

What is STEM Identity? An Interview with Jacque Eccles

On October 16, 2017, [Martin Storksdieck](#), Professor of Learning Sciences and Policy at the University of Pittsburgh, interviewed [Jacque Eccles](#) to understand her thinking and work on the topic of STEM identity. Dr. Eccles is a Distinguished Professor of Education at the University of California, Irvine. Dr. Storksdieck conducted the interview as a member of the Center for Advancement of Informal Science Education (CAISE) task force on evaluation and measurement and co-Principal Investigator of CAISE.

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



Tell us about the projects you've done that focus on identity.

I would say that I've been studying identity for the last 40 years. I haven't always used that term, but I think that's the essence of what we're studying. So what we've done in each of our studies is to look longitudinally at how children come to see themselves as being capable of mastering math and science and the extent to which they want to do that. And part of the extent to which they want to do that has to do with how close they think science and math is to whom they think they are or want to be.

How would you define identity?

I think identity is very hard to define. I would probably avoid trying to define it in any one particular way. I think the essence of it as it's being used by people who are talking about science identity is that one can imagine oneself being a scientist or being a mathematician or that doing this activity is so much a part of who one thinks one is that it is nested within this thing we would call self-concept or identity. Now, I think people have many identities and these are all those aspects of their lives that are very central to what a psychologist would call their self-concept, who they think they are.

There are other identities that people have like gender, race, or other kinds of forms of who they think they are, and they might overlap with science identity. What role, if at all, does this intersectionality play in your work?

In my work, when I think of something like identity and use terms like that, I'm trying to understand how these mental representations actually end up affecting behavior. So the decision, for example, to take a math test or a math class or to go into a career that involves mathematics or science, I conceptualize it as having the attachment piece, which is how much of this is like me. But then there's also the extent to which whether I want to become like that, and that's where it will overlap with other identities. For example, if I have a strong gender identity, I have images of what it means to be, for example, my gender identity would be female. I would have ideas about what it means to be an ideal female. Part of those would be things like femininity, but part of those could also be things like what kind of work I want to do. And it would interface with the science identity to reinforce it to the extent that I think being a female is compatible with being a scientist. And that would have to do with the images I have of both of those identities. For some people, when you say I'm a scientist, they bring up in their mind Madame Curie, and there's no conflict at all between being a female and being a scientist. For others, that isn't the image of being a scientist to them, and therefore they might be in direct conflict. It would also have to do with things like, "well, what do I want to do with my life? And, if part of my being a woman is that I want to have children, I want to help people, I want to be altruistic, I want to be noncompetitive." Then if I believe science will inhibit any of those things, then I will keep those two images quite separate. But if I have an image, for example, that I can become a biologist, and I can cure cancer, and I want to do things to help people, then that's part of my female identity, then those things are completely compatible. So when I think about them, it doesn't have so much to do with whether I endorse the term science identity or feminine identity or femaleness, it's the content of those that matter.

Why and in what ways do you think identity matters for science and learning or science communication?

Well, learning and communication are two different things. I think that within my frame, which is an expectancy value frame of task choice. So I break it down into two components, both of which are part of identity, in my view. How good do I think I am? Meaning, can I succeed at this task? And do I want to succeed at this task? And it's where these two things come together, and they become central to my core self, I think you have a positive science identity. And if you have those things, then stimulating a science identity in a person's mind will stimulate these same things. Oh, that means I get to do something I like to do, that means I get to do something that I think will further my goals for myself that I want to be—I want to learn, I want to work hard in school, I want to learn the things I need to do in order to help other people, and so I will engage this task even if in the moment it's boring or difficult. This essentially provides a reason to engage the task. And, of course, the more you engage the task for personal intrinsic reasons, the more you will be able to stick with it even if it gets hard, frustrating, or you get anxious or other kinds of things that you have to give up something else you love like going out with your friends. I mean, you have to sort of think about what's competing for a person's time and how does something like an identity increase the value of doing this as opposed to something else.

This is a great example. And it's a great foundation for this idea of persistence that people are throwing around, right?

Yes.

But it also brings up the idea how your concept or your view of approaching identity might be distinct or different from other approaches.

Well, I think what's different in ours is we try to go into the mechanisms. So we try to go into well, all right, so you have an identity. Why should that affect anything? How does it affect it? And it affects it through motivation, and it affects it through the relative strength of motivation for one activity versus another. So I'm going to do my science in school rather than talk to my friend because that's more important to me. That's more central to who I am. So I think the term "are you a science person?" is actually a quick and dirty term to summarize a lot of underlying complex psychological processes. And I think we differ in that we focused on the side these more embedded science processes, psychological processes, than if you just use this term. I think if you just used this term, you don't really know the mechanism by which it's actually influencing learning or engagement.

