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Asking Great Questions

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ABSTRACT
The questions we ask and how we ask them will make a difference in how successful we are in meetings, in collaborations, and in our careers as statisticians and data scientists. What makes a question good and what makes a good question great? Great questions elicit information useful for accomplishing the tasks of a project and strengthen the statistician-domain expert relationship. Great questions have three parts: the question, the answer, and the paraphrasing of the answer to create shared understanding. We discuss three strategies for asking great questions: preface questions with statements about the intent behind asking the question, follow the question with behaviors and actions consistent with the prefaced words including actions such as listening, paraphrasing, and summarizing; and model a collaborative relationship via the asking of a great question. We describe the methods and results of a study that shows how questions can be assessed, that statisticians can learn to ask great questions, and that those who have learned this skill consider it to be valuable for their careers. We provide practical guidelines for learning how to ask great questions so that statisticians can improve their collaboration skills and thus increase their impact to help address societal challenges.

Key Words: statistical consulting, statistical collaboration, statistical practice, statistics education, data science, shared understanding

1. INTRODUCTION
Industry, government, and academia increasingly demand that the statisticians and data scientists they hire can effectively interact with non-statisticians (Geller, 2011). For many statisticians, inadequacy in communication skills can inhibit their ability to make a positive impact on society (Hoadley & Kettenring, 1990). Statisticians need to become proficient in essential communication and collaboration skills so that they may effectively collaborate with domain experts to make discoveries and create innovations, and ultimately to transform evidence into action (Olubusoye et al., 2021) that will help societies develop and improve the lives of people worldwide (Vance & Love, 2021).

To help overcome the challenges of communication, the literature on statistical consulting and collaboration is filled with advice for statisticians to ask *good* questions. Kimball (1957) states that asking good questions can help prevent the commission of Type III errors (i.e., providing the right answer to the wrong question). Lurie (1958) writes that a statistician has the responsibility to ask scientists three "impertinent" questions and recommends statisticians provide the reasons for asking these questions to make them seem less impertinent.

In Derr's chapter on "Asking Good Questions" (2000, chap. 5), she asserts that statistical problem-solving begins with questions. The statistician needs to know what questions to ask and how to ask them to get accurate and complete information about the domain expert's problem and the statistical issues in their field. Similarly, Vance et al. (2020) advise statisticians to ask domain experts questions that will 1) improve the domain experts' understanding of their own research questions, 2) advance the domain experts' understanding of the statistical analyses that will answer these questions, 3) gather information to improve the statistician's understanding of the domain problem, and 4) improve the statistician's understanding of the statistical issues to enable the development of appropriate analyses that will answer the domain questions. Most recently, Sharp et al. (2021) produced ten videos to help students learn statistical collaboration and specifically to demonstrate the power of asking good questions.

While this literature extols the virtues of asking *good* questions, we believe that every statistician can improve their statistical collaboration skills and thereby increase their potential to help address societal challenges by asking *great* questions. This article explains how statisticians and data scientists can ask great questions and provides results indicating that this collaborative skill can be learned and successfully implemented in practice. Section 2 explains what makes a question good and what makes a question *great*. Section 3 presents three strategies for how to ask great questions, illustrates these strategies with examples, and outlines five steps to implement the strategies in practice. As a counterpoint, Section 4 provides examples of bad questions. In Section 5 we describe results from an experiment quantifying the impact of 20 questions on the task and relationship in a collaboration. We also examine survey results indicating that asking great questions is a skill that can be learned and improved with practice. Section 6 discusses how asking great questions can improve the practice of statistics and data science. We conclude in Section 7.

