

## Organizational Citizenship Behavior and Care in Chemical Engineering

### Mrs. Kristen Ferris, University of New Mexico

Kristen Ferris is a student in the Organization, Information, and Learning Sciences program at the University of New Mexico. Her research interests include faculty mindset change, change management, and organizational citizenship behavior. Much of her research is part of a National Science Foundation grant at UNM where the chemical and biological engineering department is redesigning curriculum to support diverse student retention and graduation. She intends to further her knowledge in the field of change management and faculty development to study faculty buy-in, barriers to change, and adoption of teaching practices.

### Dr. Pil Kang, University of New Mexico

Sung "Pil" Kang is an assistant professor at the University of New Mexico. His academic interests include change management, change model validation, and mindset evolution. He may be reached at [pilkang@unm.edu](mailto:pilkang@unm.edu)

### Ms. Madalyn Wilson-Fetrow, University of New Mexico

### Dr. Vanessa Svihla, University of New Mexico

Dr. Vanessa Svihla is a learning scientist and associate professor at the University of New Mexico in the Organization, Information and Learning Sciences program and in the Chemical and Biological Engineering Department. She served as Co-PI on an NSF RET Grant and a USDA NIFA grant, and is currently co-PI on three NSF-funded projects in engineering and computer science education, including a Revolutionizing Engineering Departments project. She was selected as a National Academy of Education / Spencer Postdoctoral Fellow and a 2018 NSF CAREER awardee in engineering education research. Dr. Svihla studies learning in authentic, real world conditions, specifically on design learning, in which she studies engineers designing devices, scientists designing investigations, teachers designing learning experiences and students designing to learn.

### Prof. Eva Chi, University of New Mexico

Eva Chi is a Professor in the Department of Chemical and Biological Engineering Department at the University of New Mexico. The research in her lab is focused on understanding the dynamics and structures of macromolecular assemblies including proteins, polymers, and lipid membranes. Undergraduates, graduate students, and postdoctoral scholars are trained in a multidisciplinary environment, utilizing modern methodologies to address important problems at the interface between chemistry, physics, engineering, and biology preparing the trainees for careers in academe, national laboratories, and industry. In addition to research, she devotes significant time developing and implementing effective pedagogical approaches in her teaching of undergraduate courses to train engineers who are critical thinkers, problem solvers, and able to understand the societal contexts in which they are working to addressing the grand challenges of the 21st century.

### Dr. Jamie Gomez, University of New Mexico

Jamie Gomez, Ph.D., is a Senior Lecturer III in the department of Chemical & Biological Engineering (CBE) at the University of New Mexico. She is a co-principal investigator for the following National Science Foundation (NSF) funded projects: Professional Formation of Engineers: Research Initiation in Engineering Formation (PFE: RIEF) - Using Digital Badging and Design Challenge Modules to Develop Professional Identity; Professional Formation of Engineers: REvolutionizing engineering and computer science Departments (IUSE PFE\RED) - Formation of Accomplished Chemical Engineers for Transforming Society. She is a member of the CBE department's ABET and Undergraduate Curriculum Committee, as well as faculty advisor for several student societies. She is the instructor of several courses in the CBE curriculum including the Material and Energy Balances, junior laboratories and Capstone Design courses. She is associated with several professional organizations including the American Institute of Chemical

Engineers (AIChE) and American Society of Chemical Engineering Education (ASEE) where she adopts and contributes to innovative pedagogical methods aimed at improving student learning and retention.

**Dr. Yan Chen, University of New Mexico**

Yan Chen is a Postdoctoral Fellow in the Department of Chemical and Biological Engineering at the University of New Mexico. Her research interests focus on computer supported collaborative learning, learning sciences, online learning and teaching, and educational equity for multicultural/multiethnic education.

**Dr. Susannah C. Davis, University of New Mexico**

Susannah C. Davis is a research assistant professor at the University of New Mexico. She holds a Ph.D. and M.Ed. from the University of Washington and a B.A. from Smith College. Her research explores how postsecondary institutions, their faculty, and their administrative leaders navigate organizational change and reform efforts and learn in the process. Her current research focuses on how institutions of higher education create more equitable and inclusive policies, practices, and climates, as well as how systems of power shape reform efforts.

**Prof. Sang M. Han, University of New Mexico**

Dr. Han is a Regents Professor in the Departments of Chemical & Biological Engineering and Electrical & Computer Engineering at the University of New Mexico. He earned his Ph.D. in chemical engineering from the University of California at Santa Barbara and his B.S. in chemical engineering with honors from the University of California at Berkeley. Dr. Han has over 25 years of experience in electronic and photonic materials engineering and fabrication. His current research topics include (1) writable/rewritable quantum structures by stress patterning; (2) low-cost, crack-tolerant, advanced metallization for solar cell durability; (3) thin film processing and nanoscale surface corrugation for enhanced light trapping for photovoltaic devices; and (4) microsphere-based manufacturable coatings for radiative cooling. He has close to 70 publications in peer-reviewed journals and over 200 invited/contributed papers at academic institutions, national laboratories, and conferences. He received a UNM Junior Faculty Research Excellence Award in 2005 and an NSF Career Award in 2001. He is a recipient of STC.UNM Innovation Award consecutively from 2009 to 2018, and he was elected as the 2018 STC.UNM Innovation Fellow. Dr. Han holds 17 UNM-affiliated U.S. patents and 6 pending U.S. and PCT patent applications. He currently serves as the Chief Technical Officer of Osazda Energy LLC, a startup company based on his intellectual property generated at UNM. Prior to his entrepreneurial venture, Dr. Han served as the main campus faculty member of the STC.UNM Board of Directors from 2015 to 2016.