Does it make a difference whether you call it a science entity or a STEM entity?

I think it makes a lot of difference because science isn't one thing. And, of course, it may start out for a young child being science, but somewhere along the way they're going to learn that there's physics, there's chemistry, there's medicine, there's biology, there's social sciences. Those all have very different implications for how they spend their time. So, for example, I went into microbiology when I was an undergraduate, because I wanted to help the world, I wanted to get rid of diseases and physics had no interest to me whatsoever. So I avoided physics classes. My identity was not this abstract notion of science at all; it was microbiology. And then it shifted to psychology because I thought, well, I really wanted to understand people. I understood that was equally important to saving lives. You work on it, but even if you get the vaccine, you're not going to get them to use it unless you can deal with the psychology. And so I shifted, and I began to think of myself as a psychological scientist. And I didn't define it as a social science. So in my mind, it was always an experimental science grounded in the natural sciences, never in the social sciences.

How do you currently measure identity in your work or have in the past?

We measure it very specifically. We measure it in many ways. We do ask people the extent to which they identify with science. And then we ask them the extent to which they identify. Because I use children and adolescents, I try to come up with pretty concrete ways to do this. So for example, we might use something like the implicit—the IAT where we would have a person and you would be measuring their reaction time to "is this like you or not like you?" I would show pictures of a scientist, and they would pick it. And I would show pictures of a doctor, and I would show pictures of the various things that you can depict, you know, pictorially so that the kids have an image that they're actually seeing. Or I might show someone working with test tubes or those kinds of things, and I'll see the speed with which they respond, which tells me something about how accessible the connection is between that image and who I think I am to the person. So the faster you do it, the argument is, the more

likely it is that that you identify with it. That you, at least, have thought about yourself in light of that image enough that you can get a fast response time. So that's one way to get it at a very nonverbal level. And I would do that with people, but I would also use a scale, how often do you think of yourself as a whatever it is that I'm interested in, whether it's a scientist or biologist or an astronomer or any terms that the children will understand what it is I'm referring to. Now, having done that, I then would also ask self-concepts. I would ask, how good are you at tasks like this? Not good to very good? What is the problem, how likely do you think it is that you'll be able to succeed at hard problems in this area? Very likely to not very likely? So I would get a set of questions that have to do with the person's assessment of their competence relative to themselves, to others, and to other subject areas and the importance that they attach to it. So I would say we do this. How important is it for you to do well in? And that would be the name of the courses that they're in; if I'm interested in particular courses. I wouldn't say science courses, because I think that's too abstract. What I would say is, how much do you enjoy doing the things in the course you're taking now? How much do you imagine you will enjoy doing the activities that you will be doing in your biology course next year? If you were to go to an after-school program that had activities like this, how much do you think you would enjoy doing them? So I try to get enjoyment. I try to get importance, and I try to get some questions about how much would doing this further the goals you have for yourself? So will what I learn in math help me to meet my goals? And we can get very good questions, two or three questions of that type produce very high alpha on scales. Kids are very good at answering those questions all the way down to fourth grade and maybe even younger. If we use pictures, we could get it at first graders. They're differentiated from a very early age. They're already able to tell you these kinds of things at a young age.

You've given multiple ways to measure that very independently. To what degree are these different approaches towards getting subcontexts of what you don't want to define as a full identity? How much do they overlap? How much do they confirm each other, or how much do they measure separate components of some larger concept?

We don't know the answer to that question.

Do you correlate these different approaches when you do the Implicit-Association Test?

Yes, they are correlated with each other. Sometimes they're so highly correlated, you wouldn't want to put them into the same regression equation. But within my theoretical framework, they tend to come together as they get older. The more central identity gets to a person, the more likely their values and their self-concepts are going to be highly correlated. If it's not particularly salient to their identity, they may, in fact, say I'm very good at this, but I hate it. In which case you wouldn't get a high correlation between the value being attached to it and their identity.

