Facilitating Empathic Communication Modules in Undergraduate Engineering Education

A Handbook

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1 Introduction

This handbook describes a set of four empathy modules that were developed at the University of Georgia to foster empathy communication skills in undergraduate engineering students. We would like to note at the outset that these modules have been adapted to other instructional settings to fit with different course goals, time constraints, and instructor preferences. Therefore, when reading this handbook, we encourage instructors to consider how the activities described could be adapted to meet their needs. We also note that we are in the process of writing a journal article that discusses adaptations of the original modules to different instructional settings. We have included one example of such an adaptation in **Appendix A** of this handbook.

Finally, we would like to express our commitment to sharing this work in accordance with what Froyd et al. (2017) describe as a propagation paradigm, which emphasizes systemic adoption of an educational innovation through a focus on "fit" achieved through "interacting with potential adopters throughout the development and dissemination process" (Froyd et al., 2017, p. 37). This paradigm stands in contrast to what Froyd et al. (2017) define as a "dissemination" paradigm, which privileges evidence and raising awareness of educational innovations over their usability and widespread adoption through customization. *As proponents of the propagation paradigm, we encourage instructors to reach out to us to discuss how the modules, and the concepts underpinning the modules, might be adapted to different settings.*

2 Overview of the modules

Each of the four empathic communication modules is 75-minutes long which, in the original setting, is equivalent to one class period. The modules all follow the same structure, which is illustrated in Figure 1.

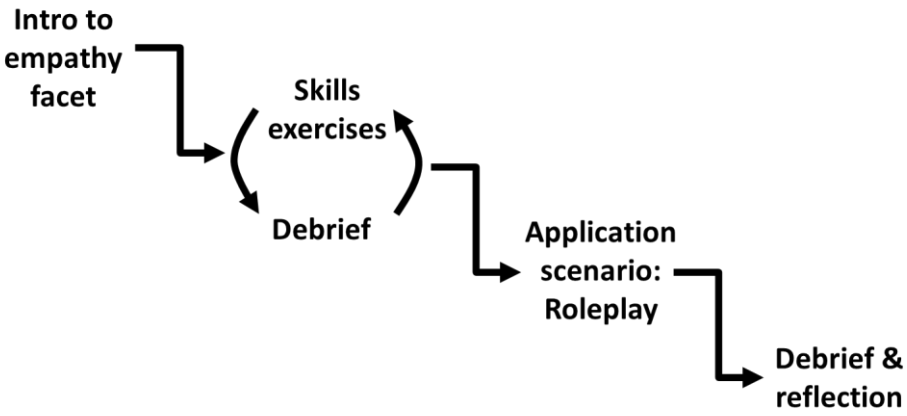

Figure 1. Structure of the 75-minute empathic communication modules

Each module begins with an introduction to the particular aspect of empathy that is the focus of the module (see Figure 2). Students are then provided with instructions that enable them to practice that aspect of empathic communication (*Skills exercises* in Figure 1). The focus of the first module, for example, is *Self and Other Awareness* (see Figure 2).

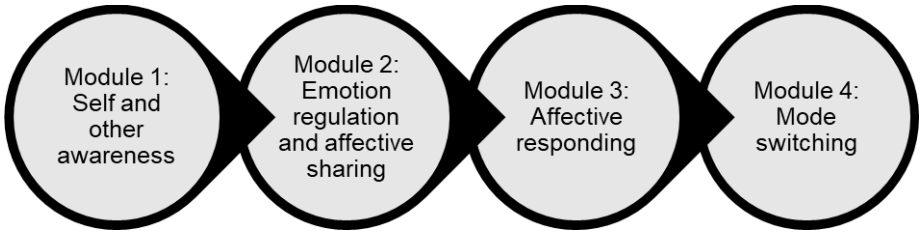

Figure 2. Topic overview of the set of four empathic communication modules

The following paragraphs provide a brief overview of some of the activities included in the first module. A detailed discussion of all four modules is provided in **Section 5**. The purpose of the following description is to illustrate how the activities illustrated in Figure 1 connect to each other to form a complete module, and to provide some anchor points for the next two sections, which discuss theoretical foundations and application scenarios, respectively.

The first module focuses on *Self and Other Awareness.* For the skills building portion of this module, students engage in a "commonality exercise," where they are tasked with talking to three people in their class and finding three things they have in common with them. This simple exercise provides students with an experience that they can reflect on with each other and with the instructor in the debrief (first *Debrief* in Figure 1).

In the debrief, the instructor encourages the students to reflect on how they used their Self in the interactions, and on how aware they were of Others, e.g., how did they judge if the person they were talking to was interested in the conversation? Or if someone was distracted and had lost interest in their conversation? Such discussions provide an opportunity for students to explore, for example, how body language impacts, or can be an indicator of, effective communication.

These skills are then put in the context of an application, or engineering, scenario, where students engage in role plays to see what using these skills in practice might look and/or feel like. In most cases, the role plays involve one to two members of the public and one engineer. The role plays are then followed by another debrief and reflection discussion. These debrief discussions oftentimes touch on topics related to engineering identity and expertise, and how engineers position themselves relative to members of the public.

3 Theoretical foundations

The empathic communication modules are theoretically informed by the conceptual model for empathy in engineering illustrated in Figure 3. For a detailed discussion of this model, we direct readers to Walther, Miller, and Sochacka (2017).

The model in Figure 3 conceptualizes empathy as a skill, a practice orientation, and a professional way of being, and is purposefully composed to illustrate the mutually dependent and supportive nature of each dimension without ascribing a conceptual hierarchy or developmental trajectory. That is, one doesn't need to become an expert in the skills dimension before progressing to the orientation dimension. In fact, considering facets in the orientation dimension may be necessary in order to effectively embody certain skills.

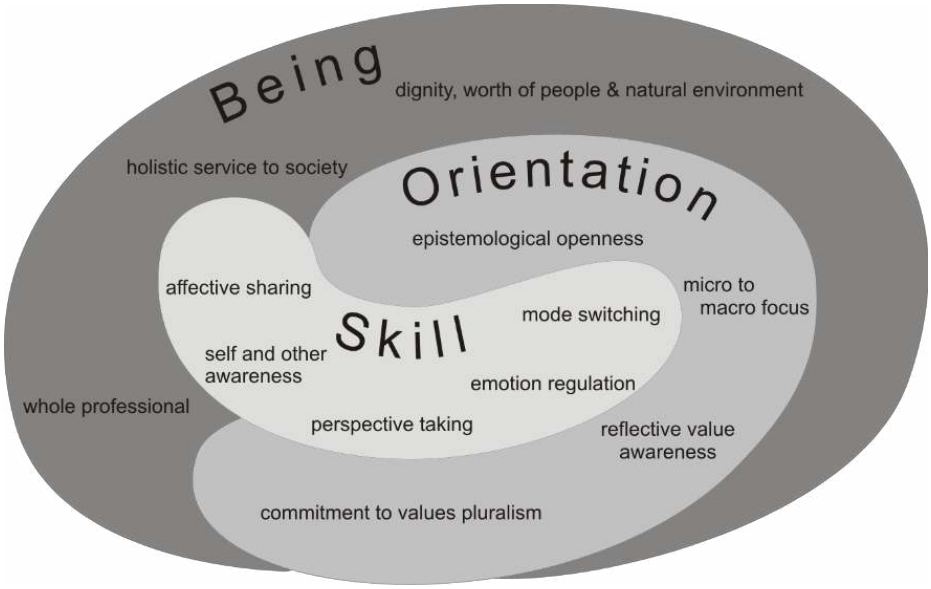

Figure 3. A conceptual model of empathy in engineering (Walther et al., 2017)

Each of the four empathic communication modules begins with a focus on one or more of the facets illustrated in the skills dimension of the conceptual model (see Figures 2 and 3). We note that perspective taking, while not the explicit focus of any of the modules, is woven throughout all four of the modules, primarily through the use of role plays in the second part of the modules. Similarly, we note that one functional aspect of perspective taking, namely affective responding, which is the focus of the third module, is not explicitly named in the model presented in Figure 3. This is not an oversight but, rather, because the five aspects that are in the skill dimension are distinct, socio-cognitive processes. As discussed in Walther et al. (2017, pp. 133-134):

> "the skill dimension comprises five distinct, socio-cognitive processes that interact with each other to form the foundation for empathic communication, relationship building, and decision-making. The orientation dimension captures a range of mental dispositions that influence how engineers or engineering students engage in practice situations. These orientations around assumptions about the nature of knowledge or the role of values influence efforts to empathically engage with others. Finally, the being dimension highlights the need to situate empathic skills, practice orientations, and their development within a contextualizing framework of broader values."

As noted previously, the debriefs on the application scenarios (i.e., role plays) oftentimes touch on topics related to engineering identity and expertise, and how engineers position themselves relative to members of the public. In the language of the model presented in Figure 3, such discussions may intersect with facets included in the orientation dimension such as epistemological openness and/or a commitment to values pluralism. More specifically, epistemological openness requires an awareness that others may construct knowledge in ways that differ to how we, i.e., engineers construct knowledge. We have observed that when students put on their "engineering hats" in the role-plays, it can be difficult for them to acknowledge and value of other ways of knowing. Therefore, while we do not always share the terminology of "orientation" and "being" with students, these dimensions oftentimes inform how we, as instructors, facilitate the debrief sessions.

4 Application/ engineering scenarios

After students practice skills related to the particular facet of empathy that is the focus of each module, they are given an opportunity to experiment with that skill in an application, or engineering, scenario. We have used several different scenarios in our facilitation of the modules at the University of Georgia, such as:

- The Flint, Michigan, lead water contamination crisis;
- The construction of the North Dakota Access Pipeline, which attracted a lot of controversy because of its proximity to Native American Indian lands; and,
- The Pacific Gas and Electric (PG&E) power blackouts, which were implemented to prevent wildfires in California.

These scenarios were selected for the following reasons:

1. Relevance to engineering. It is not a stretch to imagine engineers involved in different aspects of all three scenarios.
2. Complexity. None of the above cases have obvious right/wrong answer or outcomes, or "good and bad guys."
3. The presence of multiple perspectives. All three of these scenarios have multiple actors, such as members of the public who are differently affected by different aspects, political interests, corporate interests, environmental concerns and so on. And,
4. Contemporary relevance. Each of the above three scenarios was used at a time when there was significant news coverage of the relevant events.

The above four criteria are a good place to start when finding scenarios that are relevant to other implementation contexts.