**Dr. Abhaya K. Datye, University of New Mexico**

Abhaya Datye has been on the faculty at the University of New Mexico after receiving his PhD in Chemical Engineering at the University of Michigan in 1984. He is presently Chair of the department and Distinguished Regents Professor of Chemical & Biological Engineering. From 1994-2014 he served as Director of the Center for Microengineered Materials, a strategic research center at UNM that reports to the Vice President for Research. He is also the founding director of the graduate interdisciplinary program in Nanoscience and Microsystems, the first program at UNM to span three schools and colleges and the Anderson Business School. He served as director of this program from 2007 – 2014. His research interests are in heterogeneous catalysis, materials characterization and nanomaterials synthesis. His research group has pioneered the development of electron microscopy tools for the study of catalysts.

# Organizational Citizenship Behavior and Care in Chemical Engineering

## Abstract

Research suggests that the ethic of care is a key ingredient to learner-centered teaching and can support diverse student success [1]. Faculty may feel they show care through rigor, by holding a high standard and providing critical feedback to prepare students for harsh work environments. Students, especially from groups underrepresented in engineering, may interpret this stance as information indicating that they do not fit in the discipline. This paper investigated how chemical engineering faculty aimed to show care to students. Specifically, we analyzed faculty policies, transcripts of faculty meetings, interviews, and email exchanges, categorizing specific beliefs and practices using the organizational citizenship behavior (OCB) framework [2]. We overlay OCB with the framework by Scott [3] that intersects criticality of feedback with relationship building. We found that most faculty demonstrated OCBs of altruism and conscientiousness. They cared deeply about student success and invested time and effort in supporting students. However, some faculty did so in line with rigor, but in ways that did not demonstrate sportsmanship, courtesy, and civic virtue in their accounts of and interactions with students. In line with Scott's framework, those who also demonstrated civic virtue were able to demand much from students, who in turn rose to meet high expectations.

## Introduction and research purpose

Chemical engineering faculty typically hold high expectations for students, but this can be actualized in varied ways. Faculty may act as gatekeepers to the major, the profession, and the content. In doing so, they may be viewed by students as powerful but capricious arbiters or as cold clinicians. Faculty may act more like human resource developers, inviting students to try on engineering to see for themselves if it's a fit, and offering ever more challenging and complex work. Students may view such faculty as disingenuous, as enablers, or as trusted mentors. These perceptions can seem arbitrary and out of faculty control.

In this paper, we offer a framework for making sense of these perceptions. We illustrate the framework empirically, provisioning the reader with concrete examples. More specifically, we bring together research on the ethic of care [1], operationalized through organizational citizenship behaviors (OCBs) [2], with a framework that intersects criticality of feedback with relationship building [3]. We investigate, through cases, how faculty who exhibit specific OCBs can uplift students through critical feedback.

## Theoretical Framework

Research suggests that the ethic of care is a key ingredient to learner-centered teaching and can support diverse student success [1, 4]. Researchers have called for curricular changes to support students to develop care ethics, such as situating design problems as socio-technical and evaluating solutions from a justice lens [5], as this is in line with professional practice [6-8]. We argue that such approaches, while critical for students, can be strengthened by greater articulation of ways faculty display and model care. However, a majority of research on how instructors show care has been conducted in K-12 settings [9] or in fields where care is a major facet of practice (e.g., health care). Thus, care is poorly operationalized, especially in the context

of chemical engineering, making it unclear what faculty might do that students are likely to perceive of as care. While chemical engineering faculty have advocated for showing care, it is not always intuitive what this looks like in the classroom [10]. Faculty may feel they show care through rigor, by holding a high standard and providing critical feedback to prepare students for harsh work environments. Students, especially from groups underrepresented in engineering, may interpret this stance as information indicating that they do not fit in the discipline.

To clarify how faculty can communicate and model care, we link it to the organizational citizenship behavior (OCB) framework [2]. Bateman and Organ [11] proposed the term citizenship behavior in the field of management and they measured behaviors, including compliance, altruism, dependability, housecleaning, complaints, waste, cooperation, criticism of and arguing with others, and punctuality. They found a relationship between general job satisfaction and citizenship behaviors. OCB is defined as behaviors that contribute to “maintenance and enhancement of the social and psychological context that supports task performance” [12]. OCB can be viewed a multi-dimensional construct. Multiple researchers have offered their own frameworks for OCB with different taxonomies for the behaviors. However, a meta-analysis shows strong relationships among most dimensions [13]. The most common dimensions researchers include are [14]:

- *Altruism*: Discretionary behaviors that have the effect of helping a specific other with an organizationally relevant task or problem.
- *Conscientiousness*: Discretionary behaviors on the part of the employee that go well beyond the minimum role requirements of the organization, in the areas of attendance obeying rules and regulations, taking breaks and so forth.
- *Sportsmanship*: Willingness of the employee to tolerate less than ideal circumstances without complaining- to “avoid complaining, pretty grievances, railing against real or imagined slights, and making federal cases out of small potatoes.”
- *Courtesy*: Discretionary behavior on the part of an individual aimed at preventing work-related problems with others from occurring.
- *Civic Virtue*: Behavior on the part of an individual that indicates that he/she responsibly participates in, is involved in, or is concerned about the life of the company.”