2. WHAT IS A *GREAT* QUESTION?

Derr (2000) characterizes *good* questions as those that help the statistician identify an appropriate scientific question and then translate the scientific question into a scientific model, the scientific model into a statistical model, and the statistical model into an answer to the scientific question. In other words, a *good question* elicits the information necessary to provide a correct answer to the right scientific question. Derr's model for asking good questions has three parts:

1. Ask questions to avoid making a Type III error (Kimball, 1957).
2. Identify what one needs to find out from the domain expert. Specifically, "What type of investigation is this?" (i.e., a designed experiment, sample survey, or observational study) "At what stage is this investigation?" (i.e., is it in the planning, analysis, interpretation, or implementation stage) "What limits and constraints govern the study?" (i.e., ask questions to become familiar with typical statistical issues that arise in the domain of study)
3. Develop an effective strategy for gathering information, which means:
   A) Avoid poor communication strategies such as asking jargon-filled closed questions or leading questions
   B) Adopt more effective communication strategies such as using open probes to get general information, using closed probes to get specific information, using concrete paraphrasing to clarify one's understanding, and integrating both open and closed probes to get the general and specific information needed to translate the domain expert's problem into a statistical model.

In the ASCCR Framework of collaboration, Vance and Smith (2019) identifies *task* and *relationship* as two parts of every collaboration. This is similar to the concept in the leadership literature that effective servant leaders should focus on results and relationships (Blanchard, 2018; Greenleaf & Senge, 2002). Vance (2020) relates this to statistical collaboration by making the case that there are two terminal goals for every collaboration: making a deep contribution (task) and creating a strong relationship. Applying this theory to asking questions, a ***good question*** elicits information necessary to successfully accomplish the *tasks* of the project toward making a deep contribution OR strengthens the *relationship* between the statistician and domain expert. A *great* question does both. Formally, a

great question elicits information necessary to successfully accomplish the *tasks* of the project and strengthens the *relationship* between the statistician and domain expert.

A great question accomplishes two goals simultaneously, such as when a parent reads a child a bedtime story. Reading helps improve the child's cognitive skills (task) while strengthening the parent-child bond (relationship). Similarly, a great question improves a statistician's ability to complete the task and strengthens their relationship with the domain expert.

For example, a consulting or collaborative statistician can ask, "My goal for this initial meeting is to understand your research questions, which will help me think about the specific statistical issues. What would you like to accomplish in this meeting?" This question puts onto the meeting agenda at least two items that will elicit information about the domain problem helpful to make expert statistical decisions. This questions is also asked in a way that will strengthen the relationship by being respectful of the domain expert's wants for the meeting (Zahn, 2019).

Figure 1 shows where questions can be in the space defined by two dimensions: how well the question elicits information necessary toward accomplishing the task (x-axis) and to what degree it strengthens or weakens a relationship (y-axis). Great questions in quadrant I are high along both axes. Good questions are strong along one dimension. Questions in quadrant IV, such as the impertinent questions suggested by Lurie (1958), may elicit important information to accomplish the task but at the expense of weakening the relationship. By contrast, "bonding" questions in quadrant II strengthen relationships but detract from directly accomplishing the task. Bad questions in quadrant III sabotage progress toward making a deep contribution and weaken relationships.

3. METHODS/STRATEGIES FOR ASKING GREAT QUESTIONS

Vance et al. (2021) deconstructs great questions into three components: the question, the answer, and the paraphrasing of the answer. The question itself can strengthen the relationship by helping to align goals; increasing the amount of co-creation; improving mutual levels of trust, regard, and loyalty; and cultivating the relationship through appropriate time and attention (for details and examples see Vance et al. 2021). The answers to a mix of open-ended and closed questions can provide useful information for accomplishing the task while mitigating potential confirmation bias (Klayman, 1995). Paraphrasing and summarizing the answer creates shared understanding, which Vance et al. (2022) describe as occurring when the statistician and domain expert have a common interpretation of a concept, fact, or idea (i.e., the answer to a great question) and its relevance for achieving the goals of the project. Creating shared understanding is helpful for both accomplishing the task and strengthening the relationship. Altogether, great questions help statisticians make deep contributions to projects and strengthen their relationships, which are the two end goals of a collaboration (Vance, 2020). In this section, we discuss three strategies for transforming good questions that elicit useful information into great questions that also strengthen the relationship. We provide examples (**in bold**) to help the reader develop a sense for how and when to use each strategy in practice.