In our earliest iterations of the empathy modules, we worked with a scenario that focused on food deserts in our local town, Athens, Georgia. We selected this scenario because of the local relevance of the problem. For this scenario, we wrote character vignettes to help students get into character for the role plays. For example, we developed characters such as a single father who didn't own a car and lived far from a supermarket and a retired teacher who worked at a local food bank. More recently, we have found that asking students to write their own character sketches can be an even more effective way of engaging students in the role plays. We have done so for each of the three above-described scenarios. Setting such a task also prompts students to deeply investigate epistemological (ways of knowing) and values frames (see the *Orientation* and *Being* dimensions in Figure 3) that may be quite different from their own. Some examples of these character vignettes are provided in Section 5.1.3.We discuss more ways in which we endeavor to integrate the empathy modules with other aspects of the class in which they are situated in **Section 7: Connecting the modules to other course objectives**.

Another example of a scenario that we are in the process of developing is presented in **Appendix B**.

5 The four empathic communication modules

This section contains detailed descriptions of the four empathic communication modules that were developed at the University of Georgia. Each subsection begins with an overview of the module, followed by instructions for the skill building activity and debrief, and the application

scenario and debrief. We then share an example of a reflection prompt we give to students for homework, followed by a brief discussion of student reactions to each module. We have also described the modules here (Walther, Miller, & Sochacka, 2016).

5.1 Module 1 (Self and Other awareness): Encountering others with genuineness – Starting conversations and establishing relationships

5.1.1 Overview

Module 1 focuses on how we approach others when starting a conversation and building relationships, two activities that are critical to an engineer interacting with stakeholders and other professionals. This module's activities are designed to promote a greater awareness of how one uses the Self in interactions with Others including, for example, the intentional use of body language to convey qualities such as interest and care. This module also encourages students to develop a greater awareness of their own emotional reactions to interactions with others, as well as the emotions and body language of their conversational partner. The first part of the module comprises a commonality exercise, which asks students to introduce themselves to three other students in the class, find out what they have in common with these people, and then reflect on the experience. This skill building exercise is followed by application to an engineering scenario, which allows students to practice the skills of self-awareness when encountering others, i.e., from the perspective of *being* an engineer or *interacting with* an engineer.

5.1.2 Instructions: Skill building

Commonality exercise: Instructions for students *(typically shown on a PowerPoint slide):*

1. Talk with three people in class who you don't know very well and uncover at least three things you share in common with each person (**10 minutes**; *we use an egg timer to make three rounds*).
2. After you have completed this activity, write reflectively in response to the following questions (**10 min** *individual written reflection)*:
    a. How did you approach people /what did you do?
    b. What signals did you pick up from your counterparts?
    c. How did you feel throughout the exercise?
3. Share some of your observations and insights with the larger group (**15 min** *debrief*).

Aspects to highlight in the debrief on the commonality exercise and example questions:

- The way we approach others has a profound effect on the conversation and the developing relationship.
- We can develop an awareness of the things that cause these effects, such as, our intentions, interest in the other person, and expectations of the interaction; use of space/proximity, body language; and emotions (yours, theirs).

The debrief for the commonality exercise typically begins by asking students a general question, such as "Tell me about what this exercise was like for you?" Sometimes, such a question is enough to get the debrief going. If the conversation hits a lull, here are some additional questions that can help to focus the debrief on the above to aspects. For more information about facilitating the debrief, see **Section 6: Facilitating the modules.**

- How did you approach the first person you spoke to? (Note that this question is specific and low stakes).

- Who started off by shaking hands?
- How close were you standing to each other? Did the distances differ between the three conversations?
- Tell me about the eye contact you had or didn't have with your partners?
- Who felt awkward? Why do you think you felt that way? How do you think your partner felt? How could you tell?
- Who felt comfortable? Why do you think you felt that way? How could you tell if your partner was comfortable or not comfortable?
- Who remembers the names of the three people you spoke to? Did you set out with that intention? What impact did having that intention have on the conversation? What impact do you think having that intention *might* have had?
- Who was present during the conversations? Who was thinking about something else? Who could tell if their partner was present or not? What impact do you think that had on the interactions?

5.1.3 Instructions: Application scenario

Box 1 illustrates how the application scenario is introduced to students on a PowerPoint slide. This text is drawn from a year where the application scenario was the Flint, Michigan, water crisis.

The Flint Water crisis

You are a graduate engineer who has just been hired to work at the City of Flint Water Treatment Plant (WTP).[1]

As part of the Flint WTP's public reconciliation program, you are tasked with building relationships with members of the local community. You will begin this at the *Flint Free City Art Festival* – an annual event where local community members display and sell their art, listen to live music, watch theater performances, and so on.[2]

Form a group of three (not with your teammates!). In the following role play, each person will have an opportunity to play a member of the local community and the engineer described above. For now, select one of the three provided stakeholder vignettes. Study and internalize it.

[1]https://www.cityofflint.com/2018/03/12/city-officials-address-questions-regarding-water-shut-offs/

[2]http://flintpublicartproject.com/free-city-festival/

Box 1. Instructions PowerPoint slide for the application scenario for Module 1.

The following paragraphs provide examples of the character vignettes that are given to students to prepare for the role plays. We note that these character vignettes were written by students - we selected two of the best ones to use in the modules for that year.

Stakeholder 1: Thomas Merryweather (directly affected citizen)

> My name is Thomas Merryweather, and I have two boys ages eight and twelve. I've lived in Flint my whole life. So when the water changed, I noticed. It was brown and smelled wrong, but initially we didn't have any choice but to use it. Sometimes, the water would burn your eyes, and my children and I would break out in rashes. It would burn your skin after showers. We would get medicine from our doctor and nothing would help. My plants died, and my dog got sick. I knew some people whose

teeth were rotting out. I even noticed the water was changing people's skin color. The worst part was watching my children start to struggle in school when they used to do well.

The city kept telling us the water was safe to use and drink, but after a while, we all knew it was a lie. So we had to find our own source of clean water. That was when we started using bottled water, and we have been ever since. We cook with it and brush our teeth with it. We couldn't afford to bathe with bottled water. We took showers as quickly and as infrequently as we could. Then the state started to give us bottled water for free and we were able to stop using the water from our pipes completely. But now that the state has stopped providing water for us, we have had to go back to showering in water that is contaminated by lead. Even if, in the future, the city told us the water was safe, I'm not sure if I'll ever be able to use tap water again. Any trust I had in the city is gone, and I know I'm not the only one who feels that way.

I've wanted to move my family away from Flint ever since I noticed a change in my children, but you can't sell a house with contaminated pipes. I've known people who just took the loss and declared bankruptcy to move away. Unfortunately, I can't afford to do that. I also have family here, and it would feel wrong to abandon them. My mother lives in the local nursing home, and was frail before all of this started. Now with the threat of lead being in her water, I can't bring myself to leave. It's not like I could afford to leave anyway now that we will have to buy our own water again. I feel trapped, and I'm terrified of having to continue to raise my children in a place that is causing their mental health to deteriorate. The idea that my children will suffer and that my mother may die because of the city's cost cutting measure is enraging. If they had thought about what it would cost US, their citizens, then maybe they would never have considered it in the first place.

Stakeholder 2: Karen Warner (Environmental Protection Agency member)

I am a staff member of the Environmental Protection Agency Region 5. Our department

received reports from residents such as LeeAnn Walters as early as April 2015, long before the Flint mayor put the city in an official state of emergency. Regulation Manager Del Toral personally went to Ms. Walters' home and verified that there appeared to be contamination in her water taps. I worked with Del Toral sending samples to and getting results from the researchers at Virginia Tech to measure lead levels as well as phosphates. While I was aware that Flint's economy and infrastructure were not in the best shape, I was surprised to find out when assisting Del Toral with his reports that "Flint [had] not been operating corrosion control treatment" and the regional water director was telling residents not to worry because "the high lead from Ms. Walters residence is from the internal plumbing". (Del Toral, "Flint Sampling Update") This is confusing because Walters' house had galvanized pipes, so the lead had to come from the city- owned portion of the piping.

The evidence of lead contamination alarmed me because all our tests seemed to verify the claims made by residents, but the decision-making body of Region 5 did not treat the situation with the same urgency as we did. Del Toral wrote a memo stating that there was clear evidence of contamination as well as "Coliform Maximum Contaminant Level (MCL) violations and Total Trihalomethane (TTHM) MCL violations", but he was chastised by our administrator, Susan Hedman. (Del Toral, Memo to Thomas Poy) Hedman told us that the memo needed to be "revised and fully vetted by EPA management" before she could release the memo to the public. (Hedman) I was upset by her suppressing the memo because, while I understood the need to follow protocol and to ensure the accuracy of our findings before publicizing our findings, the review should not have taken five months and delayed our intervention into a city with a clear history of violating our regulations. I am frustrated by and disappointed in the people in charge of my region's department because they

allowed the situation to get worse by keeping the public in the dark about the contamination in their tap water.

I'm also embarrassed from the court hearing with the EPA and the Michigan Department of Environmental Quality (MDEQ) because our guidelines for testing allowed for so many loopholes that enabled the city to delay our intervention. While my group's reports clearly showed contamination, reports made by other EPA members or MDEQ members could have been manipulated to maintain the impression that the water was safe "by not forwarding the June memo until November". (Milman and Felton) I feel insulted being grouped with the ineffective and inattentive regulators and officials when the people I directly work for tried to address the issue and got chastised for it. At the same time, I could not risk losing my job by coming forward.

Our region has been investigating the infrastructure and providing relief since the city was placed in a state of emergency, but I am disappointed in my administration and the city officials who refused to admit what my manager assessed in months.

In some years, we have also prepared a vignette for the graduate engineer (see below; note that this character sketch was for the food desert scenario). Doing so has the advantage of giving a little more structure to the students' role plays. It can also be interesting, however, to see how students role-play the "engineer" without guidance, i.e., to see what assumptions students have about what it means to be an engineer.

Graduate Engineer

You are a recent graduate from UGA's mechanical engineering program working on the engineering team of the Athens Clarke County unified government (ACC). The ACC recognizes that engineering programs at UGA stress broad thinking and communication skills in addition to the technical expertise that is expected of every engineering graduate. The position on the engineering team has a lot going on and you work across many domains such as transportation, energy, and sanitation with, as your boss would put it, "a view towards a holistic planning approach".

You have been asked by her to oversee and facilitate this new project because she believes it requires your skill set and would benefit from a broad perspective. Considering the project and its strong focus on the community, you feel on the one hand honored to have been picked for this example of the 21st century engineering work you heard about back at UGA. You are also excited about being able to make a positive difference in a town that has become dear to your heart.

You feel confident that you'll be able to handle the technical or design work that might emerge from this project later on and in some ways you also feel prepared for this early phase of "holistic problem definition" as your boss' favorite phrase would go. You took a couple of classes that introduced you to socio-technical engineering work and you think of yourself as someone who gets along with others, a trait that has served you well in the classes that had a strong focus on communication and team work skills.

