58:54?) the way that you might accept and the way that we showed you earlier in this talk.

But, when they got to the gun control problem, it didn't really help the situation. And we were quite surprised, we're not entirely sure why.But those individuals who - where the

correct answers didn't agree with what they wanted A priority, they were really no more likely to get it correct if they had done the skin cream problem just before than if they hadn't. It was very inconsistent with what we expected to happen. We thought that - pointing them in the right direction, they would continue to go in the right direction.

Jill: Okay, thank you. One last question, because we actually are at 1 o'clock. We had several people asking where - if there was a place that they could find that report?

Ellen: And do you know which report?

Jill: No I'm not totally sure which one it was. I think it was the one dealing with the scientific literacy, and assessing people's scientific literacy.

Ellen: So on the slides, there'll be - the paper that had to do with risk perceptions, of climate change and of nuclear power. That's in a paper by Kahan (60:17?) Peters, in - I believe 2014. It's in the Journal, Nature of Climate Change. If somebody wanted to - if one of you guys would like to email me, I'm happy to point you in the right direction, and that might be the best way to deal with that. So let's see if I can put my email address up again.

Jill: I did get a clarification.

Ellen: Okay.

Jill: They were wondering about 545. That was the before (60:43?) one.

Ellen: Okay, that was the which?

Jill: That was the report, 545.

Ellen: Okay, let me take a look at what that is. Oh yeah, so this is the paper that was commissioned from us by the Institute of Medicine. It actually is available on the Institute of Medicine website. It's a free report. It's - trying to think of how they would get it easily? They could - so my suggestion again would be, probably to email me and I'm happy to email you a copy of it. Hang on a second, let me get the name of the (61:18?). So the full report that was put out by the Institute of Medicine is called, Health, Literacy and Numeracy Workshop Summary.

And it's a summary of an entire workshop that was put together. The paper that we did was - commissioned for it is appendix A. And then the rest of the - the rest of the book, we're discussing in part the paper that we did, and then in part other presentations that other researches did. It's actually quite a good workshop summary. But specifically

that's - the report that you're talking about is Appendix A of that book. I'm also happy to send it out to people if you email me.

Jill: Great, thank you so much.

Ellen: I wish I could only interact with people a little bit more, it's a little hard doing it from such an abstract distance.

Jill: It is, it is. But we really appreciate you being willing to talk with us today. I think we are out of time. We had a lot of questions, but we are out of time unfortunately. So I'm going to wrap up a little bit here. I want to again thank Doctor Ellen Peters for her willingness to talk to us about decision psychology. It was really an excellent discussion. We had some fantastic questions.

I did also want to remind everyone that our survey URL for this webinar is in the chat feature. So please take a few minutes to fill that out. I also wanted to refer all of you to the resources and an archive of all the previous webinar presentations that are located on our changingclimate.osu.edu website. As well as our regional site at greatlakesclimate.com. This webinar series is sponsored by the OHU climate change outreach team. And we will be hosting webinars in the coming months. We'll email you when registration is available.

Again, I wanted to thank Doctor Peters and all the participants on this webinar. We hope this was beneficial, and hope you'll join us again in an upcoming webinar. Thank you again Doctor Peters. Thank you everyone, and have a great afternoon.