

What is STEM Engagement?

An Interview with John Besley

On July 6, 2018, [Jamie Bell](#), Project Director and Principal Investigator of the Center for Advancement of Informal Science Education (CAISE), interviewed [John Besley](#), to understand his thinking on the topic of engagement. Dr. Besley is the Ellis N. Brandt Professor of Public Relations at Michigan State University in East Lansing, Michigan. His research focuses on understanding the role of the media in how people view and interact with public officials charged with managing health and environmental risks. A video of Dr. Besley's interview, as well as interviews of other researchers, is available at InformalScience.org/engagement.



What is your interest in studying engagement, and what does the concept of engagement mean in your work?

I've been using the term public engagement for almost a decade now, and I have no idea how I started using it. I just started studying public meetings and public participation, doing it in a science and risk context, but coming from a political science/political communication standpoint, where we talk about civic engagement. Somewhere along the way, the community started using this term *public engagement*, but I don't know that it has a really clear origin story. I'm actually trying to stop saying public engagement and talking about public engagement activities. When I think of engagement in most of the work that communication people do, we talk about engagement, but we mean higher-level processing. We mean what we call "[System 2 processing](#)," "[central route processing](#)," or "elaborative processing."

So, we have a dual-process model that describes how people process information. [Daniel Kahneman](#) described the two processes in his book [Thinking, Fast and Slow](#). System 1 is very fast heuristic processing, and System 2 is that central route, elaborative processing. When I think of public engagement activities, I think of engagement activities that were designed to get people to do more than just process peripherally, but to do the process centrally. I think sometimes where it gets conflated is public participation in public engagement. Some people say, "Well, if you have public engagement, there needs to be dialogue." And I don't think that's quite right. What I think is true is that dialogue is a great way to get people to think centrally. The other way to think about this is, the people who study online engagement or social engagement on media talk about the hierarchy of a 'like' versus a 'share' versus a 'comment.' What's the difference between those things? A 'like' indicates very little cognitive engagement, whereas a 'share'

indicates that the person was thinking a little more. To comment takes a lot more engagement. It's that cognitive element that underlies all of this. Personally, I'm interested in public participation activities, where scientists are interacting with the public directly, through face-to-face contacts or online or directly with policymakers. I don't actually care. Any time a scientist is communicating, I think it's an opportunity to foster engagement in a cognitive sense, and to me that's public engagement.

How are you studying engagement in your research? We've been involved in a project with [Anthony Dudo](#) where we've been surveying scientists, as well as interviewing science communication trainers, about how scientists think about public engagement and science communication. We're really interested in what they think about engagement activities, what different activities they're doing, and how much of each type they're doing. Those types include face-to-face, online, with news media, with policymakers, and so on. We're interested in quantity and also quality, as well as their objectives and goals when they communicate. We're being a little bit strategic in using the term *public engagement* rather than *communication*. But we're talking about communication as public engagement. I think one thing that actually bugs me a little bit is hearing some people use the term public engagement when they say, "There used to be science communication and that was one-way, and now there's public engagement, which is two-way." That's silly. People who study science communication and education have known for a long time that communication is multi-directional; it's two-way. So to me, public engagement is a particular way of thinking about communication, particularly communication designed to get people to think a little more. If you're designing a museum exhibit, you make it interesting. One of the things that predicts whether somebody will process centrally is the degree to which something seems interesting or relevant to them. So there's lots of things we can try to do to get people to think more deeply. I think most of the communication that scientists do is designed to get people to think more deeply and therefore probably counts as public engagement.

In informal STEM education, the term *public understanding of science* was at one point preferred to *public engagement with science* because it was supposedly a friendlier term and it somehow connoted more two-way communication. John Durant at the MIT Museum was part of that movement in the UK before he came to the U.S., and he always cautions that public engagement with science can simply be a kind of a window dressing, a superficial way of describing things that might still not constitute two-way engagement, just because they involve a Q and A or something like that. Any thoughts?