3.1 Preface Questions with Their Intent

To help strengthen the relationship with the domain expert and elicit more useful information, briefly explain *why* one is asking the question. In other words, we recommend prefacing a question with statements clarifying the statistician's intention behind asking the question. For example, on a project regarding livestock, instead of just asking "How did you assign the test diets to the animals?" (Derr, 2000, p. 86), preface the question with an explanation of why the answer will be important for achieving your shared goals. A great question would be **"The statistical models we will use to compare the effectiveness of the animal diets depend on details of the experiment, and I want to be sure I use the most appropriate model. So how did you assign the test diets to the animals?"**

Prefacing one's intent provides an opportunity for the domain expert to answer an even better, unasked question because he or she understands the intent of the question. It can also transform a

series of questions from what may feel like a bombardment to the domain expert (e.g., the impertinent questions described by Lurie (1958)) into a logically flowing conversation whose goal is to provide the statistician with all of the details relevant for creating a statistical model. Derr provides an example of such a conversation (2000, pp. 82–83), which is more pleasant for both statistician and domain expert. Prefacing intent also provides the domain expert information and a window into the statisticians' thinking. Rather than the statistician always asking questions and being on the receiving end of an information transfer, this strategy makes the process of statistical analysis more transparent and less of a mystery to collaborators.

Sometimes, instead of stating their intent, statisticians can ask questions that imply their intent. For example, **"It seems as if your research questions are not completely defined yet. I often see this with people I work with. Would it be useful if I asked you a series of questions to help clarify your options and your goals for your research?"** The implied intent behind this question is that the statistician wants to use their experience to be helpful. Questions that imply a helpful intention while clarifying the research questions are great questions.

3.2 Follow up and Follow Through: Listening, Paraphrasing, and Summarizing

A second strategy is to follow questions with behaviors and actions consistent with one's words and with one's commitment to building a strong collaborative relationship with the domain expert. Specifically, follow up asking a great question by actively listening and then paraphrasing or summarizing the domain expert's response (see Vance et al. (2022) for tips on doing this). For example, **"Am I understanding correctly? We want to determine how X affects Y in the presence of Z?"**

Another aspect of this strategy is to follow up a question with useful options for the domain expert to consider. For example, instead of just asking, **"Can the animals in the experiment interact with each other?"**, follow such a question with further clarification of the intent behind the question and specific options: **"… because if they can we may want to consider how the treatment given to one animal might spillover to another, and whether all of the animals in the pen should be considered one experimental unit. If there is only minimal interaction, we may be able to model each animal independently."**

Following open-ended questions with concrete paraphrasing is one of Derr's (2000) recommended questioning strategies. For example, the statistician might ask, **"How were the test diets assigned to the animals?"** and then paraphrase the answer in her own words while also phrasing it as a question to check her understanding: **"So, to make sure I understand, the diets were not randomly assigned to each cow, but rather the first ten cows to enter the pen were given Diet A and the next ten cows got Diet B?"** Following up with a summary that explains how the information is useful for determining the best statistical methods can help the domain expert learn statistics and thereby strengthen the relationship and improve the potential outcomes of the project.

Statisticians who successfully paraphrase such that both parties know without any doubt that they share a common understanding of a concept or idea are better equipped to apply accurate statistical representations to the domain experts' problems (Hand, 1994), avoid Type III errors (Kimball, 1957), and become stronger collaborators (Ellenberg, 2000). Furthermore, when knowledge is created together through the back and forth of questioning, listening, paraphrasing, and summarizing, the relationship is strengthened. For these reasons, questions whose answers are paraphrased to create shared understanding are great questions.