On the other hand, if you're really honest, you feel a little scared…

Having worked with the ACC for only 6 months you feel you still haven't really found your "engineering feet" yet. You are still sometimes unsure what you are supposed to be like as a "professional engineer". You tend to get your work done and people are happy with it, but it does feel different from what you thought being an engineer was like…

Take this project for example. Sure, at some level you understand what stakeholders and stakeholder consultations are, but the folks you and your boss invited to this meeting are not quite how you

imagined it would be. They have such different perspectives and life experiences. How do you approach and talk to them? What if you do something 'wrong'? Offend someone? How will they respond to you running this meeting?

And again it comes back to your search for your "engineering feet". What am I supposed to be like as the engineer in the room? What do I want to be like?"

Further details on how to introduce role plays to students provided in **Section 6: Facilitating the modules**.

Instructions for students (provided after the instructor has discussed the affordances and limitations of role plays and after the students have had a chance to internalize their character vignettes):

1. Pick who is going to be the engineer for the first round.
2. The engineer approaches the two community members at the festival, paying specific attention to the points discussed in the skill building exercise. Each meeting lasts 3 minutes.
3. Rotate the roles so that everybody has had the chance to play the engineer **(10 min).**
4. Share some of your observations and insights with the larger group (**15 min** *debrief*).

Aspects to highlight in the debrief on the application scenario and example questions:

The aspects to highlight in this debrief are the same as for the skills building portion, but are discussed in the context of how engineers relate to members of the public.

- The way we approach others has a profound effect on the conversation and the developing relationship.
- We can develop an awareness of the things that cause these effects, such as, our intentions, interest in the other person, and expectations of the interaction; use of space/proximity, body language; and emotions (yours, theirs).

Some example questions to facilitate the debrief are:

- What did it feel like to be the engineer in this setting?
- What did it feel like to be the stakeholder in this setting?
- When you played the role of the engineer, what was your goal? Do you think you achieve that goal?
- Who found it difficult to play the role of the engineer? What did you find difficult about it?
- I saw some quite lively conversations. When you play the role of the engineer, how did you respond to the members of the public when they were clearly in a state of distress?
- When you played the role of the stakeholder, what it feel like to be responded to in this way?

5.1.4 Reflection prompt for Module 1

Below we show the prompt that we give to students to guide their reflective sense-making on the activities in Module 1.

Today you participated in exercises about **encountering others**.

1. What were your experiences? What was challenging or enjoyable?

2. In what ways do you think these kinds of exercises are important/ relevant for your personal development and for your future as a professional engineer?
3. Based on your prior knowledge and experiences and what you did in class today, what is your understanding of empathy and the role of empathic communication in engineering practice?

You are not limited to just answering these questions in your reflection. Please include any other thoughts and feelings you think are important.

Submit your reflection (about two pages) as a PDF file on eLC.

We assign student reflections 1 point (1%), which makes up part of their participation grade for the class. We assign 0 or 0.5% in only very rare cases when students do follow the instructions, i.e., they submit their reflection late, do not answer the questions, or submit a reflection that has significant spelling and/or grammatical errors.

In 2019, we experimented with in-class reflection/ knowledge questions. An example of this handout is provided in **Appendix C**.

5.1.5 Student Reactions

During Module 1, there is typically some variation in the degree to which students are comfortable and engaged with the activity (for more details on student responses to the modules, see (Walther, Brewer, Sochacka, & Miller, 2020; Youngblood, Sochacka, Walther, & Miller, 2019)). The commonality exercise at the beginning of this module is usually quite well received. Some students appreciate the opportunity that this activity provides to speak to classmates who they may not have met yet. Other students, however, find it difficult to talk to people they do not know in both the context of the commonality exercise and the role play. These modules are quite different from what is typically experienced in an engineering classroom, so some students report feeling awkward or uncomfortable during the activities. Module 1 purposefully encourages a hyperawareness of body language, which also makes some students uncomfortable. Some students describe that finding common interests with their peers during the first activity reduces this level of discomfort and can increase the energy of the conversation. The role play is generally more uncomfortable for students, at first, as many students have never participated in a role play before, but they tend to grow more engaged throughout the experience as they learn and enact their roles while trying to embody another perspective. Students playing the engineer typical struggle with the focus on building relationships rather than solving the problem, which can be an interesting element to bring out in class discussions.

5.2 Module 2 (Emotion regulation and affective sharing): Self (and Other) Awareness and Affective Sharing – Engaging Others with Genuineness and Openness

5.2.1 Overview

Module 2 is designed to allow students to continue to increase their self-awareness in social settings in addition to encouraging an awareness of others (i.e., conversational partners in this context.) The module also introduces affective sharing and gives students the opportunity to practice this skill. Affective is defined as "relating to, arising from, or influencing feelings or emotions; expressing emotion." Practicing affective sharing provides an opportunity for students to become more aware of the emotional state of others as well as how they respond to that state within themselves. Module 2 somewhat artificially distinguishes between affective sharing and affective responding, the latter of which is addressed in Module 3. Affective sharing in Module 2

is limited to using body language to share another person's emotions, without explicit guidance given on how to affectively respond, by speaking, to another person's perspective.

The module begins with several body language and proximity exercises to encourage students to become even more self-aware of their use of Self in conversational settings (i.e., by exploring limits of personal space and distance, eye contact, and body language), and how we use these factors in listening to communicate our own experience and intention. Other-awareness involves using these factors as a clue as to their partner's emotional state and comfort level. The skill-building portion is followed by a role play application in which the student playing the role of the engineer conducts one-on-one stakeholder interviews. The engineer is encouraged to use the skills they have just practiced to gain a rich sense of stakeholder's emotions, experiences, and perspectives, and to express their affective sharing of the stakeholder's experience by acknowledging key feelings and statements.

5.2.2 Instructions: Skill building

Body language and proximity exercises

It can be helpful for instructors to purposefully link the modules to each other. For example, by saying something like:

> "Last week we started to explore how body language and proximity to others can impact how we communicate with others. Today, we are going to explore some limits of body language and proximity and then use our insights to practice affective sharing."

1. Establish and maintain eye contact (please note that this is not a staring competition!). Slowly move toward your partner who remains in position, until it becomes uncomfortable for you. Then stop and observe the approximate distance between you. Describe your thoughts and feelings as you moved closer and closer to your partner. Ask your partner to express what s/he experienced as you approached. Make note of your experience as well as your partner's. **(5 min)**
2. Position yourself face to face with your partner at a distance of approximately four feet. Look directly into his/her eyes until you become uncomfortable. When that occurs, simply avert your eyes. Now, move to three feet, then to two feet, each time looking directly into your partner's eyes until you experience discomfort. Then turn away. Share your reaction with each other. Now, experiment with different kinds of and degrees of eye contact within a two-to-four-foot range. For example, try looking at your partner's cheekbone or mouth instead of directly into her or his eyes. Share your reactions. Experiment further by looking into your partner's eyes for several seconds and then slightly change your focus so that you look at a cheekbone for a few seconds, and then return your gaze to the eyes. Follow that by looking at your partner's mouth for a few seconds, and then return to the eyes. Share your responses to these versions of eye contact. Make note of the form of eye contact you and your partner seem to prefer as well as those that you dislike. **(5 min)**
3. Place two chairs squarely facing one another (front to front) approximately two feet apart. Sit down. Share your thoughts and feelings as you sit face to face and knee to knee. Is it comfortable for both of you, for only one, for neither? If it is uncomfortable, alter the distance and/or angle of the chairs until it becomes comfortable. Ask your partner to do the same. Finally, compromising if necessary, move the chairs until they are placed at a

mutually comfortable distance. Make note of your partner's remarks as well as your own experiences in this exercise. **(5 min)**

Affective sharing exercise

4. Based on the results of your experimentation, place the chairs in the position and at the angle that is reasonably comfortable for both you and your partner. Some compromise may be necessary.
    a. Identify a story-teller and a listener.
    b. *For the story-tellers:* Think of a challenging experience that you are willing to share with your partner, e.g., an exam that didn't go as well as you thought it would or a challenge with a colleague at work. Tell you partner that story.
    c. *For the listeners:* Let the story-tellers tell their stories without interruption. Focus on HOW your partner is telling the (not so much on the story itself). What does your partner's voice, tone, body, and face convey to you about how they might have been FEELING during the telling. Try to show through your body language that you are interested in your partner's thoughts, ideas, and feelings. **(10 min)**

> "'Most people do not **listen** with the intent to **understand**; they **listen** with the intent to **reply**."
>
> -Stephen Covey, *7 Habits of Highly Effective People*

5. Share some of your observations and insights with the larger group (**15 min** *debrief*).

Aspects to highlight in the debrief on the body language and proximity and affective sharing exercises and example questions:

- The use of self has a profound impact on how one experiences a conversation:
    - Personal space and distance
    - Eye contact
    - Body language
- Noticing and regulating our own discomfort
- We can "feel with" others by observing these factors.
- We communicate our own experience and intention in listening through these expressions.
- As listeners, we influence the experience of someone sharing an experience with us.

Some questions that can help to facilitate the debrief include:

- "Okay, so there were a lot of exercises in the last 20 or so minutes. Let's start by talking about the one where you stood 8 feet from you partner and walked closer until you felt uncomfortable. How close did you walk until you stopped? Was the distance the same for your partner?
- Did everyone feel that X feet or so was about right? Why? Why not? (sometimes factors such as cultural background or even height differences can impact these outcomes).
- What about the eye contact exercise? What did you notice? We commonly think that eye contact is a good thing, what did you observe in this exercise?
- What did it feel like to have someone look at your eyebrow, or your cheek?

- When I was walking around, I noticed some quite different chair orientations, tell me a little about how you and your partner ended up as you did. When might thinking about chair placement be something to think about in your future careers? Do the same insights apply to how we stand near people?
- I realize that the story-telling may have been a bit awkward with only one person speaking, but putting that aside for a moment, what was it like to focus in on the story-teller and not speak in response? What emotions did you pick up in your partner? What emotions did you experience? What did you do with the emotions that arose in you?
- What was it like to have your partner listen to your story without using their voice? What indicated to you that they were listening?

5.2.3 Instructions: Application scenario

Box 2 illustrates how the application scenario for Module 2 is introduced to students on a PowerPoint slide. This text is drawn from a year where the application scenario was the Flint, Michigan, water crisis.

The Flint Water crisis

You are a graduate engineer who has been hired to work at the City of Flint's Water Treatment Plant. Part of your responsibilities includes working on the Flint WTP's public reconciliation program.