And we've started using approaches where we look for patterns. I would take all these different ways as essentially being a way of triangulating in, if there is way, and I don't know if there is. I'm a psychologist, I tend to break things apart. And I don't know if there's an aggregate that actually exists in a person's head. If the aggregate that exists in our head is a

theoretical higher-order construct. But we've started using pattern analysis. So we would take all these different measures, get them on the same scale, and then do pattern analysis and look for the people for whom they all go together and the people for whom they go together in different constellations. I would argue that the person for whom they all go together, who endorses all of these things very highly, is going to be the one that will go on and become a scientist. This other person over here who maybe really loves it, but doesn't think they're particularly good at it, but sort of thinks they see themselves that way, they may, in fact, become an amateur scientist. They may be a person who they're not going to try to make a living at this because they don't think they're going to be the very best at it, but they will enjoy doing it all of their lives, and they will stay engaged, and they won't be afraid of science. So when they say I'm a scientist, they mean something quite different than the person who is going to go on and get a PhD and spend the rest of their life doing science. I don't know where a science teacher would fit in this particular category. It would be very interesting to see whether people have a different identity for being a teacher of science than for being a scientist. Those are subtleties that actually would help us understand the particular ways people engage science as they move through their lifespan.

That makes a lot of sense. We're trying sometimes to distinguish a learner of science, a STEM identity, from more like an attitude towards science.

Right.

That makes total sense. So for you, the idea is that these things are components to this that have different predictive value.

That's right. And the value will vary across people.

Yes.

So I come back to this—it's at the personal level that it matters. It's not at the population level. So I get quite anxious when people throw all these things into a regression to find out which one is the best predictor because I think that's nonsense.

Thank you.

I think which one is the best predictor is going to vary by person.

You just provided a fairly complex picture of how one can think about this and how these different parts are connected to one another. And of course, evaluators oftentimes try to find the small scale that you use to make some claims. What are your thoughts about whether it's possible to develop practical measures of identity that can be used to guide program design or program impact evaluation?

So here I'm going to get on my soapbox. I think switching immediately into constructs like science identity is actually a move backwards. Because I think trying to measure that with a simple measure is probably not the right way to go. I think an evaluator ought to decide what the program is supposed to be producing. If they're trying to get kids interested in science, they should measure interest. If they're trying to raise the kids' self-concepts and confidence

in their ability to succeed, they should measure that. And if they want to measure where they're going to go into a career. For example, if you look at the work, and I'm going to now pick one of my favorite ones that I have trouble with; if you look at mindset, for example, mindset is about convincing kids that they can, in fact, succeed even if it's difficult. I think it's very useful for that. If we've got kids in math classrooms in the third grade and they're already giving up because they think they can't do this, that's bad. And we ought to raise that. Now, does that mean we want to turn them into having a math identity? No. Because for most of them, they don't like it, and they're never going to be a mathematician; they just aren't. I don't think it does any good service at all to say everyone should believe they could be a mathematician. That's not helpful to kids. Kids are trying to figure out what they would like to do, what they would enjoy, and what specific skills they want to take the time to master. We have a core set in schools that we say they must master, and we want to make it as easy as we can for them to master those things. That could be the goal of an intervention.

If our goal is to produce more people that go on and become full-time PhD-level scientists, then we have to do a lot more than convince them. I mean, most of those people are not going to believe they can't get better by studying harder. They're not going to have a fixed mindset because they just don't. They're having good success. They're going along. They're liking, so there would be no reason for them to have a debilitating fixed mindset. And to the extent that they have a fixed mindset, they're on the positive end of it, so that may be helpful that they have a fixed mindset, not detrimental at all. I could even make the case if you're going to go on and get a PhD in microbiology, you'd better have a fixed mindset, and you'd better think you're really good at it. Because otherwise it's not worth your time. So that's why I don't think there's one good measure. It really depends on what the purpose of the program is. I think if you want to get more people to go into something say, for example, engineering—I do a lot of work in this area—what I would do, I mean, this is for gender. I think the main reason, and we've got lots of data to support this, that women aren't going into engineering is because they think engineering is dull, boring, and it won't, in fact, let them meet their goals. So if you want to get them to go into engineering, I don't think you want to change their identity of engineers until you change their image of what engineers are. The first step would be to convince them that engineers do the kinds of things that in their other identities they think are important. Essentially what we want to do is to bring this construct of engineer closer to identities they already have rather than trying to get them to create a whole new identity, that's harder. I would go from the point of “are we having some impact to getting them to think about whatever?” If our goal is to get people in those fields, getting them to think about those fields as being compatible with whatever other identities they have.

I have another soapbox. This is spot-on with what you've just said. I have the other soapbox, which is we also have to change engineering so it actually is the way we're advertising this to the young women.