Following through on any promises made or implied via one's questions is a sure way to strengthen relationships by establishing trust and creating shared understanding. In our experience, the inverse—not following through—weakens relationships. Similarly, we recommend pursuing the logical consequences of a domain expert's answer with follow-up questions to create shared understanding of

the relevant facts of the project and thereby strengthen the relationship. For example, following up by listening, paraphrasing, and asking another question turns this next question into a great question: **"When running the experiment, did you give each animal the treatment diets in the same order?"** (Domain expert replies, "No.") **"So the animals did not receive the diets in the same chronological order… In what order did each of the animals receive the test diets, because the order might affect how we analyze the data?"**

3.3 Model and Cultivate a Collaborative Relationship

The questions we ask and how we ask them demonstrate to the domain expert what type of professional relationship we aspire to have. Do we want a collaborative relationship with the domain expert or a hierarchical one in which the domain expert (or statistician) presumes to be the only expert at the table and in a position to tell the statistician (or domain expert) what to do? To cultivate more collaborative relationships, we recommend phrasing questions as questions—not as statements, demands, declarations, or rhetorical questions. For example, rather than harshly or accusatorily asking, "You didn't randomize the treatment order, did you?", ask, **"So I can better understand the experiment and model the data, how were the treatments assigned?"**

One component of the strategy for cultivating a collaborative relationship is to soften questions that may be considered impertinent. Table 1 shows the three impertinent questions from Lurie (1958) and how they could be softened and improved to foster a more collaborative relationship.

In our experience, modeling behaviors we wish to see in the domain expert results in more productive collaborations. Just as statisticians wish to know the motivations behind the domain expert's research/business/policy questions, how the data were collected, and how they will use the results, a domain expert may want to know why a specific statistical technique was used or how a feature of the data collection process impacts the methods applied. By prefacing intent (strategy 1), a statistician demonstrates collaborative behaviors by providing the type of information she wants reciprocated from the domain expert. For example, **"Understanding your motivations and your reasons for researching this area helps me get excited about the research and really helps my brain think better statistically. So I'm curious, why do you want to answer this research question?**" is a great question that asks for the domain expert's motivations by providing the statistician's motivations.

Questions asked implicitly or explicitly to cultivate the relationship can also be great questions. For example, **"How does this meeting time generally work for you?"** or **"What could we change to make our future meetings more productive?"** To learn more about the context of the problem while strengthening the relationship, one could ask, **"Your research sounds so interesting. Can you tell me more?"** To improve communication, one could ask, **"How often would you like me to update you on what I've done? Do you prefer email or some other means?"** After delivering statistical information one should ask, **"What can I clarify?"**

3.4 Implement Asking Great Questions in Your Practice of Statistics

In our experience, individuals from beginners to advanced practitioners can learn how to ask great questions. Here are five steps for doing so:

1. Learn how asking great questions fits into the theory of communication in interdisciplinary collaborations by reading Vance and Smith's article "The ASCCR Framework for Collaboration" (2019). Then read Vance et al.'s article "Creating Shared Understanding in Statistics and Data Science Collaborations" (2022) for a deep dive into their theory of communication for statistics and data science collaborations.
2. Learn the three strategies described in this paper.
3. Practice asking great questions. Before your next collaboration meeting, write down one or two great questions to ask the domain expert. Turn a question you often ask into a great

question. Practice asking these questions out loud in front of a wall, a mirror, a pet, or a role-playing partner.
4. Get feedback on how well you implemented the strategies from your role-playing partner or the actual domain expert. Consider video recording and then reviewing meetings in which you practice asking great questions.
5. Reflect on what went well, what didn't go well, and the impact of asking great questions on your collaborations.

4. EXAMPLES OF BAD QUESTIONS

As a counterpoint, we believe it is instructive to discuss bad questions, which are those that weaken a relationship, detract from accomplishing the task of the project, or (gasp!) do both. Bad questions can sabotage a collaboration, and so we draw inspiration from the *Simple Sabotage Field Manual* (Donovan, 1944, pp. 28–32) developed by the United States' Office of Strategic Services (OSS) to encourage allies in Nazi-occupied Europe during World War II to engage in simple sabotage (Craig, 2021).

