# AC 2012-4264: CRYSTALLIZED IDENTITY: A LOOK AT IDENTITY DEVELOPMENT THROUGH CROSS-DISCIPLINARY EXPERIENCES IN ENGINEERING

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Abstract

Engineers seldom work solely within their own discipline, though they are typically trained and educated in their own area of expertise (e.g., civil engineering, agricultural engineering, etc.). As such, the identity formation of engineers throughout their education and career is a rich area of study, and one which has not been explored fully. The current project uses the lens of crystallized identity to examine perceptions of identity in the life of a cross-disciplinary engineer. Results suggest the essential nature of self-identity constructions as well as the importance of interactions with others in a variety of disciplines.

## Introduction

Currently, the professional world values people who have developed a large set of professional skills (Dall'Alba & Sandberg, 2006). While researching the development of the participants' identities, the authors of this paper saw that the development of a cross-disciplinary identity was far more intricate than a simple accumulation of new skills. We saw that participants' experiences with cross-disciplinary work left a profound mark on how those individuals saw themselves as cross-disciplinary engineers. People become experts in a field such as engineering by garnering enough situated experiences and emotions from interactions with colleagues in work scenarios helped develop an identity as a professional (see Dall'Alba & Sandberg 2006).

Engineers develop their identities from the time that they are students by becoming involved within their own disciplinary worlds, which are defined by the shared vocabulary, tools, and methods (Bucciarelli, 2003). Since engineers are so embedded in this disciplinary world, they develop a strong affinity with others who share in their common practices; however, most problems that engineers are attempting to solve require more than one discipline, which leads to

multiple vocabularies, tools, and methods. To succeed in solving these problems, the engineer must step outside of his or her disciplinary world and create a common ground with their colleagues. This requires that the engineer develop into something more than their individual concept of "engineer;" they must develop as a colleague who can communicate and function with others from different areas of expertise. Their interaction helps further the development of an engineer's professional identity, as perceived by the engineer and by others.

Individuals engaging in cross-disciplinary work face a multitude of identity-related challenges. These individuals have to work internally in order to enable themselves to adapt to a multitude of situations and epistemologies. Externally, these individuals must handle others' confusion about the nature of cross-disciplinarity and the identity or identities which can subsist within that space. In order to make sense of the multiplicity of identity in a cross-disciplinary space, the current project employs the lens of crystallized identity in regards to individuals operating in these areas.

## Literature Review

Identity has been examined through innumerable lenses and disciplines, but perhaps the most enticing question is the one which challenges what happens when these lenses and disciplines collide, mix, and overlap. Those in cross-disciplinary spaces are individuals who have found themselves limited by what disciplinary thinking can offer, and feel that in order to address the more complex and higher-level concerns which interest them, they must make bridges between and among tidily outlined disciplines (Latucca, 2001). Individuals in the cross-disciplinary space are challenging what others are comfortable with: the security of being able to pinpoint a person's identity via their occupation or area of study (e.g., engineer, botanist, etc.).

While a traditional notion of identity may be fixed and, more importantly, may be related inextricably to an individual's occupation or area of study, those in cross-disciplinary work are generally comfortable when confronted with circumstances which seem to be intrinsically unable to mesh. In other words, individuals working in-depth in a cross-disciplinary space are often comfortable with having an amorphous identity, all the while maintaining their disciplinary identity (Latucca, 2001). In this mindset, the individual's identity is continually morphing while the individual maintains their "home" identity—a situation which may seem chaotic to those not in cross-disciplinary work. In order to deal with the many roles they must occupy in cross-disciplinary work, these individuals find links between and among their identities, a practice which helps them make sense of who they are (Latucca, 2001).

Crystallized identity is a notion which challenges the commonly-held definition of identity in the literature by stating that identity is not dichotomous, but multi-faceted (Tracy & Trethewey, 2005). The dichotomous definition of identity argues that there is a "real self" and a "fake self," particularly in organizational contexts. In other words, an individual is one person while they are engaged with the organization (e.g., an accountant) but a different person when they leave the organization (e.g., a spouse or parent). Crystallized identity, on the other hand, acknowledges that a person is still their own person regardless of the situation or context they are experiencing at a certain moment—that is, a particular "facet" of their identity might be more salient in some situations than in others, but they are still the same person. The paradigm of crystallized identity also argues that the individual is not the only one responsible for their identity formation and, in fact, the organization to which they belong has influence on this process (Tracy & Trethewey, 2005). These concepts align with cross-disciplinary notions of

identity, wherein disciplines are viewed as social constructions which are continually changing and thus are problematic sources for identity formation (Klein, 2004; Latucca, 2001).