I think that's happening. If you ask kids I think this is a whole other line, and it's where I've come to after 40 years, is we do a terrible job in our country, and in most countries, giving kids any information about what various occupations do, and STEM is clearly one of those. I mean, what STEM occupation did they know anything about if their mom or dad isn't one? Medical. Because they see doctors on TV and CSI's. Maybe now they have some sense that MacGyver is back. They have this sense of if being embedded in drama, in saving lives or in

protecting the United States or finding criminals. Now, some of them, for some reason, somewhere along the way are exposed to something that get them interested in scientists. They read books about particular scientists, or they have a teacher who can tell them about particular scientists. There was work a while ago about who were the best science teachers to stimulate kids, and they tended to have been people who had been scientists and then went back to teaching. I always thought that was because they could actually tell the kids what it was to be a scientist, and they were a scientist. So the kids got a broad image of what STEM is actually about. I think if we did that, we'd have a lot more people thinking about it. And they might not pick it, but at least they'd be ruling it out for the right reasons, not because they don't know anything. I don't think this is just pertaining to STEM, it's everything.

I agree with that.

You know, so now computer science, because it's linked to gaming, is one that a certain set of kids have a much better picture of at least that aspect of it. They can imagine themselves being a gamer and going from there to be a producer of games. But that's very different from other sciences.

A lot of people, and you mentioned this as well already, the distinction between being clear about what concept we're talking about, and there are other concepts like interest and motivation and attitudes that people are interested in when it comes to outcomes for science. You already mentioned it, but how are they connected to identity? What distinguishes identity from these concepts?

To me, identity has to do with how central these beliefs about the self or these attitudes are to one's own identity. I think that during adolescence, for example, it's all about figuring out who you are. That's where I make a distinction between social identities and personal identities. Social identities are those identities that make you part of a group, make you belong. In order to belong, you have to be what you think those other people want you to be in order to welcome you into their group. That's going to affect behavior through these stereotypes that you have: "I won't be this because they won't like me." "They will reject me." Social identities have strong components about what you should do and what you shouldn't do, and that goes all the way from the way you talk to what career you're in and what your core values are. Personal identities, on the other side, are the things that make you stand out. They're the things that are unique to you, that you're going to put time into and you're going to perfect because that's the way you want to be. It isn't to make other people like you necessarily. You in terms of emotionally liking you as opposed to similar. It's to actually try to be very good at something that you think you would enjoy. And they can—the same identity can fit into either of those categories. I could become a scientist because I want to fit in with scientists, and I like the scientific community, and I want to be part of it. Or I could want to be a scientist because I love doing science, and being a scientist is so much a part of who I am that I can't imagine not doing it all of the time. But that's when I'm in my place of flow is when I'm doing this activity. Now, most people aren't there. I think that's an ideal. Very few people spend most of their life in a state of flow because they're doing what they absolutely love. Luckily you and I and people in academia come closer. We have more of an opportunity to do that, but I would say people that work as an engineer in a company probably don't feel that way very much. People who are working for Dow Chemical probably don't feel that way very much, but they're probably still doing something they enjoy doing.

But it's not because that's their identity; it's what they do for a job. It's what they do for eight hours a day, and it's wonderful, but it's not their identity. Something else is their identity. So I think we need to keep those ideas, and this is in the adult world versus the children's world. I think we need to keep those kinds of ideas distinct and know that you don't have to have this thing be the core of who you are to study it hard, to learn it, to master it, to enjoy it, and to do it for an occupation. Better if you do, but not everybody—that's not going to fit everybody. And it's certainly not going to fill the labor market needs. Most of the labor market needs are going to have to be filled by people for whom this is the best way they can imagine spending 40 hours a week, but it's not who they are.

This is always what I tell friends—that my hobby and my work are the same. If they ask you what else are you doing for fun, I say oh, I'm already doing what I want to do for fun. I'm a very privileged person.

That's right. We are very privileged. So the students ask me that. What do you do with your real life? And I said this is my real life, and there's nothing I'd rather do. So I'm not trying to work/life balance, this is my life. I am so thankful that I happened to land in that position, but there are few of us, I think if you actually look around the world and through history, that's a very privileged place.

With the case that you had before, where you made a very important point about what people should be measuring and what they're measuring and being clear what it is they're aiming at. What are some examples of resources or tools for measuring a descending identity that you have found useful other than yours?