In the business field research has demonstrated that OCB dimensions positively influence the organization and individuals in the organization. For example, when people in an organization show OCBs such as altruistic behaviors, other people (e.g. their team members, subordinates, and customers) perform better, feel happier, and tend to stay in the organization longer [15-18]. In educational contexts, OCBs in a college student group can enhance student group cohesion, learning engagement, motivation, and learning performance [19-21]. Teachers’ OCBs enhance school climate and student academic performance [22, 23]. Additionally, in educational contexts, previous studies adopted different dimensions. For example, while Koh and colleagues adopted two dimensional scales of OCB with altruism and compliance, DiPaola and Tschannen-Moran measured OCB as a unidimensional construct [23, 24]. In light of previous research, university faculty OCBs may positively contribute department’s climate, faculty development, and their instructional supports for student learning.

In this research, we situate OCBs in engineering classrooms by considering how content- or learner-centered; this is because content- and learner- centered approaches influence students’

participation and learning [25, 26]. We then overlay the OCBs with a framework by Scott [3] that intersects criticality of feedback with relationship building. Scott's framework details four quadrants: ruinous empathy is where faculty lower their expectations out of concern; obnoxious aggression occurs when feedback is critical but there is not a sufficient relationship; insincere flattery is felt when, in the absence of a caring relationship, faculty provide praise; and radical candor is possible when critical feedback stands on a solid foundation of care.

## Methods

As part of an NSF-funded RED (REvolutionizing engineering and computer science Departments) project, we investigated how chemical engineering faculty, at a large Hispanic-serving Research I university in the Southwest, aimed to show care to students. This broader project, conducted as design-based implementation research [27], has provided ample opportunities for investigating faculty and student perceptions and development in response to collaborative efforts to make the core chemical engineering courses accessible yet high quality. Our approach to data collection has involved long term participant observation, with a learning scientist embedded in the department, and with graduate students and researchers aiming to gather insider accounts by attending courses and developing rapport with students [28-30].

We collected data from 2014-2020 during a department-wide change project, with 18 faculty consenting to participate in the study. Class size varied in response to external pressures (e.g., economy, pandemic), ranging from 40-70 students in core courses. In the current study, we selected cases to highlight the range of OCBs and their relations to the four quadrants of Scott's framework [31]. To answer the research questions using qualitative methods [32], we first generated lists of the kinds of interactions that might reveal OCBs and students' responses, as well as lists of stories that stood out as important to the faculty. We characterized them as important if the faculty shared them multiple times, used a story to block or promote a change, or shared the story to troubleshoot its unexpected outcome. We gathered many possible stories, then identified those that allowed triangulation across data sources. Data included departmental and faculty policies, recordings of faculty workshops, retreats, and meetings, recordings of semi-structured interviews with faculty, and email exchanges. Supplemented by field notes, a total of 60 audio recordings, at least an hour each, were transcribed. A data log provides a summary of this data corpus, with data categorized as containing information about various topics (e.g., assessment, technical writing instruction, learner-centeredness).

The research team, composed of a learning scientist, a change management specialist, qualitative researchers, graduate assistants, and engineering faculty, individually reviewed the selected data with the OCBs and Scott's framework in mind, then met to discuss our interpretations [33]. This process also enabled the research team to perform member checking to establish trustworthiness of interpretations [34]. To enhance the credibility of our process, we made efforts to (dis)confirm our interpretations across data sources (e.g., field notes, recordings, student comments on surveys); we collaborated over six years with the department faculty, providing ample opportunity to situate interpretations; we share detailed descriptions such that readers can follow our interpretations [35].

We analyzed the qualitative data through the lens of OCBs (Table 1) situated by content-centered and learner-centered teaching approaches. We then considered how faculty actions were

perceived by peers and students using Scott’s framework [3], which intersects criticality of feedback with relationship building (Table 2). We merge these frameworks in drawing interpretations.

Table 1. The five dimensions of the organizational citizenship behavior (OCB) framework [14]

<i>Dimension</i>	<i>Description</i>
Altruism	Demonstrated in helping someone with a problem
Conscientiousness	Demonstrated when one goes beyond the minimum expectations
Sportsmanship	Demonstrated when one accepts inconveniences with equanimity
Courtesy	Demonstrated when one anticipates and prevents issues
Civic virtue	Demonstrated when one participates responsively and responsibly in one’s work in ways that show concern.

Table 2. Scott’s framework [3] intersects criticality of feedback with relationship building

<i>Dimension</i>	<i>General description</i>
Obnoxious aggression	“challenge someone directly, but don’t care about them personally” “brutal honesty”
Ruinous empathy	“what happens when you care about someone personally, but fail to challenge them directly.”
Manipulative insincerity	“praise that is non-specific and insincere, or criticism that is neither clear nor kind”
Radical candor	“you show someone that you care personally while you challenge directly, without being aggressive or insincere.”

## Results and Discussion

We first characterized content-centered and learner-centered OCBs as displayed in chemical engineering teaching. We then related these to Scott’s framework [3], which intersects criticality of feedback with relationship building.

**Altruism.** We found examples of altruism, typically demonstrated in helping someone with a problem, that were content-centered or learner-centered. When faculty took a content-centered approach, they helped students with problems they faced in learning content. They provided worked examples of problems, rubrics, study guides, and organized help sessions. In more extreme cases, they offered time outside of normal office hours. For instance, one faculty assigned incomplete grades and met with students over the winter break until satisfied the students reached a passing score. Another offered an intensive section of a course in a compressed timeline, focused on the topics several students missed, to ensure they would be ready for the spring course. Yet another implemented a highly iterative process for assignments, where they were reviewed and refined throughout the course of the semester with multiple drafts, culminating in a portfolio where students described what changed and what they learned.