In this early stage of the program, you are beginning to gather information about the perspectives and experiences of various stakeholders who experienced or were in some way connected to the water crisis.

To inform your idea generation phase, you are meeting with two stakeholders. The meetings will take place in your office in the town hall building and you are wondering how you can create an atmosphere that would encourage the stakeholders to share their perspectives.

Form a group of three. In the following role play, each person will have an opportunity to play a member of the local community and the engineer described above. For now, select one of the three provided stakeholder vignettes. Study and internalize it.

Box 2. Instructions PowerPoint slide for the application scenario for Module 2.

Instructions for students (provided after the instructor has reminded students of the affordances and limitations of role plays and after the students have had a chance to reacquaint themselves with their character vignettes):

1. Pick who is going to be the engineer, one of the stakeholders, and the observer for the first round.
2. Drawing on the strategies and insights from the skill-building activities, the engineer invites the stakeholder to his/her office and initiates the conversation.
3. As the engineer, ask questions to get a rich sense of the personal and emotional ways in which the interviewee has experienced/is experiencing the Flint water crisis and gather information about the factual context of their experience.
4. To facilitate this difficult conversation, try to express your affective sharing of their experience by acknowledging key feelings and statements.
5. Rotate the roles so that everybody has had the chance to play the engineer **(10 min).**
6. Share some of your observations and insights with the larger group (**15 min** *debrief*).

Aspects to highlight in the debrief on the application scenario and example questions:

As with Module 1, the aspects to highlight in this debrief are the same as for the skills building portion, but are discussed in the context of how engineers relate to members of the public.

- The use of self has a profound impact on how one experiences a conversation:
    - Personal space and distance
    - Eye contact
    - Body language
- Noticing and regulating our own discomfort
- We can "feel with" others by observing these factors.
- We communicate our own experience and intention in listening through these expressions.
- As listeners, we influence the experience of someone sharing an experience with us.

Some example questions to facilitate the debrief are:

- What did it feel like to be the engineer in this role play?
- What emotions did you observe in the stakeholders you were speaking to? How did you respond to them? How did they make you feel?
- When you played the engineer, what was different about this role play compared to how you engaged with the stakeholders in Module 1?
- What did it feel like to be the stakeholder in this role play? What emotions did you experience when you were speaking to the engineer? If they changed during the interaction, how did they change and why do you think they changed?
- What body language did the engineer have when they were speaking to you? What did that body language convey to you?
- When you played one of the stakeholders, what was different about this role play compared to how you the engineer responded to you in Module 1?

5.2.4 Reflection prompt for Module 2

Below we show the prompt that we give to students to guide their reflective sense-making on the activities in Module 1.

> Today you participated in exercises about **self and other awareness** and **affective sharing.**
>
> 1. Describe your feelings during the body proximity exercises. Why do you think you felt this way?
> 2. What was your experience as the engineer or stakeholder during the interview exercises?
> 3. What did you learn from this module? What does it mean for you becoming a professional engineer?
>
> You are not limited to just answering these questions in your reflection. Please include any other thoughts and feelings you think are important.
>
> Submit your reflection (about two pages) as a PDF file on ELC.

See Section 5.1.4 for how these student reflections are assessed.

5.2.5 Student Reactions

During Module 2's skill building exercises, many students report feeling self-conscious about their body language due to the level of hyper self-awareness encouraged by the activities. Students also note how much information body language can convey; some comment on how there is a lot of information in the eye area, while others describe how they find themselves looking at different parts of the body to gain different perspectives. A common example of a message conveyed through body language that students pointed out in discussion is that avoiding eye contact and looking down is associated with submissiveness and causes them to perceive others as less powerful.

The activity in which one person tells a story while the other student listens without using their voice creates interesting discussion. Some students said this forced silence allowed them to notice more of what the other person was saying beyond the words they were saying through observing their body language. Listeners noted it was easier to focus when they did not have to think of a response, while some of the speakers said they felt like they had to talk more since no one was responding to them.

Overall, students seemed more comfortable with the role play in this module now that they have been introduced to the idea in Module 1. Students who play stakeholders say the engineer's use of affective sharing made them feel emotionally validated and that their concerns were heard. In one discussion, students who played the engineer said they recognized that they were not going to "win" by proposing solutions. Instead, they acknowledged that this was an exercise in making someone feel validated in their concerns.

5.3 Module 3: Affective responding – Techniques to manage difficult conversations

5.3.1 Overview

Building on the skills of self and other awareness, affective sharing, and emotion regulation as developed in earlier modules, the exercises presented in Module 3 further develop students' practical skills around affective responding. By this point in the module sequence, students will likely have experienced how overwhelming and emotionally challenging it can be to interact with someone who is in pain and/ or different from themselves. This module's exercises are designed to develop a set of tangible skills that can be applied to better navigate these situations.

Module 3 asks students to explore aspects of affective responding such as **attending** and **reflecting**. "Attending" to the person speaking involves giving undivided attention communicated with body language and via active listening. The principal idea behind this concept is that the listener in a conversation should focus on the other, rather than on themselves. "Attending" means paying attention to what is seen and heard rather than prior knowledge ("what you think you know") about a situation or person. The second skill of affective listening is "reflecting" which is, in turn, divided into reflecting through **paraphrasing** what the other person is saying (e.g., "What I hear you saying is…" or "It sounds like…") and **reflecting feeling** (e.g., "It seems like you're feeling…", or "That seems very hard, difficult, painful, scary, anxiety-producing, uncomfortable, challenging, etc., …", or "Am I understanding you correctly – when you said _____, it seemed like you were feeling ____"). Paraphrasing is a way of telling the person who is speaking that they have been heard and that the other understands what they have said about their thoughts and experiences. Reflecting feeling is a way of telling the person

who is speaking that you understand how they feel, or that you have a desire to understand how they feel and the ability to communicate that desire.

Students first practice these methods of affective responding within a controlled exercise context, and then apply these skills in a more complex roleplay scenario around the case study.

5.3.2 Instructions: Skill building

There are many different ways to introduce each of the four empathic communication modules. In fact, we encourage instructors to draw on their own experiences to connect the modules to engineering practice. Box 2 describes how Sochacka introduces the importance of the skills learned in this module.

> By the time I facilitate the third module, students have a good sense of who I am and my experiences working as an engineer. To introduce this module, I tell a story about working as an environmental consultant in Sweden. In this story, I recount how I found myself in a conflict situation with the health and safety officer at the company where I worked. At the time I was working with an American colleague on a site that was being acquired by an American company. The American company was insisting on safety practices that were considerably more stringent that what was common at the time in Sweden. As a result, my American colleague and I were using a lot of disposable supplies, such as nitrile gloves. In this story, I tell my students how I approached the health and safety officer to ask him to order us more nitrile gloves. Instead of ordering the gloves, my colleague told me that I was wasting resources and that he had never seen so many gloves and other disposables used on a site before. In response to this, I described the PCBs on the site and asked him again order us more gloves. What I didn't realize at the time was that the health and safety officer's complaint was about more than just the gloves. There were a growing sense of resentment in the Swedish office that Americans were coming in and changing "the way things are done around here." By not being sensitive to this, I had unknowingly taken sides. A more productive response may have been to paraphrase what my colleague had said to be sure that I understood where he was coming from. I could have also tried to name the emotion underlying it. Doing so may have built a bridge between us, rather than exacerbated the sense of there being two groups in the office who were at odds with each other.
>
> I use this simple story to illustrate how the skills we are learning in the modules are just as important for our colleagues as they are for engaging with clients, contractors, or members of the public.

<u>Exercises to practice attending and reflecting (i.e., paraphrasing and reflecting feeling)</u>

The primary exercise in the skill building portion of this module entails a paired exercise where each student takes turns telling the other student about a challenging experience they have had recently while the other student practices the skills of attending, paraphrasing, and reflecting feeling. Because paraphrasing and reflecting feeling can be unnatural or awkward for some students, it can be beneficial to first take some time to give students an opportunity to get their heads around a few useful phrases. We have done this in a number of different ways. One way is for the instructor to tell a story, and to pause at different times in the story to give students the opportunity to practice paraphrasing or reflecting feeling. Another option, which can also work together with the instructor-led story, is to give student a few minutes to study the handout in **Appendix D**, and to ask students to discuss the phrases they feel most comfortable with.

Finally, we have also experimented with writing out scenarios that students can read to each other, giving students an opportunity, again, to practice different ways of paraphrasing and reflecting feeling (see **Appendix E** for example scenarios).

Following these practice activities, pairs of students are provided with the following instructions:

1. Recall a challenging situation you encountered this semester that you are willing to share with a partner. This can relate to this course, other courses, or experiences outside school.
2. In your group of two, take turns sharing the details of your experience with your partner **(10 min).**
3. [*The directions in this point are optional, they can be said by the instructor or put up on a slide.*] Focus on the following aspects to facilitate a productive reflective process:
    a. What was the situation? What led up to it? What did you do/ say? What did other people do/ say? What happened afterwards?
    b. How did you experience the situation? How did you feel in the beginning, throughout and after the situation?
    c. Stay focused on your own experience! Avoid: generalizations or blaming others.
4. As a listener, your task is to practice affective responding. Without interrupting the flow of your partner's narrative (i.e., limit your input to brief comments, gestures, facial expressions), show that you heard, understand and appreciate your partner's experience and its emotional implications through:
    a. **Paraphrasing** to ensure that you have understood what your partner says.
    b. **Reflecting feeling** acknowledge the emotional content of the story.
5. Focus on your role as listener: Don't share similar experiences of your own! Don't try to offer up solutions! Don't try to resolve the other person's issue by making general statements about the nature of the challenges experienced or by locating blame with any of the individuals mentioned in the account.

<u>Aspects to highlight in the debrief on the attending and reflecting exercises and example questions:</u>

- Affecting responding is different from a normal, 2-way conversation. Affective responding involves a focus on the other person to gain a deep understanding of their perspective (experiences, emotions etc.).
- Affective responding can feel forced, at first; this is normal.
- Being responded to in this way can similarly feel awkward.
- *Effective* affective responding is difficult.

Some questions that can help to facilitate the debrief include:

- First in pairs:
    - *Story-tellers:* What was your reaction to the comments, facial / body expressions your partner offered while you shared your experience? What worked for you? What didn't?
    - *Listeners:* What was your experience of trying to respond affectively? What did you try to do? How successful do you feel your efforts were?
- Group Debrief:
    - How did you experience your partner's effort to respond affectively?
        - What was it like to be "attended to?"
        - What was it like when your partner paraphrased parts of your story? What did you say when they understood you correctly? When they didn't?
        - What was it like to have your emotions named?