According to the crystallized identity paradigm, organizational discourse and practices contribute significantly to the traditional, dichotomous view of identity. As an example, someone could be in the "financial" department at work, and so they are defined as the "finance guy." This notion of being the "finance guy" is continually reaffirmed through the way others treat him, the way organizational practices are structured, and finally, through his own behaviors. Further, from both the standpoint of crystallized identity and the view of cross-disciplinary notions of identity, individuals' identities grow, change, and vary. In other words, identity is not stagnant but is adaptable to the context at hand (Meisenbach, 2008). The adaptable aspects of identity are particularly salient in cross-disciplinary contexts, where individuals must not only adopt different role titles but often must adopt entirely different epistemological approaches depending on their current situation (Spiro et al., 1987). An individual in cross-disciplinary situations must be able to present to, converse with, and work alongside others from a variety of different backgrounds. One can imagine, for instance, the need for someone who has a "home identity" in an engineering field having to explain an engineering-based concept to a group of marketing executives, city planners, politicians, lawyers, and so forth; the presentation the engineer might give to other engineers will not suffice, and so the engineer presenting must adapt. The requisite adaptation those in cross-disciplinary work must go through can be a painful, vague, and humbling process in which individuals have to be comfortable learning from others and living in a liminal space (Giri, 2002). It is not typical to think of oneself as cross-disciplinary, so those individuals who are in this hybrid space are working against the expected norm.

Although not always alluding to the exact term of "crystallized identity," research has utilized important aspects of the paradigm in a multitude of ways. It has been argued that what actually exists as an individual's reality does not matter as much as how that person perceives it or talks about it (Ashcraft, 2005). That is, if someone thinks something is a certain way, that perception is what creates that person's reality. In studying the declining prominence of the masculinity paradigm within the airline pilot profession, Ashcraft (2005) posits that having a more inclusive work identity (e.g., an identity which includes facets of the individual's life beyond those created and maintained within the organization) could be both tangibly and discursively beneficial to professions on the individual and group levels.

Importantly, others' perceptions and influences external to individuals' professions and organizations have an impact on the process of identity construction (Ashcraft, 2005; Norander, Mazer, & Bates, 2011). For instance, some "master narratives" from the societal perspective can call into question external perceptions of the existence of particular identities; that is, if the larger population denies the validity or existence of an identity, that denial can have a significant impact on the identity construction of the individuals in question (Somers, 1994; Tsetsura, 2010). One can refer to the phrase "a real job" to fully understand the impact of these master narratives. Individuals facing external negative perceptions of their identities can have difficulties in articulating their identities and profession to others (Tsetsura, 2010).

In order to clearly address these challenges (specifically for the population of engineers working cross-disciplinarily) and to expand on the paradigm of crystallized identity, we posit the following research question:

**RQ**: How can the lens of crystallized identity help us understand the development of individuals pursuing engineering-based cross-disciplinary work?

## Methods

Our data is taken from part of a longitudinal study that began in October 2009 and is currently undergoing its final step in data collection, which began in January 2012.. In this study participants were recruited who represented diversity in experience levels (e.g., freshmen to professionals), and in disciplinary training (e.g., civil engineering, electrical engineering, etc.). Due the longitudinal nature of our data collection, one goal of the project was to determine if the participants experienced any significant changes in their perceptions of their identity throughout their development as professionals. With undergraduate participants, we expected to see some significant change in their development of an engineering identity over the course of data collection. With engineering practitioners and faculty participants, we expected to see few changes, if any, in their development of an engineering identity as data collection continued. Another element in selecting participants for the study was the epistemological distance they had from their coworkers and colleagues. Participants having interactions with others who have a variety of backgrounds and knowledge bases is important when using the framework of crystallized identity since the participants have to display different facets of their professional understanding to their colleagues. Listing the epistemological distances from smallest to greatest, the participants could be engineers who worked with other engineers (E x E); engineers who worked with scientists (E x Sci); engineers who worked with management (E x Mgt); and engineers who worked within the humanities and social sciences (E x Hum/Soc). Depending on the width of the epistemological distance between the participants and their colleagues, we expected to see the development of their engineering identity to be either traditional or more expansive. If the participant worked alongside other people from a STEM background, we would expect them to develop a stronger traditional engineering identity. If the participant worked