When faculty took a learner-centered approach to altruism, they sought to understand and make connections between content and students' interests and experiences. They did so in order to help students make connections and identify individualized ways to support growth. For instance, an Indigenous student who was struggling, in meeting with a faculty member, disclosed their interest in solar energy for their community. In addition to helping the student understand connections between course content and solar energy, the faculty member also helped them get into a research lab studying solar energy.

Learner-centered altruism sometimes means helping students with problems outside the course, such as finding an internship and preparing application materials. One faculty member took a poll of seniors and discovering their concern about the future (both entering graduate school and industry) chose to implement a series of workshops in their course rather than overburdening students with content. This faculty member implemented workshops designed to bring outside speakers with advice and knowledge the students felt as though they lacked (determined through the survey). Workshops allowed students to ask questions and gain advice from experts in areas such as graduate admissions, industry hiring practices, and startup logistics.

We note that these examples overlap with conscientiousness, but are distinctive in that they focus specifically on helping students acquire content (in content-centered approaches) or grow in more individualized ways that often spill outside classroom walls (in learner-centered approaches).

**Conscientiousness.** We found examples of conscientiousness—typically demonstrated when one goes beyond the minimum expectations—that were content-centered or learner-centered. When faculty took a content-centered approach, they put in time and/or effort to ensure the content of their courses was always current, providing up-to-date versions of texts and materials, making sure to update notes, course materials, exams, and activities. They reviewed websites where students share answers and aimed to create assignments and exams less susceptible to plagiarism.

When faculty took a learner-centered approach to conscientiousness, they put in time and/or effort to learn about their students' interests, experiences, and lives; they used this information in planning course activities and examples. For example, several faculty hired peer learning facilitators—students who had just completed the course. Rather than simply asking these students to grade, they sought their ideas in planning the course, situating the students as part of the instructional team. Such faculty also updated their course materials, but they put effort into researching authentic applications of course content and checking with peer learning facilitators on ways to make applications interesting to students. When creating or refining assignments, they sought guidance and feedback on whether students could jointly express their understanding and interests. For instance, in Thermodynamics, after noticing that an overly open-ended project (propose an application of evaporative cooling) was not interesting to students, the faculty added specific constraints. When the project then became too constrained (all students found the same answer for using evaporative cooling to keep medicine at a specific temperature in the same environmental conditions), the faculty identified a balance in which students had options, not just about the solution, but about how they framed the problem (students made decisions about the purpose of cooling medicine as storage, or short or long distance transportation and location, and in turn these informed the kinds of solutions that made sense). Faculty also considered supports that would help students extend the kinds of problems they could address. For instance, one

faculty created an Excel tool to allow sophomore students in Mass & Energy Balances to use techno-economic modeling to make recommendations about algal biofuel production in specific rural communities. Faculty also took time to check in with students about their wellbeing. For instance, during a lecture in a junior-level laboratory course, a student mentioned being sick and therefore quarantined; the faculty stopped lecturing to confirm that the student had support at home including access to food delivery and medical care. This would overlap with altruism had the student expressed a need and the faculty member offered aid. In a senior-level laboratory the faculty instituted office hours where a portion of the time was devoted to general discussion of student lives, including wedding planning, pets, home renovation, and stories of the students' children.

**Sportsmanship.** We found examples of sportsmanship, typically demonstrated when one accepts inconveniences with equanimity, that were content-centered or learner-centered. Sportsmanship is typically the most difficult OCB to identify, as it is the absence of complaint, a construct that is somewhat challenging to envision in faculty meetings where voicing complaint can sometimes lead to needed change. Within the teaching mission, we characterize sportsmanship in terms of some of the challenges faculty typically encounter and might raise with students. When faculty took a content-centered approach, they completed grading in a timely and fair fashion without complaining to students about the burden of grading. They provided clear feedback about errors to aid students in developing accurate conceptions. They reminded students to take major assignments and/or exams seriously, including by sharing comprehensive rubrics for evaluation to show expectations, and, when students did not, they did not chastise students. They did not air concerns about students who failed to meet these marks, allowing the rubrics to communicate this to students.

When faculty took a learner-centered approach to sportsmanship, they avoided issues that might have led them to want to complain about student progress. For instance, they accepted that students have other pressures on their time and commitments to family, work, and their development as people ready for both careers and society. As a result, they made major deadlines clear and scaffolded students to make progress and receive feedback along the way. They therefore situated revision as endemic to learning, not as a failure to be correct on the first try. They made reasonable accommodations for students who suffered hardships, and did not make them feel guilty for needing extensions. For instance, one faculty relaxed the need to have assignments submitted on time entirely with the request that students communicate with the instructional team about the late work and convey a plan for completion. This allowed students to dynamically manage their time when unexpected issues arose, including several students who suddenly became caretakers for others due to the COVID-19 pandemic. In many such cases, the students seeking supports were high achieving and reluctant to accept help, but by displaying sportsmanship, faculty reassured students that it was appropriate to do so. In this way, faculty reinforced a mastery rather than performance approach to learning.