        - How was this conversation the same or different to one you might have with a friend of yours?
    - What were the challenges for the Listeners? (Followed by specific questions around: paraphrasing without using the exact same words, appropriately identifying and naming/framing emotions, withholding own judgment, refraining from sharing own experiences).

5.3.3 Instructions: Application scenario

The application scenario for Module 3 is introduced to students in much the same way as the application scenario for Module 2 (see Box 3). The difference is that now students have learned the skills of affective responding.

The Flint Water crisis

You are a graduate engineer who has been hired to work at the City of Flint's Water Treatment Plant. Part of your responsibilities includes working on the Flint WTP's public reconciliation program.

In this early stage of the program, you are beginning to gather information about the perspectives and experiences of various stakeholders who experienced or were in some way connected to the water crisis.

To inform your idea generation phase, you are meeting with two stakeholders. The meetings will take place in your office and you are wondering how you can create an atmosphere that would encourage the stakeholders to share their perspectives. **To achieve this, today you try to use affective responding techniques.**

Form a group of three. In the following role play, each person will have an opportunity to play a member of the local community and the engineer described above. For now, select one of the three provided stakeholder vignettes. Study and internalize it.

Box 3. Instructions PowerPoint slide for the application scenario for Module 3.

Instructions for students (provided after the instructor has reminded students of the affordances and limitations of role plays and after the students have had a chance to reacquaint themselves with their character vignettes):

1. Pick who is going to be the engineer and who are the stakeholders. There is no observer in this exercise.
2. Drawing on the strategies and insights from the skill-building activities, the engineer invites the two stakeholder to his/her office and initiates the conversation.
3. As the engineer, ask questions to get a rich sense of the personal and emotional ways in which the interviewees have experienced/are experiencing the Flint water crisis and gather information about the factual context of their experience.
4. To facilitate this difficult conversation, using affective responding techniques (attending, paraphrasing and reflecting feeling) to connect with the stakeholders. Note that, in contrast to Module 2, in this exercise your task is to build relationships with two stakeholders.
5. Rotate the roles so that everybody has had the chance to play the engineer **(10 min).**
6. Share some of your observations and insights with the larger group (**15 min** *debrief*).

Aspects to highlight in the debrief on the application scenario and example questions:

As with Modules 1 and 2, the aspects to highlight in this debrief are the same as for the skills building portion, but are discussed in the context of how engineers relate to members of the public.

- Affecting responding is different from a normal, 2-way conversation. Affective responding involves a focus on the other person to gain a deep understanding of their perspective (experiences, emotions etc.).
- Affective responding can feel forced, at first; this is normal.
- Being responded to in this way can similarly feel awkward.
- *Effective* affective responding is difficult.
- One additional point to emphasize is that affective responding can be even more difficult in a 2:1 conversation.

Some example questions to facilitate the debrief are:

- Think back to earlier role plays. What was different about this role play when you were the engineer? A stakeholder?
- What did the engineer do? What was the result of this/these actions?
- What was hard? What was easy?
- How did it feel to be an engineering and to respond to the stakeholders in this way?
- How did it feel to be one of the stakeholders and to be responded to in this way?

5.3.4 Reflection prompt for Module 3

Below we show the prompt that we give to students to guide their reflective sense-making on the activities in Module 1.

> Think back through today's module on **affective responding**:
>
> How did these activities challenge and/or align with the ways that you think about yourself becoming an engineer?
>
> Which parts of the exercises did you find particularly challenging/uncomfortable/useful/[insert your other reactions here]….?
>
> Submit your reflection (about two pages) as a PDF file on eLC.

See Section 5.1.4 for how these student reflections are assessed.

5.3.5 Student Reactions

Students again typically find it difficult to respond only in an affective way without making connections to their own experiences or sharing similar stories as is typically done in casual conversation (but is likely not appropriate in a conflict or tense scenario). Some students find it especially difficult to put feelings and emotions into words, both for themselves and for other people. Many students rely on asking questions as a mechanism to show engagement with the conversation as well as to paraphrase and clarify details of the story. Students are generally very engaged with telling their own stories; student often express that the techniques of affective responding really make them feel like their partners are truly listening. Students are beginning to feel comfortable with role play at this point. The role play is purposefully designed as a setting in which affective responding is a useful form of communication to facilitate conversation with the stakeholders, and many students note its effectiveness, especially compared to their experiences in earlier role plays with the same stakeholders.

5.4 Module 4: Mode switching – Integrating analytic and empathetic communication

5.4.1 Overview

Module 4 seeks to synthesize the concepts discussed in the previous modules through introducing the concept of mode switching. This module invites students to apply both analytical and empathic communication by practicing switching between these two modes. Students build on prior skills and learn to distinguish between and integrate empathic and analytic facets of engineering communication.

Mode switching is defined as the ability to recognize and consciously apply empathic and analytic cognitive mechanisms. The empathic mode involves affective listening and responding in which the focus is on the speaker. The analytic mode, a more natural mode for many engineering students, focuses more on gathering information required to define and solve the problem. This mode also encompasses proposing solutions, giving advice, and evaluating solutions. Successful engineers who wish to have good relationships with stakeholders and the communities they serve need to balance these two ways of communicating and learn how to effectively switch between them.

5.4.2 Instructions: Skill building

The skill building activity in this module is similar to those in the second and third module – students take turns at telling a story while their partner practices the skills of empathic communication. In the skill building activity for this module, however, students are given the opportunity to experience (both as the story teller and the responder) the difference between empathic and analytic forms of communication.

As with the other modules, there are many ways to introduce this activity and the significance of mode switching. Some of our go-to sources are the three examples provided in Box 4. The first of these examples includes a quote from the design firm, IDEO. This firm has designed all manner of products from shopping carts to fighter planes. One of IDEO's strengths is learning about the user experience and they use empathy as a way to do this.

The second quote comes from the neurosciences, which has found that empathic and analytic thinking mutually suppress each other. One potential implication of this work is the need to balance out the types of thinking we engage in in engineering education. Finally, the third example reports on a study which found that engineering students are less concerned for public welfare when they graduate compared to when they begin their studies. This study has similar implications to the Jack study, that is, the need to balance the focus in engineering programs on material and physical objects.

Another approach is to find a successful engineer who exemplifies mode switching. An example we like is Lisa P. Jackson who was the first woman of African American descent to serve as the head of the US Environmental Protection Agency. When Walther and Sochacka saw Jackson give a keynote at the American Society for Engineering Education, during question time a member of the audience asked Jackson what made her so successful. Jackson replied that when she graduated as a chemical engineer and started to work on contaminated sites, she got ahead because she "was able to do the math and science in the morning" when she was investigating the sites and then "talk to people affected by the contamination in the afternoon."

Empathy in Action: Studies and Applications of Mode Switching

International design firm IDEO says about mode switching in professional applications: "A design environment that's built around trust will promote empathy, but designers also need to build self-awareness about the mode they are operating in, and to develop a mental habit of switching modes" (Battarbee et al., 2003).

A neurological study conducted by Jack et al. (2013) found that there is a reciprocal inhibitory relationship between "tasks requiring social cognition, i.e., reasoning about the mental states of other persons [what we understand as empathic communication], and tasks requiring physical cognition, i.e., reasoning about the causal/mechanical properties of inanimate objects [what we associate with analytical communication]." (p. 385)

A longitudinal study of 236 engineering students at four U.S. colleges found that students' "public welfare commitments and public welfare concerns decline[d] significantly over the course of their engineering education" (Cech, 2014).

Box 4. Some ways to introduce the concept of mode-switching to students.

We discuss the following descriptions of empathic and analytic communication with students before starting the mode switching exercises. We have also had success with printing out these points for students to have them to refer to during the activities. It may be necessary at this point to review the skills of attending to the listener, paraphrasing, and reflecting feeling.

Empathic mode

- Affective listening, responding (i.e., attending to the listener, paraphrasing, reflecting feeling).
- Focus is on the speaker
- Goal is to connect with the other person(s)

Analytic mode

- Gather information required to define, analyze, and solve problems
- Establish causation, understand relationships between variables, consider priorities
- Explore solutions and evaluate solutions
- Goal is to work toward a better state of affairs

The directions for the mode switching exercise in Module 4 are provided below (note similarity to Module 3).

Mode switching exercises

1. Recall a challenging situation you encountered this semester that you are willing to share with a partner. This can relate to this course, other courses, or experiences outside school. Pick a different story to the one you told in Module 3.
2. Select who will be the story-teller and who will be the listener.
3. In the first round, the listener responds analytically (see above notes on the "Analytic mode.")
4. In the second round, the story-teller recounts the same story and the listener responds empathically.
5. Swap roles and repeat steps 3 and 4 **(total of 15 min)**.

Aspects to highlight in the debrief on mode switching exercises and example questions:

Some questions that can help to facilitate the debrief include:

- How did it feel to be responded to analytically? What did you like? What didn't you like?
- How did it feel for your partner to the respond to you empathically? What did you like? What didn't you like?

We would like to point out here that there are no simple right and wrong answers to these questions. Some students appreciate helpful suggestions put forward by their partner in the analytic mode. In our experience, however, most find the analytic responses jarring and the suggestions to be self-evident.

Similarly, some students appreciate being heard in the empathic response part of the exercise. While others feel like the empathic responding can be artificial. Comments like this are a great way to emphasize the importance of mode-switching, and that being just analytic or empathic is oftentimes not appropriate.

5.4.3 Instructions: Application scenario

Box 4 illustrates how the application scenario for Module 4 is introduced to students on a PowerPoint slide.

The Flint Water crisis: Town Hall Meeting

You are a graduate engineer who has been hired to work at the City of Flint's Water Treatment Plant. Part of your responsibilities includes working on the Flint WTP's public reconciliation program.

After a first outreach phase with individual meetings and individual interviews with stakeholders in your office, now this is the time for bringing together a broader audience to discuss the current situation and next steps for Flint.

This meeting will take place in form of a town hall meeting, bringing together you as the project engineer, directly affected stakeholders, and a broader public.

Box 5. Introduction PowerPoint slide for the application scenario for Module 4.

Instructions for students

In recent years, we have used a "fish bowl" activity for the final application scenario activity. This involves asking for 4-5 volunteers to play the roles of stakeholders and an engineer. Each volunteer is given time to study their role. The engineer is asked to review the two different types of communication practiced in the skill-building activities and to switch as they feel is appropriate in the role-play. The rest of the class gathers around the volunteers to observe the role play.

Another option is to divide the class into groups of 4-5 and to ask each group to conduct their own mode-switching role play. We have found, however, that this can get out of hand and that there is more value in the fish bowl approach. That said, we always have some students comment that they wish they had had the opportunity to practice mode-switching themselves (and not just observe it).