I think the two-way thing is a tactic that you can use to get people to think more deeply. It's really important, and we should absolutely do it because it works. The question is, is the reason we want people to think more deeply only so that they increase their understanding of some scientific concept? The reason that deeper level cognitive processing is so important is because that's how we form beliefs. If you're just processing heuristically, you're not developing new beliefs. To develop a new belief, you have to follow a process that's a little bit more effortful. These beliefs could be about scientific topics like how climate change works. But they could be about lots of other things too. So a lot of our work is focused on what other types of beliefs might develop as a result of a high-quality public engagement activity. They could be beliefs about the scientists: "I had a chance to interact with this scientist, and it turns out that he really cares about the same things that I care about. I believe that he cares about my community." It could be beliefs about competence: "Wow, these scientists know a lot, they're really competent." It could be beliefs about identity: "This scientist that I'm interacting with, he's not that different from me." Or they could be beliefs about efficacy: "I had no idea that this would work or that if we did this, it would make a big difference," or even self-efficacy: "I can do this. I didn't realize I could do this thing." It could be beliefs about norms: "I didn't realize that other people thought that," or, "I didn't believe other people wanted me to do that." At the most basic level, there's a belief about interests: "I didn't know that was so interesting. I didn't know that that was such a fascinating topic." So there are all these

different beliefs that could be formed as a function of high-quality engagement. But people don't develop beliefs unless you engage them cognitively. If the understanding is just peripheral, that passes and it's gone. So to me, engagement is about the formation or change of beliefs. I *mean change of beliefs* in a scientific sense, like a new consideration, or a new element to how I think about some subject or some people. It's not change in the sense of believing one thing one day and another thing another day.

Take the example of a soda. You could say, "I believe that this contains water. I believe that aspartame isn't bad for me. I believe that this can is a good price. I believe..." It's all these little granular beliefs. When I want to know your overall attitude toward Dr Pepper is or diet Dr Pepper, it will be a function of the accumulated, accessible beliefs. Accessible means the beliefs that are most top of mind. When we do a survey, we're trying to get at the most accessible beliefs. People use those accessible beliefs to form their attitudes. Most beliefs are also associated with an affect. An attitude is some combination of beliefs and affect toward the topic. So typically when we measure attitudes, we really are asking about attitude-laden beliefs or values—or affect-laden beliefs, as I say. Affect is not a discrete emotion like disgust, it just has some valence, like "I think it tastes good and that's good." "I think it tastes sweet and that's good." When I teach this concept, I draw Mr. Buckethead, which is a head and there are ping-pong balls in it and each ping-pong ball is a consideration. Belief is a consideration. So, for any given topic you throw ping-pong balls into the head, and the more you know about it, the more ping-pong balls there are, and they have positive or negative valence. When I ask you a survey question, when there is priming you take the top things that are most available to express your attitude. That's all described by [John Zahler in *Attitude Accessibility of Approach*](#).

Trying to change attitude is tossed around a lot as a goal of communication. In our work, we talk instead about changing *beliefs about* interest, about content, about people, or about norms or efficacy.

Those are different beliefs that I could change if I get my audience to think a little bit more.

[*AAAS defined engagement as requiring mutual learning on both parts. What do you think of that definition?*](#)

I love AAAS, but I do not love their definition. I've suggested at various times that they might want to reconsider the definition, because it's not really accurate. They argue that mutual learning is a very broad term, so what I call changes in beliefs, they would call mutual learning. I think that is how they finesse the point. But I think the problem with mutual learning is, it still frames it as a question. "I learn about you, you learn about me." But learn *what* about you? And you learn *what* about me? Until we get to that more detailed conversation about what we mean, what beliefs are being learned or brought onboard, it's not that helpful.