alongside other people from a non-STEM background, we would expect them to develop a more expansive engineering identity. The epistemological difference between our participants and their colleagues would be important in seeing how the participants were able to interact in a cross-disciplinary setting. Overall, our study has maintained thirty participants. The table below shows the chart for distribution of status and epistemological difference for all of the participants. All participants were de-identified with a pseudonym chosen by the researchers; similarly, their data was thoroughly de-identified so that no individuals or organizations would be recognizable through the participants' responses.

| Pseudonym | Status | Epist. Distance |
|---|---|---|
| Alice | Graduate | ExSci |
| Alvin | Faculty | ExSci |
| Becky | Graduate | ExSci |
| Bernadette | Undergraduate | ExE |
| Charlotte | Graduate | ExE |
| Donald | Undergraduate | ExMgt |
| Doug | Industry | ExMgt |
| Evelyn | Industry | ExMgt |
| Floyd | Faculty | ExE |
| Frances | Undergraduate | ExE |
| Gertrude | Faculty | ExE |
| Grant | Undergraduate | ExE |
| Hortense | Graduate | ExE |
| Ignacio | Industry | ExMgt |
| Jordan | Undergraduate | ExE |
| Kirk | Undergraduate | ExE |
| Kyra | Faculty | ExSci |
| Leo | Faculty | ExHum/Soc |
| Lily | Undergraduate | ExE |
| Marge | Undergraduate | ExE |
| Nadine | Undergraduate | ExHum/Soc |
| Octavio | Undergraduate | ExHum/Soc |
| Queenie | Undergraduate | ExMgt |
| Sebastian | Undergraduate | ExE |
| Uma | Undergraduate | ExHum/Soc |
| Vladimir | Graduate | ExE |
| Wallace | Graduate | ExSci |
| Xavier | Graduate | ExE |
| Yancy | Post-doc | ExHum/Soc |
| Zoltan | Graduate | ExSci |

Table 1. Study participants and experience levels

For sake of brevity and parsimony, we chose a small collection of participants in this paper who are representative of the study participants throughout the entire study. The table below shows the chart for distribution of status and epistemological difference for the participants who are being examined in this paper.

| Pseudonym | Status | Epist. Distance |
|---|---|---|
| Alvin | Faculty | ExSci |
| Becky | Graduate | ExSci |
| Evelyn | Industry | ExMgt |
| Gertrude | Faculty | ExE |
| Grant | Undergraduate | ExE |
| Ignacio | Industry | ExMgt |
| Uma | Undergraduate | ExHum/Soc |
| Vladimir | Graduate | ExE |

Table 2. List of select study participants and background

The data presented in this study are mainly from photo elicitation interviews. Using the method of interviewing allowed the researchers to ask open-ended questions so that the participant would speak freely about his or her experiences and it allowed the researchers to probe the responses to understand any tacit meanings (Patton, 2002). The protocol was semi-structured and probes were used to gain further understanding of the participants' stories. The interviews lasted between one and two hours. Images were used as the key portion of the interview, as visual media have been shown to elicit stories from study participants that would have otherwise been overlooked by the interviewer (Gross & Levenson, 1995; Harper, 2002). The researchers asked the study participants to bring in four images for the interview. While the researchers used the word “images”, we wanted the study participants to be free to choose whatever kind of images they thought were appropriate, be it clip-art, personal photographs or other general images found online. The images that were used were ones which participants felt

represented their personal lives, professional lives, disciplinary lives, and cross-disciplinary lives. The personal life photo dealt with aspects such as personal strengths and daily routines of the participants which affect their understanding of their self-awareness. The professional life photo showed the communities of practice with which the participant identified. The disciplinary life photo dealt with the participants' understanding of their place in the discipline that they identified with. Finally, the cross-disciplinary life photo dealt with the participants' understanding of how to operate in a cross-disciplinary environment, and what that meant to them. The questions used in the interview aimed to unpack the qualities of the images that the participants found important. These images that participants provided were important since they helped the participants weave a story linked to a physical experience rather than an abstract concept. This allows the researchers to hear a story that is more in-depth, since pictures allow the participants to talk about important matters that may usually be tacit.