**Courtesy.** We found examples of courtesy—typically demonstrated when one anticipates and prevents issues—that were content-centered or learner-centered. When faculty took a content-centered approach, they anticipated which topics and assignments/exams would prove difficult for many students. They provided or offered additional resources, such as study guides, help sessions, and examples. They provide low-stakes assessments to prepare students for high stakes



assessments. They communicated clear and comprehensive course policies so students understood their responsibilities.

When faculty took a learner-centered approach to courtesy, they anticipated issues students may face with teamwork; they used research-based means to form teams and provided tools and resources for students to develop as team members. For instance, one course provided specific discussion about how best to be part of a team doing collaborative work online rather than in person. Faculty also anticipated students might experience loss, grief, and other hardships that negatively impact performance and learning; they provided options for students in line with the severity of the hardship. They communicated this in course policies so students understood their options.

**Civic virtue.** We found examples of civic virtue—typically demonstrated when one participates responsively and responsibly in one’s work in ways that show concern—that were content-centered or learner-centered. When faculty took a content-centered approach, they used low stakes formative assessments to make instructional decisions. Faculty responsively revisited information that was poorly acquired and provided resources when only a subset of students showed need of them. They checked for individual understanding on group projects. They responded enthusiastically when students displayed interest in the content and aimed to motivate those who did not by reminding them of the importance of the content.

When faculty took a learner-centered approach to civic virtue, they also used low-stakes formative assessment to make instructional decisions, but rather than reteaching missed content, they sought other resolutions. For instance, they met with other faculty to create a new assignment that represented a major shift in how the content was framed or to determine where else in the program students might encounter the information. In some cases, they questioned the accuracy of the assessment because they had other sources of information about what the students knew. For instance, one faculty member chose to implement a portfolio as the final assessment in a laboratory course; they instituted a short, written assignment that asked students to argue for and show evidence of what they learned through the semester. The faculty found that this method asked students to display what they knew in a dynamic way that also removed high-stakes pressure on student performance. When students did not express enthusiasm or interest in content, they sought ways to connect content to students’ experiences. For instance, when describing evaporative cooling, faculty offered multiple examples, from swimming to Indigenous water storage. In such instances, we see that faculty recognize that their own passion for a topic may not be meaningful to students, and they make an effort to identify connections that matter to students.

While we also found examples where faculty did not display OCBs, our focus here is to characterize how chemical engineering faculty communicate care in content-centered and learner-centered ways, and to consider how students interpret these and respond, using Scott’s framework of obnoxious aggression, ruinous empathy, manipulative insincerity, and radical candor. We provide examples from our data below to build our interpretation and then summarize these links more generally (Table 3). We include a map of the connections between OCBs and Scott’s framework so readers can see how learner-centered and content-centered OCBs align to specific aspects of Scott’s framework (Table 4).

Table 3. Summary of links between Scott’s framework and learner- and content-centered OCBs

<i>Dimension</i>	<i>OCBs</i>
Obnoxious aggression	Faculty display primarily content-centered OCBs, especially content-centered altruism in the form of critical feedback without displaying care for the person. Students perceive feedback as harsh. In displaying content-centered contentiousness, they watch for plagiarism and respond in ways that show they value content and codes-of-ethics over learners. Even when not displaying poor sportsmanship, their policies communicate to students that accuracy and efficiency are valued over meaning-making. This can serve as an incentive to high-performing students and a disincentive to lower performing students and students with lower self-efficacy. In displaying content-centered courtesy and civic virtue, faculty prepare resources and provide feedback on progress; with few truly low-stakes opportunities for feedback, these reinforce the primacy of accurate and efficient knowledge acquisition.
Ruinous empathy	Faculty display short-sighted learner-centered altruism and courtesy behaviors, expressing care for students in ways that lower their expectations out of concern. Paired with content-centered contentiousness, sportsmanship, and civic virtue—which anchor the course value system to efficient and accurate content acquisition—students recognize that faculty don’t see their potential in engineering. Ruinous empathy may be situational, such as a temporary response during the pandemic, or a response to select students for whom faculty develop lower expectations.
Manipulative insincerity	Faculty display content-centered altruism and civic virtue, communicating expectations above what they know students can meet through planned assignments, exams, and feedback, paired with praise for students’ accomplishments on challenging work. In the absence of a caring relationship, students mistrust the praise or view it as ineffective feedback. Faculty display some learner-centered sportsmanship and courtesy behaviors as they view issues as endemic to authentic practice, but their content-centered values, communicated through content-centered altruism and civic virtue, suggest to many students, even, and sometimes especially to high performing students, that there is little hope or clarity about how to meet the disciplines expectations.
Radical candor	Faculty primarily display learner-centered OCBs, especially learner-centered altruism, courtesy, and civic virtue. Collectively, these learner-centered OCBs equip faculty to plan and respond in ways that support learning. When they offer critical feedback, students perceive it as an opportunity for growth.

**Obnoxious aggression.** One faculty member who exclusively exhibited content-centered OCBs was viewed by many students as brutally honest. Using Scott’s framework [3], we would categorize this faculty as displaying obnoxious aggression from the students’ point of view. This included the faculty member assigning fractions of a single point to assignments with hundreds of total possible points. Other faculty who displayed mostly content-centered OCBs, and especially content-centered altruism, invested effort in providing feedback to students with a focus on detail and accuracy. Yet, because they primarily showed care about the content, and not about the learners, students perceived the feedback as obnoxious aggression. Students in some

courses responded as if it were a self-fulfilling prophesy, investing less effort and self-sabotaging out of a belief that they could not succeed in a particular faculty member's course. More advanced students tended to persist regardless, yet expressed concerns about their potential to others.