[*Can you talk some more about the study you're doing with Anthony Dudo?*](#)

It's a project that has led to a bunch of different papers. It was funded through NSF's [Advancing Informal STEM Learning \(AISL\)](#). We found it really helpful to think about engagement activities as leading to changes in beliefs, and those changes in beliefs are ultimately the levers that lead to changes in behavior. Another way to think about the deficit model is an overreliance on a single path to changing behavior. Let's say my communication objective is to change beliefs about the facts around science, and I hope that if I can change those beliefs, I can change behavior. Our view is that beliefs about scientific facts and processes are one kind of belief. But there are other beliefs, beliefs about scientists and efficacy and norms, that you could also shape.

I'm also working with [Sarah Garlick](#) on a project with [Hubbard Brook](#) and [Harvard Forest](#). They already have a great culture of public engagement, but they want to make it even better. So over the course of three years they want to do some projects at the sites that fosters or enhances this culture around public engagement. We're trying to

determine, first, what the culture of public engagement is. I think you have to start with a community of people who have positive attitudes toward engagement, being engaged, and have other people perceive that to establish it as a social norm. People have to feel that they can make a difference through being engaged, which is efficacy. Also, if you really want to get high-quality engagement, you need a culture of engagement in which people are focused on achieving goals. They're not just communicating for the sake of communicating or engaging for the sake of engaging, they have some sort of logic model in which they're clear on what they want to achieve through engagement, and they're clear about what types of beliefs they might have to communicate toward to achieve those goals. It's about moving from quantity questions to quality questions, making sure that the culture puts resources into ensuring quality, not just encouraging activity.

The audience for the project is the scientists at the site. We want to ensure that there's a culture in these two [Long-Term Ecological Research \(LTER\)](#) sites, Hubbard Brook and Harvard Forest. Ultimately if our approach works, if we can find a good way to think about that and foster that type of culture, then we want to bring it out to the broader LTER Network. I did public opinion research sometime around 2010, in which rather than studying the public, we started studying scientists and how they think about engagement focused on the communicator, because the whole time, the communicator is the one who has to make choices. Their choices about what they say and what they do are the things that affect the quality of the communication.

What's the relationship between this type of engagement at the cognitive level and learning?

It is learning. This is where the AAAS definition may not be entirely wrong. It could be understood as learning, but the question, is learning about what? It's not just learning about facts and processes of science, it's learning about the people

of science, the impact of science. If I think that scientists on average care about their communities, which of course they do, is that something I've learned? Did I learn that scientists care about their community? It's a philosophy of science question: "If I believe something and it's true, is that knowledge?" Of course there's so much more to it than that; you have to be able to use the knowledge. It has to have a functional element, like literacy for example is knowledge you can use. So I think whatever you do in a classroom or in an informal environment to get people to pick up the things they need to learn, those use the same basic cognitive processes. In order to learn, people have to be motivated to process information, so they have to want to do it, to some extent. But they also have to be able to do it. They might not be able to if there are loud noises, if they're distracted or hungry, or if the information contains jargon and they can't process it because they're focused on, "What does that word mean?" Again, interest is part of motivation, and we're trying to make sure learning environments in classrooms trigger both interest and motivation through their communication.

And I think one of the differences between science communicators and other types of educators is that as a science communicator, I may be happy to achieve my communication objective, which is to change beliefs. In contrast, other educators might have the goals of changing behavior. You might develop a belief that scientists care about people like you or have prosocial motivation. Getting you to develop that belief might be my communication objective, whereas education folks might not necessarily want that as an objective. We also know that if someone has a teacher and they think that their teacher doesn't care about them, they're not going to pay attention to that teacher. So you might have an objective to get the student to perceive the teacher as caring, so that the student will be more likely to listen to the facts and lessons that the teacher is trying to get across. For science communication, it may be enough to get people to recognize that scientists care, or for the people to realize that they have the ability to do something.

To affect behavior, you need to know what beliefs to shape that will affect that behavior. Just teaching people stuff without altering their beliefs doesn't have any effect, so you might put less time into it.