Aspects to highlight in the debrief on the application scenario and example questions:

The key aspects to focus on in this debrief are:

- When mode-switching occurred and,

- What its impact was on the conversation.

Some example questions to facilitate the debrief are:

- To the volunteers: Describe how you experienced this conversation. Did you notice the engineer switch modes at any point in the conversation? What was that like for you? Why do you think they switched modes then?
- To the engineer: What was it like to switch modes? Why did you switch at that point?
- To the rest of the class: What did you observe? How did mode-switching impact the conversation?

Oftentimes, students describe that the conversation starts in the empathic mode, and that this enables the engineer to build a relationship with the stakeholders. After this relationship is established, the conversation then naturally progresses to an analytical mode, and then may transition back to the empathic mode if the need arises.

Depending on time, the instructor can also select a new round of volunteers and perhaps even different stakeholders to repeat the above activity.

The final debrief can venture into the territory of times students have experienced empathic or analytic modes of communication in work or work experience settings; or when they think each mode would likely be most appropriate in what they imagine work will be like.

We like to end the modules with a comment that communicates how "empathy is the glue that binds people together" – that the effort of trying to understand another's perspective is the basis for a healthy relationship, whether that relationship be at work or in our personal lives.

5.4.4 Reflection prompt for Module 4

Below we show the prompt that we give to students to guide their reflective sense-making on the activities in Module 4.

Read through the following statements and think of specific incidents they bring to mind. Write about them. You don't have to directly or specifically answer the statements.

> There was a moment during today's module when I started to realize that…
>
> During today's module, I struggled to get my head around…
>
> When my partner responded analytically to my story, I was surprised to feel that…
>
> When my partner responded empathetically to my story, I was surprised to feel that…
>
> As the engineer/stakeholder in the role play, I suddenly understood how…
>
> During the role play, I found it challenging to…
>
> Submit your reflection (about two pages) as a PDF file on eLC.

See Section 5.1.4 for how these student reflections are assessed.

5.4.5 Student Reactions

For many students, Module 4 is when it all starts to make sense, when all the pieces fit together. The activities in this module provide opportunities for students to *feel* what it's like to be responded to in empathic and analytic modes. After working through the first three modules in the empathic mode, some students find the analytic mode quite harsh and impersonal. Such

experiences are important for understanding the value of building relationships in engineering through perspective-taking, affective responding etc.

6 Facilitating the modules

6.1 Achieving buy-in

It is important to make a strong case to students for why empathy is a relevant skill for engineers. We do this in a number of ways, such as:

- Discussing a study led by Google that identified psychological safety, which comprises social sensitivity (also referred to as empathy) and conversational turn-taking, as the most crucial feature that contributes to team success (Duhigg, 2016).
- We also tell stories from our own work experiences that illustrate how important it is to build relationships with all kinds of people, from colleagues to clients to members of the public, and how empathic communication can help with this.
- Sometimes we show this video (RSA ANIMATE: The Empathic Civilisation https://www.youtube.com/watch?v=l7AWnfFRc7g), which is a stop-motion, whiteboard animation that places the need for empathy in a broader societal context.
- We have also spoken about Dan Pink's (2006) notion of the Whole New Mind, which describes six essential aptitudes, or "senses," for career success in the 21st-century (design, story, symphony, empathy, play, meaning).
- See Section 5.4.2 for three additional references that point to the importance of mode-switching in engineering.

6.2 Introducing the role plays

Participating in a role play in an engineering classroom can be an awkward and uncomfortable experience for some students. Instructors can help students more productively engage with role plays by discussing the affordances and limitations of role plays just prior to the role play in Module 1 and then briefly before the role plays in Modules 2-4.

One approach is to discuss the following points, which summarize the affordances and limitations of role plays. Another approach is to ask students who has participated in an educational role play before, and then to ask those students what they gained from the experience. Quite often these students come up with the following points themselves. These points can then be reiterated by the instructor.

Affordances

1. Role plays provide a **low stakes** environment in which to practice new communication skills. "It's better to try out these techniques with your classmates than on your clients or members of the public!"
2. Role plays provide a great opportunity to **"try on"** what it might be like to be another person with experiences and values that are different from your own. Role playing someone else might make you more aware of and enable you to better appreciate diverse perspectives when you work as an engineer.
3. The benefits of a role play don't come from discrete outcomes or solutions produced in the discussion, but from **participation**.

4. Role plays work best **when everyone buys in** to the scenario. If you commit to the role play, your classmates are more likely to commit, too!

Limitations

1. It can be hard to get into character. Sometimes getting into character might feel artificial or like you are essentializing someone. Role plays do not and cannot offer perfect representations of the characters you are playing. Be patient and kind to yourself and others who are trying their best.
2. The time that is allotted to the role plays in the modules is limited. This constraint makes it even more important to commit to the process!

It is important for instructors to address the purpose and importance of the roleplay prior to the activity in each module. Role plays provide an opportunity for students to practice the skills of empathic communication as introduced in the modules, in addition to implicitly requiring students to practice the empathetic skill of perspective taking through requiring them to step into someone else's shoes and take on the role and opinions of a stakeholder. It can be useful to remind students that the purpose of the roleplay is not to fix a problem. It is to learn how to communicate in a way that will enable them to more effectively engage with stakeholders and the community as future engineers.

6.3 Effective debriefing

Effective facilitation of the class debriefs is one of the most important elements of the empathy modules. As a facilitator, it is the instructor's responsibility to facilitate the conversation through asking questions and highlighting important points to probe students to dig deeper and think more critically about their empathy skills and the way they approach others.

The modules work best if **instructors model the skills of affective responding**, as discussed in Module 3, when facilitating the whole-of-class debriefs. Notably, instructors should try to "reflect back" what students say through paraphrasing and reflecting feeling. For example, an instructor might say, "okay, so it sounds like when you were the engineer you felt frustrated because the stakeholders were angry at you and you didn't know how to solve their problems. Is that about right?"

Another technique is for instructors to try to **bring the entire class into the conversation** and build a shared narrative through giving students an opportunity to express experiences or emotions similar to those their peers describe. For example, the instructor might say, "Ben described how he experienced/ felt X… Did anyone else feel the same way/ have a similar experience?" Instructors can also try to involve the entire class in the discussion through questions such as "Is that true for everyone?"

To lend further structure to the conversation, it can be helpful to work towards integrating key points of discussion, for example by saying something like, "So, when Ben said A and Jessica said B, it seems that C"). **If the conversation is at a lull**, one strategy is to **ask a direct question** about a point that hasn't yet being discussed and ask students to discuss the answer with their neighbor and then report what their neighbor said.

In facilitating a debrief, it is important to remain **non-judgmental**. Doing so may entail **acknowledging student experiences such as awkwardness** with engaging in these types of activities in an engineering class, for example by saying something like, "I realize that doing X

was probably a bit awkward for some of you. But let's put that aside, as much as we can, and focus on Y." It is also the facilitator's role to reinforce the module through connecting the discussion back to the purpose of the exercise, e.g., becoming conscious of how we use ourselves in interactions with others. Wherever possible, instructors should also try to **tie the discussion back to the professional context** and highlight its relevance to engineering practice. Personal stories of engineering practice experiences can be an effective means of doing this.

6.4 Teaching space considerations

The success of the modules can be drastically affected by the space in which they are enacted. For those modules that require students to move in the room, it may require prior rearranging of the setting in order to effectively and efficiently facilitate the modules. Many of the modules involve conversations in pairs, so instructors should make sure the space allows for this group dynamic. Special attention should be given to Module 2, which requires students to move around in order to experiment with their comfort levels in regards to proximity. Module 4 asks for groups of five to participate in the role play, which may also necessitate rearranging the instructional space.

Many of the modules and exercises call for working in pairs. An issue that can arise with working in pairs is odd numbers. When groups of three are necessary, one student may fill the role of observer and note what they observe in the interactions of the other two students. Some students are natural observers and can learn a great deal from this process, so the instructor may ask a student to self-select as the observer for a group. The observer can also serve to provide interesting feedback to those participating in the activity. If time allows, students may switch roles with the observer participating in the activity. If all students are comfortable with the activity, another option is for the instructor themselves to participate in the activity with the student (Note: This is generally best reserved for Module 3 or 4 when students are more used to the idea of role play and skill building activities).

7 Connecting the modules to other course objectives

The original set of four modules at the University of Georgia are part of a sophomore, mandatory course as part of the design sequence for mechanical engineering (MCHE 2990: Engineered Systems in Society). This course has four learning objectives and 50 or so learning outcomes. The four objectives, and learning outcomes that are relevant for the empathic communication modules, are provided below. A full list of the learning outcomes for this course is provided in Appendix F.

Course Objectives:

In this course, students will:

1. Acquire the language and skills necessary to identify and solve complex, socio-technical problems in engineering practice settings.
    a. By the end of this course, students will be able to:
        i. Communicate effectively with a client to identify their needs and, if necessary, distinguish between their wants and needs.
        ii. Appreciate the necessity and value of engaging with the client as the expert in their problem setting.

2. Gain an understanding of historical and contemporary perspectives on ethical decision-making in engineering.
3. Learn and practice key skills for communicating effectively in the modern engineering workplace.
    a. By the end of this course, students will be able to:
        i. Describe the primary tool used in engineering communication.
        ii. List at least five ways in which physical proximity to another person can impact the quality of communication.
        iii. Recall and practice the three core skills required for affective responding.
        iv. Distinguish between, and describe the affordances and limitations of, empathic and analytic forms of communication.
        v. Define mode-switching and recognize when it occurs in conversations.
4. Study contemporary engineering case studies.
    a. By the end of this course, students will be able to:
        i. Chronologically describe one contemporary engineering case study in depth.
        ii. Recall key events associated with at least one other contemporary case study.
        iii. Apply concepts from the course to gain a deeper understanding as to why one of the cases unfolded as it did.
        iv. Identify and describe three orthogonal stakeholder perspectives on one of the cases.
        v. Describe the epistemic beliefs and values orientations of these three stakeholders.

As shown in the above objectives, this course introduces to students the notion of engineering taking place within complex, socio-technical systems with important ethical implications for diverse stakeholders. These kinds of ideas can be perceived by students to be somewhat abstract. We use real-world problems and the empathy exercises to make these abstract ideas more accessible to students. It's one thing to discuss the impact of a particular engineering technology on a group on a theoretical level; we have found that it's quite another thing for students to vicariously experience that impact through the empathy exercises. We have discussed these observations in more detail here (Walther et al., 2020).