**Ruinous empathy.** We found no faculty who were perceived by many students as what Scott characterized as having ruinous empathy, though we observed a few instances of it, especially amidst the pandemic. For instance, faculty were uncertain about how to evaluate student work, when prior to the pandemic, the same students turned in high quality work. We would characterize this as tied to courtesy and altruistic behaviors, as faculty struggled with whether to simply lower their expectations or to find ways to sustain and scaffold learning.

Those faculty whom students viewed as being obnoxiously aggressive indicated in various ways that they viewed other faculty as displaying ruinous empathy. Specifically, faculty who took a highly content-centered approach raised concerns that other faculty must have lowered their standards to allow students to pass their courses, even prior to the pandemic.

**Manipulative insincerity.** We found few instances of manipulative insincerity overall, though two notable situations stood out as such. In the first, faculty provided highly authentic problems paired with critical feedback, but they did not develop rapport with students. These faculty showed their passion for the problems, and when they eventually praised students for the progress made, students expressed mistrust. Here, we see content-centered OCBs of courtesy and contentiousness, as these faculty indeed invested deeply in the problems beyond the teaching mission.

In a similar case, students in the brainstorming phase of a highly authentic problem were asked to submit questions to a forum asking anything they were wondering about the topic. The faculty (also expert in the field of the problem) responded to the questions, in many cases with criticism of the student understanding of this new topic (before they had a chance to learn and explore) and dismissed students who engaged in impractical but creative ideation. Faculty displayed content-centered OCBs by holding students to a high standard for the authentic context.

In another instance, following norms in their own education, faculty used exams that they expected students to perform poorly on, then applied a curve or set a scale such that most students received passing and even high scores. In the absence of a caring relationship, students viewed this as a form of hazing.

We anticipated also finding instances related to content-centered sportsmanship, in which faculty, as they shifted from typical technical writing instruction ("bleed all over it") to research-based feedback-and-revision, might display an aversion to student complaints, and as a result, provide minimal feedback in ways too vague for students to use. Perhaps because of a close partnership with a writing instructor, we did not identify instances like this.

**Radical candor.** We observed several faculty who primarily exhibited learner-centered OCBs and would be categorized as displaying radical candor. In these cases, faculty especially displayed learner-centered altruism, and this served as a powerful foundation for their other learner-centered behaviors, especial civic virtue and courtesy, where they anticipated and

responsively tailored supports, while also showing compassion. For instance, faculty provided critical feedback while making it clear that the goal was student growth, signaled by allowing students to make revisions. One faculty member provided written feedback to student groups, then met with them over Zoom to address concerns and discuss specific plans for improvement, thus allowing students to achieve the level of work quality they desired. Faculty communicated that such feedback was a normal part of the learning process, rather than framing it as rating or ranking students by their accuracy and efficiency.

While we have characterized that faculty who primarily display content-centered OCBs are likely to be perceived by students as obnoxiously aggressive, and those who primarily display learner-centered OCBs as radically candid, differentiating between ruinous empathy and manipulative insincerity is more subtle (Table 4). In both, faculty displayed content-centered conscientiousness and civic virtue, as well as learner-centered courtesy. We found that altruism and sportsmanship differentiated these two ways students tend to perceive faculty (Table 4). When faculty showed learner-centered altruism paired with content-centered sportsmanship, this stance signaled ruinous empathy to students, suggesting that faculty held a high bar many could never meet. In contrast, when faculty displayed content-centered altruism paired with learner-centered sportsmanship, this stance signaled manipulative insincerity to students, suggesting that repeatedly revisions of their work was more a form of hazing than learning.

Notably, we observed the same students' behaviors in courses from semester to semester, across faculty. This provided some confirmation that students' behaviors were shaped by their perceptions of faculty in relation to the four categories proposed by Scott. For instance, we saw that in a course taught by a faculty member who consistently displayed radical candor, students exhibited both critique and care with one another. Likewise, in an in-class activity, students shared research they had done on different algal species as contenders for algal biofuel production. When one student shared their disappointing set, another student immediately suggested eliminating these algae from consideration, but then asked if the first student was okay with that decision, as they wanted "everyone's voice to be heard."

We observed in a course taught by a faculty member perceived as obnoxiously aggressive, students were reluctant to participate. The instructor reported difficulties to other faculty, including that students were not taking feedback on work, not communicating with the instructor if there were questions, and were stubborn and not open to learning. Yet the same students the next semester, in a course taught by a faculty member they perceived as having radical candor, appeared highly engaged. They proactively interacted with the instructors and their peers, took feedback well, and engaged with the course material. The instructor noted that the students rose to the occasion and did whatever was asked of them. These observations align to learning theory previously applied to chemical engineering education [36], showing that learners rise to the occasion when faculty jointly show care—especially in ways aligned to learner-centered OCBs—and hold high expectations.

Table 4. Mapping between content-centered (CC) and learner-centered (LC) OCBs and Scott’s framework shows that there are different patterns in content- versus learner-centered OCBs that produce perceptions aligned to Scott’s framework

OCBs	Obnoxious aggression	Ruinous empathy	Manipulative insincerity	Radical candor
Altruism	CC	LC	CC	LC
Conscientiousness	CC	CC	CC	LC
Sportsmanship	CC	CC	LC	LC
Courtesy	CC	LC	LC	LC
Civic virtue	CC	CC	CC	LC

### Significance and implications

We found that characterizing OCBs as learner- or content-centered provided a means to understand the ways chemical engineering faculty aimed to show care in their teaching. By interpreting these behaviors in light of Scott’s framework of criticality of feedback and relationship building, we can see how variability in behaviors, and especially a mix of learner- and content-centered can shape particular perceptions. Together, we argue this approach can aid faculty in understanding students’ reactions to their teaching, and we share some implications for teaching based on this approach.