While hearing the participants' stories, the researchers asked probing questions to draw out tacit elements of the participants' experiences. After being transcribed, the interviews were analyzed using an online software program, Dedoose, which allowed the researchers to highlight and codify elements of the interviews that reflected the lens of crystallized identity and aspects of identity important in cross-disciplinary work. Each researcher reviewed the data multiple times, using emergent themes which were continually checked for intercoder reliability. The emergent themes sprang from a parent code of emotion, specifically as related to cross-disciplinarity, career, and in relation to others. Under these child codes included concerns of transition (whether deliberate, forced, and/or unconscious), conflict (between self- and other-perception of one's identity), and definition (self in relation to others). Emotion emerged as the parent code because participants generally displayed emotion when they were indicating their

awareness of something unusual—for instance, they were uncomfortable with being categorized in a certain way by others, or they found it intriguing that they discovered a new area of study to pursue. A multitude of child codes developed out of the overarching parent code of "emotion," all of which tied back into the multiple aspects of individuals' identities. Using crystallized identity as a lens for this research made it possible to isolate given lines in stories in order to see how our study participants developed from their experiences.

When looking at the data, it is essential to understand what elements from the participants' interviews are important in explicating the utility crystallized identity. Since that framework looks at the development of identity through interactions with others, it is important for the researchers to isolate those elements of the interviews. With regard to this framework, we isolated the questions regarding the participants' explanation for using the photo they chose for their professional and disciplinary life. These photos are important because the participants both chose and used them in order to unpack their experiences regarding their interactions within communities of practice and how respected they feel within their work. These questions allow the participants to freely express any emotions they feel are relevant. It is also important to note that while the participants vary in age, gender, professional training, and epistemological distance, there are some common themes found in their answers. Underlying this observation is the importance of crystallized identity in understanding all the participants' stories. The following section will highlight excerpts from our group of eight participants.

## Results

The explanations the participants give with regards to why they chose a particular photo shows a level of emotional engagement with their discipline and their work. When Vladimir, an

civil engineering graduate student, discusses his choice for the disciplinary life photo, he begins to weave a story about how he perceives his discipline to be important.

> A lot of the other engineering schools—I thought there are really important things that I like and enjoy in life you know, I like having a cell phone, so I'm glad that someone designed that. So when we're talking about essential needs for life, it was like the civil engineer's work. And so I guess that's what attracted me to it in a way.

Due to his rationale that civil engineering is so essential to everyday life, he is able to take pride in his work and expresses how happy he is to be a part of the discipline. Since he understands that his discipline plays a vital role to projects he is on, Vladimir approaches his colleagues by showing how his work is closely tied to the beneficiaries of his projects. Therefore he views his contributions as being important to the projects on which he works. In another portion of the interview, Vladimir states how having a common understanding of what his discipline is can lead his colleagues to appreciate his work. Through their professional or disciplinary photos, participants tended to show what they connect to in their discipline. Evelyn, a practicing engineer, also shares her reaction when asked about her professional life photo:

> …Other people who work for me that I spend a lot of time working with and helping them to grow professionally. So that's what it really represents 'cause at the heart of it, besides loving to travel I love to mentor people.

From Evelyn's photo and accompanying statement, we get insight into the importance of mentoring, which she feels is an integral part of her professional work and identity. For Evelyn, mentoring means passing something onto the next generation, leaving a legacy that is beyond her work to the impact she has had on somebody's life:

> First of all I never had a woman mentor; which, you know, I look back I had men that helped me, but not women and I really enjoy helping especially younger or less experienced women because I think that women experience the workplace in a different way than men do and have different issues that come up. I like to feel like I'm passing something on to the next generation… I've learned a lot, I've had a lot of experiences, and I want to pass that on; so it feels good to leave a legacy behind that isn't just my work; to make an impact on somebody else's life.