According to the Paulo Freire school of thought, it's important for students to be able to "read the world as well as the word". So in other words, you're not just teaching your subject, you're also teaching who you are and much more. Do you agree?

Yes. I think that the biggest public engagement activity in the world is all the students on campus everywhere, who are not even science students. Their biggest exposure to science ever is their experience on campus. So 40% of Americans got to college, and that's our biggest ever opportunity not just to teach them about science but teach them who scientists are and shape their views of science, even of the other students in the dorm who may be biology or physics majors. That can affect how they think, their schema for what a scientist is, for the rest of their lives. I don't know that we've studied it. But to me, it's a missed opportunity, providing Gen. Ed. sciences but not doing science communication.

So back to engagement: how are you measuring it in your work?

We're measuring engagement activity, as well as attitudes, norms, and beliefs around engagement, goals for engagement, and objectives for engagement. We're asking things like "About how much are you doing of this, and how are you doing it? How willing would you be to do this or that? How willing are you to take part in face-to-face events? How much are you willing to communicate online? How much are you willing to interact with scientists? How much have you done? How often?" We measure lots of things around engagement, including the amount of engagement and people's willingness to engage.

We've been using a fairly simple set of measures adapted from various communication approaches, the same way that scientists have measured how often people donate money to a charity, how often

they read a newspaper. We ask, "How often in the last year have you done a thing?" The classic criticism for that is that in a survey, we want to be relatively general, so we can't have a million categories. We might want to know how often people have taken a science survey or given a lecture, but we have to lump things together. We measure engagement using four different groups: face-to-face interactions, online, directly with policymakers, and through the news media. But you could break each of those down into as many subcomponents as you want.

How do you see motivation and interest in relationship to engagement?

I would say that one objective of public engagement might be to get somebody interested or motivated to learn more about science or to seek out scientific information. On its own, interest could be an objective. Similarly, identity could be an objective. A person might do engagement in order to convince others that that person is not that different from them, that they have a shared identity. Or an objective could be to get people to believe that they're the type of people who could be scientists, that they have the ability to do it. I would think of that as self-efficacy. A common communication goal is to get kids to choose a science career, especially kids from communities who might not otherwise choose scientific careers. So if the goal is to get kids to consider a scientific career, you'd first need them to think that science is interesting, and then you need them to think that they have the ability to do that. You also, it turns out, need them to believe that the people who are doing science are nice people, so if they go into that field they're going to be around non-jerks. So interest, motivation, and identity are potential objectives that you can achieve through high-quality, thoughtful engagement. Once you've chosen your objectives and goals, then you start thinking about tactics. For example, if my objective was to get people to identify with me as a scientist, I should say words that show that I'm like them. I should choose communicators that are like them. You can start there. Once you're clear about what you want

to have happen, the tactics start to become pretty clear. If I want you to think that scientists are warm, I have to show you scientists being nice and talking about why they do their work. The tactics to me become pretty clear once the objectives are clear.

We use *strategy* for the whole process. We say that a strategic communicator is somebody who figures out their goals, uses theory to figure out which objectives to achieve to get their goals, and then figures out tactics. Strategy is knowing that path from goals to objectives to tactics.

How would you advise a designer of an experience or a setting for informal STEM learning or science communication to use what you're finding in your research?

I'd say to start with the goals, and when you define goals I think it's worth thinking about behavior. What is the behavior you ultimately want the audience to have? Maybe you want people to support something, or to do something, or to consider a certain career. After setting the goal, you should think about what would have to fall into place for the audience to do that behavior. What's preventing them from doing that? Perhaps they don't know enough? Perhaps they're not interested? Maybe they don't think that doing the behavior will make any difference? So you need informative research to figure out what the objective is, the thing that can actually affect the communication. You can't use communication directly to make a kid choose a science career. There are intermediate steps, and you have to figure out what's in the middle there, in that black box. When you figure that out, perhaps it's something like the kids identifying with scientists and feeling efficacious about their science abilities. But what activities are going to get people to identify with the science and the scientific community, and what activities will help them feel efficacious? So you build back from your goals. Too often I think people start with the tactics, like, "I'm going to start a Twitter account." That's it. They start with the tactics and then think, "Well, what can I achieve with this?"