We also note that empathy is relevant to three out of four of our course objectives. For the first objective, we emphasize the importance of empathy for getting to know clients/ stakeholders and understanding their needs. There is a wealth of literature and resources that unpack this idea (see for example: http://dschool-old.stanford.edu/wp-content/themes/dschool/method-cards/empathy-map.pdf). The third objective focuses more specifically on the skills dimension of communicating empathically, while the fourth objective probes the orientation dimension of our conceptual model of empathy in engineering (see Figure 3). More specifically, when we work with our students to examine contemporary case studies, we encourage students to investigate and different perspectives on the case and how those different perspectives connect to different epistemic beliefs and values.

Such course integration, however, is not a necessary condition of implementing empathic communication exercises into undergraduate engineering classes. As illustrated in Appendix A, such efforts can be much more tightly scoped.

We hope that the information in this handbook is helpful for instructors who are considering integrating empathy into their teaching. We are open to both feedback on the information we have shared and to work with you to adapt our work to your context.

8 References

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9 Appendices

Appendix A: Adaptation of the conceptual model and empathic communication modules to a different instructional setting (developed by Tom Shepard, from St Thomas University).

Engineering Ethics/Empathy/Stakeholder Assignment

Engineers are in the business of creating new products, technologies, systems and infrastructure to benefit society. In most projects, there are many stakeholders, or people whose lives will be impacted in a big or small way, by the outcome of a project. This potential impact on stakeholders is something that receives little attention in most undergraduate engineering courses whose primary role is to instruct you in fundamental engineering principles, concepts and problem solving techniques. Thus, it is easy to lose sight of the importance of stakeholder feelings, concerns and engagement for an undergraduate as it does not receive the same emphasis as technical material. However, many practicing engineers are faced with the challenge of balancing technical needs against the desires of various stakeholders. These stakeholders can range from people within the company (say Marketing, boss, or project team member) to the end user of a product or even somebody who just happens to live near the end product (i.e. a pipeline running over your land).

Engineers, like most people, possess empathy, which is the ability to understand and share the feelings of others. While thinking analytically may be the more natural mode of operation for an engineer, it is also important that they switch into empathy mode at times. To avoid, or ignore, the feelings of potential stakeholders can result in a lot of wasted time and money. Think here of a project that is tabled due to public out-cry, or even lack of understanding of customer needs. Too often it is easy to forget that there are two sides (at least) to every story. Too often when facing a dissenting opinion or seemingly inappropriate action we fail to ask – "Why would that person think that, or do that?"

The aim of this assignment is to engage you in the act of thinking empathically in an engineering context and to identify if/how the NSPE code of ethics speaks to empathy expectations within engineers.

1. Read the NSPE Code of Ethics for Engineers in its entirety:
https://www.nspe.org/resources/ethics/code-ethics

- Does the NSPE code of ethics expressly state, or even imply anywhere, that empathy might be expected of engineers? Justify your answer while citing specific sections of the code as appropriate. (Let that liberal arts education shine!)

List of scenarios/interactions or potential interactions (***see below***)– based on real events/stories from working engineers – students choose a single scenario from the list and complete the assignment based on that scenario

- Background, stakeholder 1(engineer), stakeholder 2 (could be a range of parties depending on scenario)

2. What additional stakeholders could there be with an interest in this scenario?

- List as many as come to mind. What concerns could each of these have regarding this scenario and its potential resolution(s)?
- Do these different groups all have equal priority or should some stakeholder's concerns merit greater consideration than others? Explain.

3. How do you think stakeholder 2 feels? If you feel comfortable sharing, briefly describe an experience from your life when you have felt similarly (a couple sentences is fine).

4. Write a short memo as stakeholder 2 to stakeholder 1 that takes into account their feelings while balancing any conflicting concerns. The goal of the memo is… (depends on scenario, roughly a paragraph)

5. How do you think stakeholder 1 feels upon receiving this memo? If you feel comfortable sharing, briefly describe an experience from your life when you have felt similarly (a couple sentences is fine).

6. Write a short response memo as stakeholder 1 to stakeholder 2 that takes into account their feelings while balancing any technical and ethical concerns. The goal of the memo is… (depends on scenario, roughly a paragraph)

7. Are there any aspects of the NSPE code of ethics that are relevant for the scenario you choose? Explain, while citing specific sections of the code as appropriate.

Assignment Reflection Questions

8. Why would an engineer want to approach a problem both analytically and empathically?

9. Which part of the assignment did you find most challenging? Why?

10. What part of the assignment did you enjoy or find rewarding?

11. What key insights do you take away from this assignment?

Civil Engineering Scenario

John (stakeholder 1) is a pavement engineer working for a major metropolitan city. As part of his job, John goes into all of the neighborhoods of the city to inspect the roadways and curbs to assess if they need repairs or replacement. Curbs can be a particularly tricky part of his job. When any part of a curb along a city block needs to be replaced, all of the homeowners on that side of the block receive an assessment that requires them to cover part of the cost of the curb replacement. The rest of the cost is covered by the city budget that effectively comes from taxes on all of the city residents. During an inspection in an economically depressed neighborhood, John notes that a few sections of curb along a block need to be replaced. Some of the curb that needs to be replaced looks to be in good condition but would fail to drain water towards the storm sewer properly. Some of the curb that needs to be replaced would drain properly, but is in very poor condition with significant cracking. And there are large sections of curb that will drain properly and contain superficial cracking that should last for many more years which John decides to leave untouched.

Steve (stakeholder 2) is one of the residents along this street. He notices that some of his neighbors' curbs are being replaced while his, which looks to his eye to be in similar condition, is being left untouched. This raises confusion and concerns for Steve. He contacts the city to find out who made the decision about the curbs and is given John's contact information.

Mechanical Engineering Scenario

Liz (stakeholder 1) is a young manufacturing process engineer who is new to her job at a large engineering firm. Upon inspecting a pressure sensor manufacturing line she notes some opportunities for improvement. The current line sends parts through in large batches to three consecutive stations – once all parts in the batch are processed at station 1 they move on to station 2, etc. If there is a quality issue in a component this system would install that fault into an entire batch of sensors before being detected at the last stage of testing. If a customer requires a change in sensors, the line would need to complete all the parts that have begun step 1 before changing over the fixtures to start work on the different sensor. In this manner, the current line presents avoidable issues that could be mitigated by having single parts pass through the system instead of batches.

John (stakeholder 2) is a technician who has worked on this pressure sensor manufacturing line for ~20 and basically followed the same process for all these years. John takes pride in helping produce parts that are instrumental to the operation of commercial and military aircraft. John has learned that there are changes planned in how the pressure sensors will be made. As far as he is concerned the system he has been using for years is perfectly fine as evidenced by the fact that the system has stayed the same so long, the continued high quality parts that are manufactured and seemingly happy customers.

Chemical Engineering Scenario

Delvin (stakeholder 1) is a research engineer for a large global petrochemical company. His area of expertise and research is on the stability of plastics and the permeability of chemicals into plastics. During his work he has discovered that ammonia reacts with a new plastic used by the company for piping with the result that continuous contact with ammonia could cause the pipe to degrade and be destroyed within a matter of hours/days.

Peter (stakeholder 2) is an engineering team leader and the supervisor of a variety of engineering groups involved with the testing, research, product development and market rollout of new plastics. Peter, who is effectively Delvin's boss, has a very optimistic and positive energy about him and is excited about finding new opportunities for his group's products. As part of his role he leads teleconference calls that include many of the engineers from his groups as well as his counterpart and engineers from a facility in Europe. During one of these teleconferences, Peter announces with excitement that piping made from the new plastic has been installed in a recently built ammonia plant. This is same plastic that Delvin is 95% certain is not compatible with ammonia. Delvin is participating in the teleconference and is immediately concerned as contact with or inhalation of ammonia can have tremendously negative health impacts.

Appendix B: Example scenario we are currently in the process of developing

In conversations with colleagues at UGA about the empathy modules, Dr. Peter Carnell, a Professor of Practice, suggested the following scenario, which is currently taking place in Florida. This scenario fits the four criteria outlined on in Section 4 and speaks to the value of asking colleagues for application ideas.

TROUBLE IN PARADISE CITY

Paradise City is a rapidly urbanizing coastal community with a thriving tourism industry. There are nearly 10 linear miles of beachfront property within the City limits. For years, the City has owned and operated several beachside parking lots. Utilization rates continue to increase annually at each of these sites.

The City Council has directed their staff to conduct a study to determine the feasibility of constructing a multi-story parking garage over the existing 200 space, single grade parking lot at Snail Lovers Park. The scope of the study will include developing a report that includes:

- A pre-design concept of the structure with ingress and egress points;
- A traffic impact analysis;
- A constructability review that identifies and evaluates permitting requirements, zoning parameters, height restrictions, setbacks, etc;
- A recommended user fee schedule and annual revenue projections; and
- Conducting a series of public meetings with the community, gathering input and reporting that back to the City Council.

Impacted stakeholder groups include:

- The Paradise City Chamber of Commerce;
- "Find Your Paradise", the City's Visitors Bureau;
- The Paradise Board of Realtors;
- Various homeowner and condominium associations;
- The Sons of Beaches Environmental Education Society (SOBEES); and
- Citizens Against Everything, a local tax watch group.

City staff is scheduling and conducting publicly advertised meetings with the various stakeholder groups invited to participate. More than 200 people attended the first meeting. Some of the comments received included the following:

- Seymour Bucks from the Chamber of Commerce wants a retail shopping area built adjacent to the parking structure and rented out to local businesses at a discounted rate.
- Nomar Carson from the Tranquil Shores Home Owners Association contends that the area will be overrun with more vehicle traffic.
- Bonita Vista is worried that a high rise structure would block her view of the beach.
- Gail Storm from SOBEES claims that such a structure would damage the beachside eco-systems and make the area more vulnerable to disaster-related wind and flood damage.
- Lea Cerone from the Board of Realtors wants the city to prohibit Air B'n'B rentals near the park and promote responsible home ownership.
- Anne T. Party from Citizens Against Everything objects to spending millions of her "hard earned tax dollars" on the project.

- Vincent Wigglesworth Jr., the son of the noted 20th century entomologist raises concerns about the potential impact of the structure on the breeding grounds of the endangered Tropical Lunar Tic. He then itemizes all 47 benefits of this insect to society.
- Kay Yaker from the Paradise paddlers group wants space within the structure to secure kayaks and canoes and wants the floor heights within the garage to be high enough to accommodate vehicles carrying watercraft.

Appendix C: In-class alternative to a take-home set of reflection questions for Module 1

Students were handed out a double-sided sheet of paper with the following questions on it (to be completed during class-time).