The lens of crystallized identity can give us a means to understand why Evelyn has made the choices she has made and why those choices are important to her. By understanding how they fit within a particular project, Vladimir and Evelyn are able to make their connections to their colleagues and further develop their roles within the project. In wanting to leave behind a legacy of impacting the lives of other women, we can see how Evelyn strengthens her identity as an engineer. We are able to see how their interactions have influenced their identities by asking the participants with which groups they identify. We asked the participants to reflect on how they feel in relation to the people with whom they work, and the majority of participants explained how interacting with their colleagues leads them to develop a new understanding of their identity as an engineer. Grant, who is an civil engineering undergraduate student, shows who his interactions with his colleagues has helped him shape who he is.

> I would like to identify myself with someone who is very passionate about their idea. Which means maybe they're not motivated by just money, or selling, or what they would get out of it—I think if someone's really just very sincere about their idea or product or something they're going to really push to get it to work. -Grant

Grant identifies with people who are passionate about their work. He remarks how the emotional aspect of work can affect the product that is produced—a good product comes from someone who loves what he or she is doing. It is evident from this statement that Grant wants to work in a field where he is able to exhibit passion, because that will make his work more rewarding. As Grant continues his story, it is clear that he seeks out experiences in engineering where he works with other passionate people to create engineered solutions to problems. These experiences allow him to further connect himself to civil engineering. For some participants, reflecting on their experiences can reveal some tension between the prioritization of different modes of thought and values between disciplines. Ignacio, a practicing engineer who

contemplated being involved with education, remarks in the statement below about the tensions he experienced:

> And I was like, "What do I want to do with this degree?" And I was actually searching and so, you know, the logical response to a search is that you find. It wasn't something that, you know, I was 5 and said, "I want to be professor," and then spent my whole years scheming towards that goal. It was just something that I think I had stumbled upon. Though there are people that are like that, I know. I'm just not one of them.

While being inspired by a professor to seek academia as a possible career path, Ignacio had to understand how he can apply his engineering degree to an academic setting. His development as a member of engineering faculty was how to relate himself to others in academia, remembering that he "would interview with a mechanical engineering department and the bulk of mechanical engineering faculty would not value what [he is] doing because they don't see how it's mechanical engineering." The statement below also shows how Ignacio has some difficulty in finding common ground with others because he has a broad background in engineering.

> At the same time I wouldn't be able to get a job in an industrial design department because I don't have a degree in industrial design even though I do research that's related to product development. So ironically the best fit for me has been, so far, has been in a marketing school even though that's not my background at all. It's just that they, in this particular situation, they understand how the research that I'm doing relates… is useful when you're trying to understand customers which is a huge part of marketing.

We see that Ignacio's experience with his colleagues lead him to understand who he is as a professional. While trying to secure a job as engineering faculty, he has a hard time convincing other engineering faculty of his worth. However, his interactions with faculty in marketing show that once his work is respected and understood, he is able to adapt within his new job. Such experiences are not limited to those within a professional setting. Even when explaining their work to family members, participants engaged in creating an identity through their interactions. Becky, a biomedical engineering graduate student, shows how that by her interaction with her

family, she develops confidence in her own ability as an engineer, acknowledging that she had to "develop sort of a confidence because no one in [her] family is in science or engineering and they don't quite understand why [she's] getting a Ph.D. in engineering. So that's kind of had to make [her] become more confident to explain and be more sure of [her]self." That confidence is stemming from the fact that her family is now aware of what she is doing as an engineering student and she has developed a clear way of communicating her work with them to establish common understanding.

This story about her family leads her to discuss more about being a graduate student. Later on in her interview, Becky explains how her interactions with other students have had an impact on her identity as an engineer. Her added confidence in being able to explain ideas to others helps to reinforce how she views herself as a competent engineer. In the excerpt below she explains how being a grad student is like being in the transition from student to professional. In this place, she feels caught between two worlds:

> I see grad school as kind of like a mentor/mentee kind of thing. Whereas the professor is a professional with a job, and the mentor, and I'm kind of learning from him while like learning to be self-sufficient with my own research to eventually get a real job as they say. So that kind of thing I guess. Like it's kind of in between I'd say.

Even participants who have a solid understanding of their roles and identity talk about how their colleagues influence how they see themselves. Gertrude, a faculty member, reflects on how her community impacts her identity development.