First, we note that mixed use of learner- and content-centered OCBs can affect students’ perceptions of the feedback that is critical for their learning. In line with Scott’s framework, faculty who consistently demonstrated learner-centered OCBs were able to demand much from students, who in turn rose to meet high expectations. This aligns to research in engineering teaching showing that care for the student as a person, evidenced by focusing on their individual characteristics and needs, is different from putting care-as-effort into teaching [37]. In our case, we saw altruism when faculty made connections with students and supported their learning through individualized supports. Similar to the findings reported in understanding faculty response to the COVID-19 pandemic, students benefited when faculty “authentically cared not only about their academic success but as individuals” [38].

Second, as the other learner-centered OCBs largely hinge on learner-centered altruism, our research suggests faculty should identify ways to show their interest in students, build rapport, and be ready to respond with patience rather than judgment. Faculty can share their own challenges as a means to build rapport—not in a way that suggests poor sportsmanship, but that shares the human experience (e.g., acknowledging their own and therefore students’ potential difficulties navigating the pandemic, feeling pressure related to an impending grant deadline, much as students do about assignment deadlines). Likewise, even in large enrollment classes, faculty can signal their interest in student wellbeing through opportunities for students to share their experiences and concerns, such as in muddy point questions, minute papers, and brief surveys. If possible, peer learning facilitators—undergraduate students who previously competed

the course—can be helpful in scaling caring practices, informing faculty of issues that are emerging.

Third, as student behavior appeared to be shaped by faculty OCBs, faculty who display learner-centered altruism may also benefit team dynamics and academics. Past research has shown that students who display OCBs benefit academically as they are able to learn more from peer interactions [19]. Collectively, our findings are in line with caring pedagogy research [39] that reports increased motivation and learning outcomes on the part of students when they perceive faculty as caring about them by getting to know students and providing constructive feedback [40]. This line of work suggests that part of why learner-centered instruction is effective is that students increase in their engagement and see more opportunities to learn, such as from feedback and from peers. Faculty who care and hold high-but-reachable expectations for students may see similar expectations and behaviors reflected by students.

### ***Acknowledgments***

This material is based upon work supported by the National Science Foundation under Grant No. 1623105. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

### **References**

- [1] N. Noddings, "The caring relation in teaching," *Oxford Review of Education*, vol. 38, no. 6, pp. 771-781, 2012.
- [2] D. W. Organ, *Organizational citizenship behavior: The good soldier syndrome*. Lexington Books/DC Heath and Com, 1988.
- [3] K. Scott, *Radical Candor: Fully Revised & Updated Edition: Be a Kick-Ass Boss Without Losing Your Humanity*. St. Martin's Press, 2019.
- [4] M. Pantazidou and I. Nair, "Ethic of care: Guiding principles for engineering teaching & practice," *Journal of Engineering Education*, vol. 88, no. 2, pp. 205-212, 1999.
- [5] K. L. Gunckel and S. Tolbert, "The imperative to move toward a dimension of care in engineering education," *Journal of Research in Science Teaching*, vol. 55, no. 7, pp. 938-961, 2018.
- [6] J. L. Hess, J. Strobel, R. Pan, and C. A. Wachter Morris, "Insights from industry: a quantitative analysis of engineers' perceptions of empathy and care within their practice," *European Journal of Engineering Education*, vol. 42, no. 6, pp. 1128-1153, 2017.
- [7] R. C. Campbell, K. Yasuhara, and D. Wilson, "Care ethics in engineering education: Undergraduate student perceptions of responsibility," in *Frontiers in Education Conference (FIE), 2012*, 2012, pp. 1-6: IEEE.
- [8] J. Strobel, J. L. Hess, R. Pan, and C. A. Wachter Morris, "Empathy and care within engineering: Qualitative perspectives from engineering faculty and practicing engineers," *Engineering Studies*, vol. 5, no. 2, pp. 137-159, 2013.
- [9] L. M. Owens and C. D. Ennis, "The ethic of care in teaching: An overview of supportive literature," *Quest*, vol. 57, no. 4, pp. 392-425, 2005.