If I wanted to measure [identity], and I would, you need to make it age appropriate. Of course, we don't often. We often take and imagine how we would want to express it, and then we give it to a 10-year old, and that's not going to work. So you need to pilot all of this very carefully with the population you're going to work in. I think if I wanted to get at this core identity, I would use these pictorial measures. I think the implicit identity stuff is probably a reasonable way to go. I don't think you can assume if they can't do it, it doesn't mean that they don't have the identity. It just means that lots of things can affect how fast you push that button. But if they pass that button very fast, then you could probably infer it is part of their identity. On the other side, you can't say well, it's not part of their identity. I think you could also get them to be able to push that button quickly on the yes or no side if you gave them practice working on the computer. You've got to take that into account that there are other things that drive that behavior. I think you could give them some choices between tasks and see which one they pick. It really does depend on what you're going to use the data for. If you want to see whether or not you've increased the extent to which they enjoy something, ask them how much they enjoy it. They'll tell you. A one to seven scale with two or three items works perfectly, and there are many of those around. So you can look at that.

There is [a group at the University of Virginia](#) and at George Mason who are developing a quick and dirty measure of expectancy value on cost measures. They've specifically tried to develop a set of measures that have a minimal number of items. In order to do that, they're having to operate at the general level rather than the specific level. They're going to be getting it at the level of science or math, not at the level of biological sciences versus the

physical sciences. In terms of gender, I think that's a very critical distinction. Because if the girls think you're talking about physics, they're going to appear to be disinterested when they're, in fact, very interested in the biological sciences. So again, that's one of these cases that you need to be thinking about how specific should you be and what is going to be your inference that you're trying to get from it. I actually think we have reasonably good measures to measure these subcomponents, and they don't take a lot of time. You can measure several of them and try to triangulate.

What kinds of measures do you have?

Well, I have measures of ability, self-concepts across a whole variety of areas: math, the various sciences, English, athletics. A lot of skill-based areas, and we have measures of expectations for success, immediate success, future success, and success in occupations or in college. We do how would you do in a career. We have a set of questions that ask them how well they would do in a career that doesn't label the career but mentions the skills. So one that requires you to use math, one that requires you to work with people, one that allows you to work with a computer—one that allows you to program computers. We have items like that. We also have a whole set of items that ask how much you enjoy doing things like that. How much anxiety you experience when you do it, or if you imagine yourself doing it. How comfortable you would be doing these kinds of activities, either in the present or in the future. How important it is to you to be good in each of these things. If you could—how likely you would be to some more of this if, in fact, it was an option. So if you had five minutes, how likely would it be that you would do this kind of thing versus that kind of thing? We find all of these things are very easy to measure on questionnaires. For younger kids, you can use pictorial aids, so they can understand the concepts of a little to a lot by using bars, by using smiley faces. And all of those things are we find pretty easy to measure.

You mentioned that it makes a big difference when you ask a girl—particularly when you don't have time to figure out what is it they're interested in. But you don't want to use the term signs or STEM because it's too broad, they don't understand necessarily or they're making an association you don't know.

Yes, that's the hard part, is you don't know what they're thinking.

Would you then say that potentially it's a useful approach to distinguish and say I'll do this now for biology, and I'll do it for chemistry, or for physics and see the difference between those two, at least for the kids who have experienced these terms already?

That's right. And we do that. These are not hard things for them to fill out. So they can do it quickly, and you don't need ten items. You need two or three items, and you get a very good measure. They make more sense when they're looked at against each other. What we're finding now, for example, is if we want to know who's going to go into sciences, it matters just as much as we know how good they think they are in English. Because if they think they're equally good in math and English, then they're much more likely to pick something outside of science. Not that in science, but then someone who doesn't have that pattern. And that's a girl pattern. So what we're finding is that it looks more like the girls aren't going into science because they can go into something else. Not because they don't want to go into

science. So it isn't science versus not science. It's science versus other concrete things. If you don't ask about those other concrete things, then you don't know why they're saying they're not going into science. And we jump to the conclusion that there must be something wrong with them that they didn't pick science. But there's nothing wrong with them. Most of them have done it because, in fact, for them, they would prefer this to that. They don't have any doubts about that, they could do that fine, but they think they'd rather write novels.

Is there any one publication or good website about that somebody can use as an entry-point into your work that you would recommend?

For that particular point, [Wang and Eccles](#), and there was a psych/science paper. It makes it very clearly, and then we followed that up a little bit. The gender difference is probably thought of as girls having more choices. Girls are more likely to have multiple skills than boys are.