> I think in general as you're interacting with a community you reflect on yourself and you reflect on the other members of your community and how you're similar; how you're different; and, in some cases you're wanting to be different, you're trying to figure out, okay, what's the different thing that I bring to this group. And at the same time you think about what are ways that I am similar, what are ways that you want to be more like this community. And sometimes you think about, okay, how well am I representing this community to other people that aren't part of this community as I interact with them? So I think that's another concern … if I'm representing the engineering education community when I interact with people who aren't part of engineering education I want to represent engineering education, so yeah, that's really part of my identity? I guess so.

Here Gertrude finds herself reflecting on where she stands in a given group. She has to understand both what distinguishes her from and what aligns her with her cohort. She wants to be able to stand out enough to contribute something unique but still wants to be similar enough so that she feels aligned with the community. To fulfill that, Gertrude has to show a facet of her that is unique in comparison to her colleagues. Importantly, while interacting with those who are outside her field of engineering education, she feels that she has to be a good representative of her field to others. By showing her colleagues that she is unique and has important contributions to make, she positively represents her role as an engineering researcher to others who may not fully understand what engineering researchers can bring to the table.

When asked whether they feel respected by people within or outside their discipline, the participants provided an array of answers. Much like the answers given regarding their communities, participants' discussions on whether they feel respected reflect their feelings of affinity toward others with whom they work. With this strong sense of affinity, the participants are able to effectively communicate with others and develop mutual understanding of their colleagues' worth to establish respect between them and their colleagues. Here Gertrude explains that respect comes from spending time with others and having them understand where you come from and what you do.

> I think to some extent it depends on how much of an interaction we've had. So, for people who I haven't had a chance to actually talk with, or really have an interaction with then I would say there's – there's probably times where they would dismiss me or my community or my professions just because they don't have enough of an understanding of me or us. But for people I've interacted with then I feel like most people, or people pretty much are interested in who I am as a professional and the perspective I bring as well as you know those different communities in general.

Since interactions with colleagues form a major component of the multi-faceted aspect of crystallized identity, it is particularly important for individuals to seek an experience where

others appreciate what each other can bring to the project. This is showing us how Gertrude finds that is important to be unique within a group but still have a similarity with her colleagues. Grant has a similar reaction to the question of whether or not he feels valued in his working experiences:

> …I'm not fully a[n] industrial designer. And because I'm not an expert, or I didn't take all the classes, or I don't have a degree in it, you know on paper, they'll say, "Alright, this guy doesn't know what he's talking about." Or, you know, I've seen a lot of the applications, or in the jobs, you know, the GPA's really high and very important for some of these jobs, but … my GPA isn't anything outstanding, but because of that I'm automatically neglected. And you know just saying, "Alright, this person is stupid." Or not stupid, but you know he doesn't have the GPA requirements, we're not going to look at your – or we don't even want to talk to you or look at your accomplishments, or look at your personality. And because of that I think that's kind of you know almost like a respect, I mean that's kind of disrespectful. And you know I see this with the advisors, the industrial designers, or the liberal arts advisors, and they look at me and like, "You're an engineer. You're not one of us." And you know I get that attitude and that feeling. And the same with the engineers. You know if I'm with the engineering advisors they're like, "Well, you know, you're a mechanical engineer, but you're also working with the liberal arts department, we don't know what you are."

He explains that since he is a mechanical engineer who works within liberal arts, he has difficulty in gaining respect from other engineers. Since other engineers do not understand why he is working within the liberal arts, they may not value what he can contribute. The lack of respect Grant feels from fellow engineers clearly has an impact on his self-identity work, and could extend further into his development as an engineer and/or as a professional. Having an engineering background that strays from normal disciplinary boundaries can affect how other engineers value Grant's work and how Grant views himself as an engineer. For another undergraduate, Uma, respect is an issue of how others perceive your level of reliability:

> I mean with everything you have to like prove yourself. And there's some things where… as a person I'm probably respected, but as far as like engineering, there's some things that I can be relied on, and some things I can't and it's just a matter of being able to prove myself to them that I can be reliable and respected.

