

What is STEM Identity? An Interview with Heidi Ballard

On October 31, 2017, [Jamie Bell](#), Project Director and Principal Investigator of the Center for Advancement of Informal Science Education (CAISE), interviewed [Heidi Ballard](#) to understand her thinking and work on the topic of STEM identity. Dr. Ballard is a Professor of Environmental Science Education at the University of California, Davis. Dr. Bell conducted the interview on behalf of the CAISE task force on evaluation and measurement.

A video of Dr. Ballard's interview, as well as interviews of other researchers, is available at InformalScience.org/identity.



What projects have you done that focus on identity?

Well, so that's a good start because it gives me something concrete to talk about. It's of a core area of my work, so I have lots of projects that I could give you an overview of briefly and then maybe you tell me which ones sound like you'd like more detail. I would say the first project where I really started to dig into the idea of identity, particularly with respect to science, and probably spawned a lot by that National Academies report, is for a project that I am doing with the [Cornell Lab of Ornithology](#) folks on what we call [EESIP, for Examining Engagement and Science Identity Through Participation](#).

And so what all of my projects are looking at is how and what people learn and how they participate in citizen science projects or other kinds of community science projects. So in the EESIP projects we were specifically looking at what I later learned were "narrative identities." We just did phone interviews with 80 people across six different citizen science projects that we structured as stratified by the levels of the models of citizen science that we talk about as collaborative, contributory, collaborative and co-created projects with increasing engagement into the scientific process from those three.

And then we selected folks that were engaged variously in those projects and interviewed them over the course of four years, and we've just done our last round of interviews. We asked those folks not only real details about how they participate in the project, what exactly they do when they consider themselves to be participating in the project but also how they

see themselves with respect to science. If they see themselves as knowing, as understanding and doing science, if they think others see them that way, those kinds of questions. Another more recent project is what we call the Youth-Focused Community and Citizen Science and that one is focusing on youth as participants.

The previous project was adults exclusively, and so the youth-focused project is actually digging in a lot more with the idea of agency. We're looking at case studies of about 10 different cases, trying to represent the range of ways that kids participate in citizen science and community science projects, and we did interviews and field observations any time they were doing anything with the project. We did pre- and post-interviews, and we were looking at a lot more of the sort of enacting of identity and how the kids are moving through those spaces, how they're seeing themselves, the roles they take up when they're participating, and the expertise that they see themselves gaining in particular science and environmental science areas.

So that's the project where we looked at the fact that because in citizen science and community science so many claims are made about people taking environmental action as a result of doing it, enacting, engaging with their community, civic engagement, i.e., making change in their community as a part of community science. We wanted to look at that, so we started looking at agency and how people, i.e., kids, saw these science activities that they were doing, and participating in science as also acting on their world.

We came up with this framework of environmental science agency where it's looking at how and what kids come to understand about the norms of knowledge, skills, and inquiry and processes of science. But also what roles they take on and how they identify their own expertise—that's the identity piece in those areas and in what ways do they use them—that is to say, science, to take action either in the environment or community.

We took that framing, and we're still analyzing a mountain of data, but we have identified key practices that kids seem to be going through when they were developing environmental science agency, and when they were taking on and seeing the ways that they could use science and the science they were learning in the project to take action in their lives. And we looked at those things that kids were going through, things like key practices and youth having ownership over data quality, when they were allowed to. They were seeing themselves as experts in some small method, some particular part of the science process that was theirs and they started taking it to other parts of their lives, taking it into school, taking it into the after-school program, things like that.

We saw that as a key practice. We have others, too, and we're trying to identify more with all the data, more cases that we have. Then we took this framework and used it with a third, new project that I've got going. We're in our first year, and this is one of the [Science Learning+](#) projects funded by the U.S. National Science Foundation, with the Wellcome Trust and the Economic and Social Research Council (ESRC) in the UK, and it's a collaboration across researchers and practitioners and natural history museums.

The three natural history museums that we're partnered with are the Natural History Museum in London, the California Academy of Sciences in San Francisco, and the Natural History Museum of Los Angeles County. And those folks who are running citizen science and community science projects out of the museums, or led by the museums that are working on

the science in those museums, the research that those curators and researchers are working on and engaging in citizen science. And again, we are looking at youth. So we're taking up this environmental science agency framing to think about identity and applying it to these very different settings that include the online settings like [Zooniverse](#) and [iNaturalist](#) as well as short-term settings like the bio blitzes, where it's a one-day event. So if you think about identity development, for example the question of whether someone's identity with science is going to be impacted by a four-hour event in a park somewhere, that's the kind of thing we're trying to look at.