I love the communication training community, and we've done a lot of work interviewing trainers, but I think a lot of what they do is teach people skills, like how to speak clearly, or how to tell stories. But there's very little clarity on the effect of speaking clearly in terms of goals. There are probably good reasons to speak clearly; it makes it easier for your listeners to process information, and it helps you avoid coming off as a bit of a jerk. It could make you more likely to understand the words you're saying, or help you be perceived as caring about the community. If you use shared language with your audience, it might affect identity. But most of the training focus is just on mastering the skill, not thinking about goals and the real outcomes of each tactic that you might do. So you miss the opportunity to work backward from goals.

It's really important to understand the ultimate purpose of what you're trying to do. If your goal or objective is for people to have certain knowledge or beliefs about quantum physics, I'd say, "Well, why do you want them to have that? What will happen if they get that? And what does that achieve?" Maybe you'll answer, "I just want them to know it." Well, is that enough? Maybe that's enough. Sometimes that is enough in an education context because students need to know one thing before they can go on to the next thing. They need the baseline information. But in the context of public communication, there are many things that the public doesn't need to know. And it's a bit rude for someone to assume they need to know it.

What about scientists who believe that if people understood how particular things work in nature, they would extrapolate that to social systems and there would be benefits for society?

If that were true, the scientists should be able to prove that. It's not like people haven't tried. We've tried to look at the relationship between various types of knowledge and people's attitudes or behavior. There's a minor effect, not a big one. But scientists don't want to just communicate for the sake of communicating. They want something to

happen because they communicated. So to make that thing happen, you have to think about the short-term objectives you need to get to that goal.

Could the “something” that happens simply be a greater appreciation for science?

Sure, that’s one goal. There is an argument that we should just get people to like science because it’s an important part of our culture. And I believe it is. I think people should see science as an integral to culture. I want that to be true because I think that means that they will then make better decisions. I think epistemologically that if you have a scientific mindset, you’re going to make better decisions that will make the world a better place.

What are the big questions about engagement that you feel need further exploration?

The more I get into this, the more I realize we need to learn. I’ve been trying to find a study about the effect of jargon. I don’t know much about the impact of using jargon. I think it probably makes information easier to process, for people who understand it, and that’s good. I think it probably also makes you seem like a jerk, distant and non-caring, if you use jargon, so with certain audiences not using jargon is good. But there’s no good research on this, nothing that says “If you do this tactic, it will have this effect on the people with whom you’re communicating.” So we’re trying to think about what we really know about the impact of tactics and potential objectives. One of the problems with all this is that you can’t do everything. You can’t meet every objective. On a 60-minute talk show, how many of those minutes focus on content? How many cover what we know, the research findings, and how many focus on the value of that knowledge, the reason for doing the research? [Katharine Hayhoe’s](#) really good about talking about this kind of thing. She’s an evangelical Christian and a climate change researcher at Texas Tech University who’s also a Canadian. So back to the 60 minutes example, you can spend 30 minutes talking about the research, then maybe five or 10 minutes talking about the reason for doing this work. You can maybe spend 10 minutes talking

about efficacy beliefs. You can’t do everything. So I think the researcher needs to figure out the right menu of beliefs given their goals.

One place where you can see this a little more clearly is in health promotion literature. Health promotion theories are very much about building campaigns to affect individual behavior. But we don’t tend to think in that campaign mode. The other thing that’s really important for the community to think about is, a lot of training is focused on the individual. We train one scientist at a time to communicate about their research. That’s not how communication works. In the real world, you get a group of people to talk about a topic on a similar message, and you coordinate. A political party doesn’t just have every person go out and say whatever they want. They try to coordinate messages across people. So how do you make the community more than the sum of the individuals? Science communication now is very individualistic. And I think that’s probably a function of the scientific community; we’re all individual researchers, we run our own labs and our own things, but communication effectiveness isn’t about that. If you want to have an impact you’ve got to do some coordination.