According to Uma, if your colleagues do not rely on you to do something it is because they feel that you have yet to prove your ability to handle the task. This is important to Uma since she wants to continue to develop from a student to a professional. She has to show her

capabilities in order to be accepted by her peers. According to the paradigm of crystallized identity, Uma has to show her colleagues that she is more than able to handle the tasks that are given to her to make the project successful. The statement below shows how she sees the relationship between respect and reliably contributing something to a project:

> Like when we actually do something—at the beginning you're always given, everyone's given an opportunity. It's unspoken but you're always given an opportunity to show yourself and do something first. And then once you all settled in, and we understand each other's strengths and weaknesses, and it's just kind of like we rely on certain people to do certain things I guess.

Uma feels proving your worth brings respect and acceptance, while Ignacio feels he is respected because he feels he provides a specific contribution. Ignacio spoke of how he uses his engineering training to be aligned with a group of engineers but uses his communication abilities to provide something unique to his colleagues in order to be respected.

> Even I know some engineers that I've worked with appreciate me because… they may have a hard time communicating with a business manager. . . There's this importance in what they're doing and I'm able to communicate that better for them. And vice versa, able to communicate with the managers trying to [talk to] the engineer; I function pretty well as a go-between even though it's not something I enjoy doing all the time. Just because I play in both fields and I can sort of see the big picture, and I'm not sure if I want to say the word "empathize" but maybe I do empathize with both sides in the process.

Using the lens of crystallized identity allowed the participants' experiences to clearly speak to how they developed their identities as engineers. The participants stressed feeling positively toward their work as well as being able to identify with their colleagues. Feeling positive and gaining respect were essential for them to continue pursuing opportunities in engineering. While there may have been tension between the participants and their colleagues, it is the participants' response to the tension which allows them to understand where they stand in regards to their peers' view of their work. Developing a better understanding on how participants interact with others can help engineering researchers understand the development of engineering identity.

## Discussion

Acknowledgement of how identity is a multi-faceted construct and implementation of this knowledge via participants' stories allowed the importance of emotion to blossom within their narratives. Participants spoke of themselves as still being the same core person but having to acquire a solid level of confidence to address their multiple facets to a variety of audiences—such as in Becky's case. Other participants made it clear that they had to deliberately work for respect and to carve out a space for their specialized skill set and approach—such as, for instance, Uma and Ignacio.

As with all research, the current project has certain limitations. Although having in-depth data for all thirty participants, the present study was limited for practical and manageable purposes to eight participants. Although an attempt was made to represent data from a wide swath of participants—pertaining, for instance, to participants' ages, genders, and areas of study—the sample is not perfectly or ideally representative. The present study serves as an entry point for utilizing the lens of crystallized identity in engineering work, as well as a step toward compiling the large amount of rich data accumulated from over two years of working with these thirty participants.

Using the lens of crystallized identity on how people navigate their experiences and use them to develop an identity allows engineering education researchers to be able to use this lens as a means to further understand student development. If a student's experiences determine whether or not he or she becomes aligned to engineering then it would be beneficial to develop sensitivity to students' stories about how they felt while conducting engineering and cross-disciplinary work. Not only could the lens of crystallized identity be used to help with student

retention, it could also be used to cultivate a greater appreciation of professional development as a whole. Having professional engineers who can negotiate experiences with professionals from different fields is essential to the success of any project since problems are becoming so complex that multiple disciplines must work together in order to solve them. Understanding engineers' experiences regarding how they felt (dis)respect from others would be important in determining what can lead the success of a project. The level of respect that a participant feels they received from their colleague will cause them to put up a facet of themselves to their colleagues in order to be included as part of the solution to the problem being addressed.

## Conclusion

Over the course of the upcoming months, all thirty participants of this particular research study will complete their part in the data collection phase. As researchers, we intended to look at the variety of transcripts we have collected over the 2.5 years and continue to use this lens to understand the variety of ways the participants are experiencing cross-disciplinary work. We expect that using this lens on all the participants will show more ways in which engineering students and professionals have to demonstrate how they can contribute to the success of their project to their colleagues. Seeing how they have to bolster their identity to others will be important for us to understand how using engineering in cross-disciplinary experiences is perceived. The lens of crystallized identity has an implication for all engineering education researchers to see how we can get future engineers to successful contribute their specialized knowledge to any project that they encounter.

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