I am also using the environmental agency framework with a new project with Public Lab looking at community science, which is focused a lot on environmental justice issues like water and air quality monitoring. And we're also applying the framing to adults because it's going to look really different with adults. So with that one we're doing some small case studies with groups that are tackling an environmental problem or question in their area, one in the Gulf region and then one with frac sands in Wisconsin.

Across all those projects, do you think about a definition of identity? Is it contextual in each project or, as you said when enacting identities, there's a way of thinking about it that might be different than other projects?

There's a couple of ways that they are different and a couple of ways that they're really similar. My perspective on identity and identity theory and the research that gets done and the different ways that identity gets studied has evolved in the last seven years or something when I started working on the first project.

The EESIP project looking at adults is the way into a kind of definition. It's looking at how people tell stories about how they see themselves, and so it's just the narratives that people tell in reflection on their participation in the projects. And so it turns out that that's only one way to look at identity. We're really [working with] usually very articulate adults. It's hard to have a five-year-old really be very meta or talking about their identity, right? But with adults, you can ask a lot more sort of meta kind of questions about how they see themselves.

So thinking about those narrative identities, it gives you a picture of the universal things across all the projects is identity, is about how people see themselves, how they feel like others see them, and what kind of a person they want to become. And I think across all the projects, it's very consistent that identities are not fixed. They're not fixed in time. They're not fixed in setting, and so you can be a different kind of person and see yourself in a different way as a different kind of person with respect to science or with respect to anything—lots of different ways over a given day with different people. So the whole idea of identity as situated, learning and identity are intertwined through what you do and who you interact with. That's true across all of the projects.

I would say that the first project, the adult-focused project is really about the stories people tell about themselves. Whereas, with the kids, what's also very cool is that I've learned a lot about identity research and that being able to observe people while they're doing the practice because identity is about practice. A lot of learning theory talks about how people form their identities through practice, and those things are shaped entirely by a setting and the people, but it's about that practice. So it's about being able to watch kids or people

participate in the projects doing the thing that they are focused on, who they talk to, and how they talk and position themselves.

We talk a lot about roles and positioning, so watching the interaction really matters. That's where those projects are really different, in that we're doing a lot of really focused observations on the youth-focused projects because that's how we've been able to structure it. But in terms of the definitions of identity across the board, it's situated. It's interactional, and being able to really watch those interactions makes a difference.

And you already said this, but is identity, in as it manifests in those different projects—do you see it as integral to the learning?

Oh, yeah. There's lots and lots of research out there already on the knowledge that people take up, i.e., the science knowledge. And there's a lot that's getting better about looking at inquiry and how people are thinking and reasoning around science. But, what that [Learning Science in Informal Environments](#) book really did is highlight that identity is a specific aspect of learning that seems to really influence a lot of the other things. I see identity as influencing all those other areas of learning, and so if someone identifies with science and sees themselves as someone who does science or understands science or uses science, then that's going to influence what they decide to study in college or what they decide to take for a job or what they decide to do when they're choosing a car to buy. All those sorts of things get influenced by how people see themselves with respect to science.

In your conceptions of it, and as you're working with this construct and measuring it in the projects that you mentioned, are there ways in which your thinking about it and/or measuring it that you would say are distinct from what you know others are doing?

Yeah. It's interesting because I'm trying to be in conversation with a lot of different people. So when I do this work I'm learning so much from the research and theory that's going on right now. But I know that there's a lot of research out there that thinks of identity as a lot more static and takes on a kind, a particular identity, and talks about types of identity. They assign people to these categories, and if you see yourself as a "birder," that's how you see yourself, and that's your identity. And so now I'm going to approach [as a researcher] anything that I think about you because you see yourself as a birder. But it may be that I only see myself as a birder when I'm outside, and I don't see myself that way 90-other percent of the time.

So in that way, I think that's different. Also by assigning people to boxes and saying identities are static—there's lots of research that is survey-based and basically asks if you see yourself as a scientist or not. So that's something that I will completely unpack and say needs to be changed in all of my projects, which is that it is simply not the only way that you can think about yourself with respect to science.

So all of these surveys that just ask, "do you see yourself as a scientist?" are missing a lot of the story. In the EESIP project we identified eight or so really solid, different aspects of science identity that are not just whether participants see themselves as a scientist.

When we're talking to adults on that project, and also on the community science project, one of the main findings is that people specifically say they do not think of themselves as scientists, and they don't want to. It's like that's someone else's job, and that's great. There are scientists that are working on this project, but I am someone who is collecting data or doing advocacy and outreach for this project. Or, I am a teacher working with other people to help them participate in this project—so people have lots of other ways that they identify with science and identify with the project that aren't just about being a scientist.