I love the training programs, but most of the people who do the training simply started doing it. They were science communicators, scientists who had a good experience and are charismatic themselves. They’re not necessarily building off an evidence base in the way that the health promotion people are. The idea that you should go out and make up your own campaign about how to get somebody to do something, like take their pills—well, you shouldn’t do that. You should approach it more thoughtfully, but some scientists are perfectly happy setting up a website, starting a blog, and pontificating on what science communication is.

Are there any resources that you would point people to, so they can get a better understanding of engagement in the ways that you're talking about?

Most of it's very academic, like books on health communication campaigns. That's one of the things I hope to do if I do a sabbatical next year; I'll write a book where I talk about each objective. The closest thing right now is [J.B. Zegalia's book](#) on seven things that are influences. One of them is social norms, and so on. It's very persuasion-oriented, but a lot of people are talking about it. It covers changing beliefs, ethics, and so on. If a scientist wants to be perceived as warm, I wouldn't tell them to say things that aren't true, just so they will be perceived as caring about their community. But if it is true, is it acceptable to say that? There are interesting ethical issues about what happens when you start trying to shape beliefs about facts and processes.

Going back to goals: Exhibit developers sometimes build a three-dimensional piece to model a physical phenomenon. Their only goal in doing so is to get other people to appreciate the phenomenon by interacting with it in this exhibit. Is that an acceptable goal?

Well I would argue that it's fundamental for museums and science centers to foster positive experiences with science. If you want people to value science as integral to our culture, for that to happen, you need them to have positive experiences with science. So if the objective is to provide a positive affective experience with science or a scientific concept, then you need to create exhibits that give people that experience. This is the business of planetariums, right? Knowledge about space really doesn't get the visitors anywhere, but it gives them a positive experience. Science festivals and science cafes aren't about sharing knowledge either. They're about giving people positive experiences with science and with scientists. The challenge is that people can't just have one positive experience with science. They need to have multiple, regular, consistent positive experiences with science. Which means we need novelty, which

means we need new things, which means we need clever things. So I'm all for exhibit designers and media creators whose objective is to give people a positive experience with science. I've been trying to think about how to assess that, how you can get at people's cumulative positive experiences with science.

The trouble with some exhibits is that there's nothing in them about the exhibit designers. I think science centers and science museums are more about people. So I really think that people's perception of scientists matter. I think an exhibit would be super cool if it included not just a cool thing but the story about the person who built it and why they did it. To me, that would have more impact than just the thing. Think about the interactions that happen at a science festival. You have people showing things off: "Here's a really cool thing." Or people sharing with their friends, "Hey, look. I found a really cool thing." So we need to do some AB testing to determine whether there is an advantage to having the cutout of the woman with her story in the exhibit, or a video monitor of her explaining how she built it: "I'm really fascinated by this phenomena. And I made this thing to try to share it with you." We need to figure out which is better.

Some science museums follow a protocol for exhibits that you have to have three pieces of interaction: the person, the phenomenon, and then the other person. That way it's presented as showing, not telling. Do you agree with that approach?

Absolutely. I think there are different ways to show it too, like active versus passive voice. That's why I would love to see this AB testing, this iteration, to figure out if this way is better than this other way. But that kind of work is hard to get published because it's not always super theoretical. It's applied, but nobody pays for the applied stuff. I'd love to see academics doing more of it though. You see a bit of it in framing, which is a different type of objective because it's not about beliefs. It's about the context in which something is presented.

Sometimes in framing studies, people will prefer one frame to another; you can test words like genetically engineered versus genetically modified. We should be testing the impact of a smiling

scientist versus scientists in a group versus smiling scientists in a group: all the little things that might have small effects but they're cumulatively, over time, affecting people.



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