- [10] T. Q. Gardner, "A Framework to Guide Design of Interactive and Constructive Learning Opportunities," in *Proceedings of 2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah*, < <https://peer.asee.org/29683>, 2018.
- [11] T. S. Bateman and D. W. Organ, "Job satisfaction and the good soldier: The relationship between affect and employee "citizenship"," *Academy of Management Journal*, vol. 26, pp. 587-595, 1983.
- [12] D. W. Organ, "Organizational citizenship behavior: It's construct clean-up time," *Human performance*, vol. 10, no. 2, pp. 85-97, 1997.
- [13] J. A. LePine, A. Erez, and D. E. Johnson, "The nature and dimensionality of organizational citizenship behavior: a critical review and meta-analysis," *Journal of applied psychology*, vol. 87, no. 1, p. 52, 2002.
- [14] P. M. Podsakoff, S. B. MacKenzie, R. H. Moorman, and R. Fetter, "Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors," *The leadership quarterly*, vol. 1, no. 2, pp. 107-142, 1990.
- [15] C. C. Lin and T. K. Peng, "From organizational citizenship behaviour to team performance: The mediation of group cohesion and collective efficacy," *Management and Organization Review*, vol. 6, no. 1, pp. 55-75, 2010.
- [16] P. M. Podsakoff and S. B. MacKenzie, "Impact of organizational citizenship behavior on organizational performance: A review and suggestion for future research," *Human performance*, vol. 10, no. 2, pp. 133-151, 1997.
- [17] S. Bruque, J. Moyano, and R. Piccolo, "OCB and external–internal social networks: effects on individual performance and adaptation to change," *The International Journal of Human Resource Management*, vol. 27, no. 1, pp. 1-22, 2016.
- [18] S. M. Walz and B. P. Niehoff, "Organizational citizenship behaviors: Their relationship to organizational effectiveness," *Journal of Hospitality & Tourism Research*, vol. 24, no. 3, pp. 301-319, 2000.
- [19] B. J. Allison, R. S. Voss, and S. Dryer, "Student classroom and career success: The role of organizational citizenship behavior," *Journal of Education for Business*, vol. 76, no. 5, pp. 282-288, 2001.
- [20] J. Byun, S. P. Kang, V. Law, and Y. Seo, "Citizenship Behavior and Learner Engagement in Collaborative Learning: Exploring Dual Mediation with Emergent Leadership and Group Cohesion," *International Journal of Teaching and Learning in Higher Education*, vol. 32, no. 3, 2020.
- [21] S. X. Chen and T. P. Carey, "Assessing citizenship behavior in educational contexts: The role of personality, motivation, and culture," *Journal of Psychoeducational Assessment*, vol. 27, no. 2, pp. 125-137, 2009.
- [22] M. DiPaola and M. Tschannen-Moran, "Organizational citizenship behavior in schools and its relationship to school climate," *Journal of School Leadership*, vol. 11, no. 5, pp. 424-447, 2001.
- [23] M. F. DiPaola and W. K. Hoy, "Organizational citizenship of faculty and achievement of high school students," *The high school journal*, vol. 88, no. 3, pp. 35-44, 2005.
- [24] W. L. Koh, R. M. Steers, and J. R. Terborg, "The effects of transformational leadership on teacher attitudes and student performance in Singapore," *Journal of organizational behavior*, vol. 16, no. 4, pp. 319-333, 1995.

- [25] M. T. Hora, "Exploring faculty beliefs about student learning and their role in instructional decision-making," *The Review of Higher Education*, vol. 38, no. 1, pp. 37-70, 2014.
- [26] K. Trigwell, M. Prosser, and P. Taylor, "Qualitative differences in approaches to teaching first year university science," *Higher education*, vol. 27, no. 1, pp. 75-84, 1994.
- [27] B. J. Fishman, W. R. Penuel, A.-R. Allen, B. H. Cheng, and N. Sabelli, "Design-Based Implementation Research: An Emerging Model for Transforming the Relationship of Research and Practice," *National Society for the Study of Education Yearbook (NSSE Yearbook)*, vol. 112, no. 2, 2011.
- [28] P. Atkinson and M. Hammersley, "Ethnography and participant observation," in *Handbook of qualitative research*, vol. 1, N. Denzin and Y. S. Lincoln, Eds. no. 23) Thousand Oaks, CA: Sage Publications, 1994, pp. 248-261.
- [29] H. Becker and B. Geer, "Participant observation and interviewing: A comparison," *Human organization*, vol. 16, no. 3, pp. 28-32, 1957.
- [30] D. L. Jorgensen, *Participant observation*. Wiley Online Library, 1989.
- [31] R. E. Stake, *Multiple case study analysis*. Guilford Press, 2013.
- [32] N. K. Denzin and Y. S. Lincoln, *Strategies of qualitative inquiry*. Sage, 2008.
- [33] M. D. LeCompte and J. J. Schensul, *Designing & Conducting Ethnographic Research (The Ethnographer's Toolkit (2nd ed., Vols. 1–Book 1 of the Ethnographer's toolkit))*. Lanham, MD: AltaMira Press, 2010.
- [34] R. E. Stake, *The art of case study research*. sage, 1995.
- [35] J. W. Creswell and D. L. Miller, "Determining validity in qualitative inquiry," *Theory into practice*, vol. 39, no. 3, pp. 124-130, 2000.
- [36] B. Abdul *et al.*, "Experience with a cross-disciplinary intensive, hands-on pre-transport course," in *ASEE Annual Conference and Exposition, Vancouver, BC*, 2011.
- [37] J. A. Baier, I. Hilliger, X. Hidalgo, and C. Melian, "What is care in Engineering teaching?," *Proceedings of ASEE Annual Conference & Exposition*, 2020.
- [38] L. A. Gelles, S. M. Lord, G. D. Hoople, D. A. Chen, and J. A. Mejia, "Compassionate Flexibility and Self-Discipline: Student Adaptation to Emergency Remote Teaching in an Integrated Engineering Energy Course during COVID-19," *Education Sciences*, vol. 10, no. 11, p. 304, 2020.
- [39] A. Velasquez, R. West, C. Graham, and R. Osguthorpe, "Developing caring relationships in schools: A review of the research on caring and nurturing pedagogies," *Review of education*, vol. 1, no. 2, pp. 162-190, 2013.
- [40] T. F. Hawk and P. R. Lyons, "Please don't give up on me: When faculty fail to care," *Journal of management education*, vol. 32, no. 3, pp. 316-338, 2008.