1. What is empathy?
   [Instructor discussed the Google study, which describes how "conversational turn-taking + social sensitivity (empathy) = psychological safety," and how Google identified psychological safety as the most important feature of effective teams. The instructor also discussed the definition of empathy with the class and showed some different definitions from dictionaries and the literature.]

2. Why is it important for engineering?
   [See above notes.]

3. Notes from outrospection animation.
   [see video here: https://www.youtube.com/watch?v=BG46IwVfSu8]

4. Reflection questions for the first activity.
   a. How did you approach people /what did you do?
   b. What signals did you pick up from your counterpart?
   c. How did you feel throughout the exercise?

5. Reflection questions for the second activity.
   a. What was it like?
      i. To be the engineer? What did the residents say to you? What did you say/do in response?
      ii. To be the resident? What did you say to the engineer? What did they do? How did you feel?

6. What are the three most important take-aways from today's class for you?

Appendix D: Handout on paraphrasing and reflecting feeling

Paraphrasing

Paraphrasing is repeating in your own words what you interpreted someone else to be saying. Paraphrasing is a powerful means to further your understanding of what the other person is saying. When paraphrasing:

- Put the focus of the paraphrase on what the other person implied, not on what you wanted him/her to imply, e.g., don't say, "I believe what you meant to say was …". Instead, say **"If I'm hearing you right, you said that …?"**
- Phrase the paraphrase as a question, **"So you're saying that …?"**, so that the other person has the responsibility and opportunity to refine his/her original comments in response to your question.
- Put the focus of the paraphrase on the other person, e.g., if the person said, "I don't get enough resources to do what I want," then don't paraphrase, "We probably all don't get what we want, right?"
- Put the ownership of the other person's words on him/her, e.g., say **"If I understand you right, you're saying that …?"** or "If I understand you right, you believe that …?" or "If I understand you right, you feel that …?"
- Don't judge or evaluate the other person's comments, e.g., don't say, "I wonder if you really believe that?" or "Don't you feel out-on-a-limb making that comment?"
- The paraphrase should be shorter than the original comments made by the other person.

"What I hear you say is…. is this correct?
"It sounds like …."
"If I am hearing you right, you said that…?
"If I understand you correctly….?"
"So, you're saying that…?"
My sense of what you're saying is…
Let me see if I understand you correctly…

Reflecting feelings

Reflecting feeling is a powerful way of communicating to the other person that they are being understood and it also signals that they can continue sharing their perspective.

Understanding and reflecting nuance emotions:

To effectively embody this skill, we need to be able to reflect others' feelings with some nuance. Just saying "that sounds bad" does not serve the same function as saying "It sounds like you were quite frustrated when…"

The following emotion words can be a starting point for articulating the feelings of others:

ANGRY: irritated, enraged, insulting, annoyed, upset, bitter, resentful, infuriated, fuming
DEPRESSED: lousy, disappointed, discouraged, powerless, dissatisfied, miserable
CONFUSED: unsure, doubtful, uncertain, perplexed, embarrassed, hesitant, skeptical
HELPLESS: alone, paralyzed, fatigued, vulnerable, empty, hesitant, despair, frustrated
INDIFFERENT: neutral, weary, dull, bored, preoccupied
AFRAID: worried, fearful, alarmed, anxious, nervous, terrified, suspicious, frightened
HURT: crushed, tormented, dejected, rejected, offended, heartbroken, humiliated, appalled, wronged
SAD: pained, grief, anguish, desolate, pessimistic, unhappy, dismayed

Expressing degree or intensity of emotions

In addition to capturing the type of emotion we also try to capture its intensity:

"You feel ... a little bit ... quite ... very ... extremely .... (emotion)."

Some useful phrases to start with when reflecting feelings:

"So, you were frustrated when ...?"
"You feel..." "You sound..." "You look..."
"You're feeling..."
"You feel (feeling word) because (content)."
"You feel ___about ___." "You feel ___ when ___."
"I gather that you are feeling ____"
"I can tell that ____"

Appendix E: Example scenarios to practice paraphrasing and reflecting feeling

Scenario 1

Yesterday was my first day working as a graduate engineer at Company X. Today, on my second day(!), my boss asked me to redesign a part on the robotic arm that moves supercharger components from one part in the process to the other.

[Pause to give students an opportunity to paraphrase and reflect feeling]

He suggested that I start by going down to the shop to discuss the problem with the technicians there before I come up with some preliminary designs. That was a little odd, because I had never talked to these people.

[Pause to give students an opportunity to paraphrase and reflect feeling]

So, I went down to the shop and approached the lead technician. I tried to introduce myself but he sort of waved me off. I patiently waited a few minutes and but whenever I tried to establish eye contact he just ignored me. He made me wait for 45 minutes! I felt like I wasted most of my second day waiting around.

[Pause to give students an opportunity to paraphrase and reflect feeling]

Scenario 2

Okay, so once again we were drilling a test well on a Saturday. The drillers were only supposed to be onsite for 3 weeks and we were already into week 5 and so that made weekend work unavoidable. It was freezing cold.

[Pause to give students an opportunity to paraphrase and reflect feeling]

About 15 feet or so down the second well, we all heard a loud bang and saw the drilling equipment suddenly recoil. I guess it could have been anything, though the most likely explanation was that we hit a methane pocket, which meant that there was methane under the site. Seeing the equipment jump like that was scary.

[Pause to give students an opportunity to paraphrase and reflect feeling]

I suggested to the drillers that we stop and run some tests but they were so exhausted, cold and sick of working on Saturdays that they argued for going on. I eventually yielded. I know it was the wrong decision but what could I do?

[Pause to give students an opportunity to paraphrase and reflect feeling]

Appendix F: Complete list of course objectives and learning outcomes for MCHE 2990: Engineered Systems in Society, taught at the University of Georgia

Course objectives and outcomes:

1. Students will acquire the language and skills necessary to identify and solve complex, socio-technical problems in engineering practice settings (maps to ABET Student Outcomes 1 and 2)
    a. By the end of this course, students will be able to:
        i. Communicate effectively with a client to identify their needs and, if necessary, distinguish between their wants and needs.
        ii. Appreciate the necessity and value of engaging with the client as the expert in their problem setting.
        iii. Draw a systems map to visually represent a complex, socio-technical problem.
        iv. Define and distinguish between classroom and workplace problems.
        v. Recall at least six of the twelve features of workplace problems discussed by Jonassen et al. (2006).
        vi. Use the 12 features of workplace problems to discuss the complexity of a given, real-life, engineering problem.
        vii. Create a spray diagram to sketch out relevant elements of a complex, socio-technical problem or an argument.
        viii. Define and distinguish between reductionist and complex systems approaches to problem solving.
        ix. Recall and provide examples for simple, complicated, complex, and chaotic problems.
        x. Apply reductionist and systems thinking approaches to solve real-life problems.
        xi. Evaluate the affordances and limitations of reductionist and systems thinking approaches for analyzing and solving different kinds of problems.
        xii. Define, contrast, and apply the perspectives of the technological determinism and the social shaping of technology.
        xiii. Recognize in texts which of these two lenses (technological determinism and/or the social shaping of technology) have informed the writer's analysis of a particular technology.
        xiv. Define, contrast, and provide examples of positivist and constructionist ways of producing knowledge.
        xv. Identify which aspects of a specific complex, socio-technical problem setting are informed by positivist and constructionist ways of knowing.
        xvi. Define "politics" and "technology" according to Winner's theory of technological politics.
        xvii. Classify technologies as authoritarian or democratic based on Winner's article.

xviii. Recall five different ways in which artifacts have political qualities.
xix. Discuss and justify why a particular technology fits into one of these five categories.
xx. Use Winner's theory of technological politics to critically evaluate a contemporary case study.
xxi. Define and distinguish between traditional and reflexive engineers, as outlined in Table 1 on page 10 Recite the paramountcy clause in the engineering code of ethics.
xxii. 8 of the Robbins article.
xxiii. Define and provide examples of the cradle-to-cradle approach and "technical nutrients."
xxiv. Discuss the significance of "the power of intentionality."

2. Students will gain an understanding of historical and contemporary perspectives on ethical decision-making and practice in engineering (maps to ABET Student Outcome 4)
    a. By the end of this course, students will be able to:
        i. Define and contrast traditional and morally deep approaches to engineering ethics.
        ii. Identify an integral community for a given problem setting.
        iii. Consider an ethical question/scenario from holistic and atomistic perspectives.

3. Students will learn and practice key skills for communicating effectively in the modern engineering workplace (maps to ABET Student Outcomes 3 and 5)
    a. By the end of this course, students will be able to:
        i. Describe the primary tool used in engineering communication.
        ii. List at least five ways in which physical proximity to another person can impact the quality of communication.
        iii. Recall and practice the three core skills required for affective responding.
        iv. Distinguish between, and describe the affordances and limitations of, empathic and analytic forms of communication.
        v. Define mode-switching and recognize when it occurs in conversations.
        vi. Describe and practice conversational turn-taking.
        vii. Define psychological safety and describe ways to foster it in a group setting.
        viii. Recognize the presence or absence of psychological safety in a group setting and, in the case of the latter, be able to change the dynamic to foster a more psychologically safe environment.
        ix. Plan, design, and deliver a purposeful and well-structured presentation.
        x. Deliver an engaging presentation through a focus on connecting with, and relating to, your audience.
        xi. Recall, critique, and apply the five rules for effective PowerPoint presentations outlined in the "Death by PowerPoint" TEDTalk.

xii. Provide constructive criticism to improve your classmates' presentations.
xiii. Plan and produce a professional engineering report.

4. Students will study contemporary engineering case studies (maps to ABET Student Outcomes 2 and 4)
    a. By the end of this course, students will be able to:
        i. Chronologically describe one contemporary engineering case study in depth.
        ii. Recall key events associated with at least one other contemporary case study.
        iii. Apply concepts from the course to gain a deeper understanding as to why one of the cases unfolded as it did.
        iv. Identify and describe three orthogonal stakeholder perspectives on one of the cases.
        v. Describe the epistemic beliefs and values orientations of these three stakeholders.
        vi. Use the concepts from the course to think critically about a contemporary case study with the view to deriving transferable lessons.
        vii. Be comfortable with complexity and nuance and avoid the inclination to arrive at black and white conclusions.
        viii. Discern what is known and what is not known about a particular case, and be able to identify possible ways to address those knowledge gaps.
        ix. Recognize the impacts that our own subjectivities have on how we evaluate contemporary engineering case studies.
        x. Interpret a contemporary engineering case study using the following concepts: traditional and reflexive. engineering; cradle-to-cradle and upcycling; Laszlo's discussion of systems thinking/science principles.
        xi. Creatively apply the above concepts to a new setting.