I think that's a huge difference. The other thing with the youth projects is that we're trying to get away from—and I was a high school and middle school science teacher for several years, so I know about multiple choice tests and standards and that there are some things we want kids to learn by the time they get out of school about science—but with these informal settings, we're really trying to see what aspects of science do kids take up that they see as meaningful and consequential for their own lives.

And that's important because maybe a kid realizes that talking to strangers when they pass by as we're collecting water quality data is part of science. So I don't think of myself as a math person, but I'm a chatty person so maybe I can still do science, and that's a really important piece that's different from maybe some other ways that people think about identity. It's also consistent with a lot of other folks that I'm learning from who think about identity as a process, and a gerund, and that it's iterative and generative and all those kinds of things, so I love that idea of it as a gerund.

Obviously you're thinking about it, as you said at the beginning, and its nuanced and complex, and so those things need to be attended to in the different contexts that you're studying it. You've already mentioned a few ways—a few methodologies for measuring the construct. So could you just say a little bit more about those? What are the ways in which you're measuring identity?

So, again with the adults, we're relying really heavily on the interviews. And the main thing that we try to do is ask really open-ended questions first and then zero in if we don't hear specific details about things that we're interested in. But the tack we took on these longitudinal interviews was to be really explicit and bring the interviewee into our thinking, and not be “cloak and dagger” about it, like asking them questions where we're then going to judge whether they've changed their identity with respect to science over time, or where we ask, “do you think that participating in this project has changed the way you think about science?” If you ask how you see yourself with respect to science. Tell me about that. Some will respond “no, not at all. I do not see that.” But then if you probe a little bit more, some stuff other comes out, so we try to get at it both ways.

Longitudinal interviews over time, where we keep some of the questions the same and some of them we modify or add over the years. The field observations, primarily ethnographic field observations, for the youth projects and trying to really pay attention to the “focal youth.” It's really pragmatic to look at the focal youth that are in a group. So, you might have one or two focal youth in the group at a time, but seeing how they position themselves when they're taking on something or asking a question or making a move versus when they're hanging back and making notes about those kinds of things in the observations, how they interact with the

adults and what the adults do or don't, what the adults open up or make space for and what they squelch.

And we're doing all this really rich observations and then these pre- and post-interviews with kids, and that's giving us these great rich stories about, and examples of, what it looks like when someone's doing this kind and how their identity might be changing, or ways that they're tackling new aspects of their thinking and identity. But the thing that we've been getting from practitioners in the field in citizen science, from people working with kids and people working with adults, is that it's nice for us as researchers to be able to do all that in-depth work, but what about us? How are we supposed to look at identity and agency in our participants when "I'm just a project leader for a citizen science project?" or "I'm just a teacher." [They say] "I don't have time to do that kind of stuff." So in the [Science Learning+ project](#), we're calling it "learn citizen science," and we're planning to develop surveys, and we're going to try to translate what we've been learning about capturing aspects of environmental science identity into survey questions. It might still be that you have to make a lot of these questions open-ended, e.g., it's probably not going to be a drop down menus and multiple choice. But it's still not going to be replacing the more qualitative, ethnographic stuff. But we are working on surveys and survey questions because that's what's realistic for practitioners.

How do you think about how other identities besides science identity, e.g., gender, socioeconomic status, ethnicity, etc. How do those, or what influence do they have on science identity, and do you take that into consideration?

Something that I should make sure to point out is that I think what's really cool and important about looking at identity, when you're talking about science learning, is that it's about prioritizing how people from really different backgrounds and people with lots of different experiences in their families and in their neighborhoods with respect to science actually can be resources for taking up science in terms of how you identify with science.

So the idea of looking at identity and agency is—going back to my roots and participatory action research where you have to think about power, and the fact is in a lot of contexts, science is power—whether someone identifies with science matters in how much control they might feel like they have in their lives. And so certainly with respect to environmental issues, land management issues, and things like that, science has a lot of primacy.

If you're thinking about communities of color, or low-income communities, if you're thinking about young people, those are all communities that don't necessarily identify with science in the ways that provide a lot of control and power in decision making. So that's how we think about what we really are trying to pay attention to, and specifically not just talking about citizen science, which is basically a white, middle-aged, well-educated thing to do in a lot of this country, but to also talk about community science. And we're looking at those contexts where people that don't necessarily have a lot of say, in pollution, e.g., pollution campaigns where they can take up science and use it for themselves in ways that give them more power.

In terms of thinking about the identity, we listen for when people talk about how their other aspects of their identity, age and gender and race and ethnicity and sexual orientation play into what they're doing with respect to science. But we haven't been asking those questions explicitly ourselves.

There's a lot of talk about intersectionality and the other constructs that are maybe related like interest, motivation, self-efficacy. You've clearly thought about those as well and how they intersect. Could you say just a little bit about that? And in looking at identity, how do those reinforce or play against it?

Well, so that actually was a big, hairy mess for us in a lot of ways. I still struggle, and I would go to the literature and see some of the explanations about interests or motivations that were nearly identical to some of the explanations about identity that I was seeing and seeing how those pieces fit together. I'm still trying to make sense of that. I tried really hard to think about whether identity was an umbrella under which interest and self-efficacy fell or that maybe it's more of a Venn diagram where there are, you know, overlapping sets but not entirely. So we, I, struggle with that a lot.

I think that interest has a lot of overlap with identity, but it's not the same. So I guess I would say that I do kind of see identity as more of an umbrella. And I know also that theoretically self-efficacy as a construct comes from a pretty different place from a lot of the identity research. We ask questions in the interviews on it about confidence, like how confident are you in your ability to [do this]? And that's when we say we're looking at self-efficacy. I know that one of the researchers I've looked at, who does think of identity as whether someone sees themselves as a scientist or not, did an entire study with self-efficacy questions and identity questions and how those things relate to each other—distinguishes between them. And I would agree that those are kind of overlapping sets.

Does your self-efficacy thinking, does that come from the Developing, Validating, and Implementing Situated Evaluation Instruments (DEVISE) project at all? And, in general, are you in alignment with DEVISE?

Yeah, so the [EESIP](#) project that I've been talking about, the portion of that project is those interviews is focused on science identity, but the other piece of that project is to give the [DEVISE](#) surveys to the participants in those same citizens science projects. And that's what Tina Phillips has been doing, and what we're doing now is really the fun part, where we are looking statistically at the way different projects or different kinds of people answered the DEVISE survey questions with respect to self-efficacy, with respect to science inquiry and science inquiry skills, which were really just questions about their confidence in those skills. So it's a lot more self-efficacy stuff and a survey about their motivation—how does that jibe with what we're hearing in the interviews.

And so what I've been focusing on, which I think is just so fun, is to say, “okay, how did this person that I interviewed for four years answer the survey questions [over time] and does this make sense or does it sound like two totally different people?” Initially they're pretty consistent with each other so, happy day, they're, corroborating each other. But then, how did the interviews flesh out what we heard in the DEVISE questions, and what's the flesh that we can put on the bones from the survey? The survey was just a snapshot in time, whereas the interviews were over four years. So we can say we gave this person a survey in year three of four, so how can we see where they came from and where they went? It's really cool.

Any resources you would point people to?

You brought up DEVISE. So if you're thinking broadly about measuring and understanding, and informal science learning outcomes from citizen science participation in particular, then [look at] [the evaluation handbook for citizen science](#) that is on the [Citizen Science Association website](#) that came out of Cornell Lab of Ornithology and includes DEVISE. But the authors are very clear that they do not try to tackle identity because it's a big, hairy construct. And so that's why we did this project. This was a follow up for them on DEVISE, where we try to dig into science identity with these other methods that that I'm using.

But so for identity, in particular, the couple of things I would actually like to point you guys to from our work are resources for practitioners about environmental science agencies. So we have research briefs that are [two-page, color glossy PDFs](#) about what environmental science agency is and about what agency is and why it matters, and what are five journal articles I could look at if I were a practitioner and I wanted to really dig into this and cite it for a proposal, for example.

So those research briefs are on the website, the [Youth-Focused Community Citizen Science \(YCCS\) site](#) at UC Davis. But then also we have [research briefs on the key practices](#) that we've figured out really matter for youth. So if you're thinking about designing or implementing any citizen science project, or any kind of science inquiry with kids, these are some practices; and on youth, sharing findings with outside audiences, their data ownership, (taking ownership of data) and then their engagement with complex socioecological systems, like seeing the social and ecological systems as intertwined.

Those are the key practices that we've done research briefs on so far. But one of the things that we'd like to do for the [Science Learning + project](#) is to get some of these tools out. Eventually we'd like to have these surveys out for people to use, but that's going to be a few years probably.

The other thing is that we have videos that that I'm really excited about because [one has all our project partners](#)—so museums, educators and schoolteachers, and then researchers and environmental education organization people all talking about why youth-focused citizen science might be good for learning. Why we are seeing it as good for learning, science learning. And [the other one](#) is talking specifically about environmental science agency and these key practices.