The OSS manual describes techniques for general interference with organizations and production and for lowering morale and creating confusion. Many of these techniques resonate in statistics and data science collaborations. Some of the OSS recommendations for sabotage that inspired 10 examples of bad questions in Table 2 are:

- Bring up irrelevant issues as frequently as possible.
- Refer back to matters decided upon at the last meeting and attempt to re-open the question of the advisability of that decision.
- Insist on perfect work in relatively unimportant products.
- Pretend that instructions are hard to understand and ask to have them repeated more than once.
- Give lengthy and incomprehensible explanations when questioned.
- Act stupid.
- Be as irritable and quarrelsome as possible without getting yourself into trouble.

5. RESULTS OF ASSESSING GREAT QUESTIONS

5.1 Students' Self-efficacy in and Perceived Value of Asking Great Questions

This paper's definition of and strategies for asking great questions have been taught for eight semesters by the first author in his combined graduate and undergraduate course on statistical collaboration. Students read an earlier version of this article (Vance & Smith, 2021) and then engage in exercises and activities to practice asking great questions in class and on real collaboration projects. We conducted a post-course survey of nine students from the Fall 2020 and Spring 2021 semesters and a pre- and post-course survey of all 21 students from the Fall 2021 semester (F2021) to assess how they self-report their skill in asking questions. The F2021 Students were also asked to rate how valuable they thought the method of asking great questions would be in their careers.

On a scale from 1 (strongly disagree) to 6 (strongly agree), students were asked how much they agreed or disagreed with the following statement: "I can ask appropriate questions for statistical collaboration." At the end of the course, the Fall 2020 and Spring 2021 students (n=9) responded with a mean of 5.44 (SD=0.73), meaning the average response was midway between "agree" and "strongly agree." In F2021, all 21 enrolled students responded to the item at the beginning of the course with a mean response of 4.38 (SD=0.86), midway between "somewhat agree" and "agree." At the close of F2021, those students' mean response was 5.38 (SD=0.59). A matched pairs t-test confirms that the F2021 Students did significantly increase their self-efficacy in asking questions (p=5.2e-05). One F2021 student reflected: "I think the biggest revolution that happened to me during this class was when I realized that a great question doesn't only improve your own knowledge about the problem at hand but also increases the relationship amongst all parties."

At the end of the semester, F2021 Students rated—on a 6-point scale from "1-not-valuable-at-all" to "6-extremely-valuable"—how valuable they thought the "Asking Great Questions" strategies will be throughout their careers. The students' mean response was 4.38 (SD=1.32), midway between "moderately-valuable" and "very-valuable."

The results from the previous two paragraphs indicate that students generally feel that asking great questions is valuable, that they learned this skill throughout the semester, and that they ultimately feel confident in their ability to ask great questions.

5.2 Experimental Design for and Results of Assessing Questions

We developed a list of 20 questions drawn from examples in this paper that a statistician might ask a domain expert during a collaboration meeting. We presented these questions to the 21 F2021 students and a panel of 48 statistical collaborators/consultants from the ASA Statistical Consulting Section (CNSL). From the CNSL group, 33 (69%) were "highly experienced", with at least 10 years of experience in academia, private practice, industry, or government; four (8%) had 5–9 years of experience; one (2%) had less than 5 years of professional experience; six (13%) were students; and four (8%) left that question blank. All 69 respondents were asked:
"On a scale of -5 (very negative) to +5 (very positive) what is the direction and extent to which the question helps the statistician and domain expert:

- accomplish the ***TASK*** toward making a deep contribution?
- create a strong ***RELATIONSHIP***?"

The respondents first assessed the 20 questions (in a random order) on the Task dimension and then on the Relationship dimension to generate ratings on the dimensions as independently as possible. The questions, their short label, their mean ratings, standard errors, and correlations between dimensions are presented in Table 3. The label "*I*" stands for impertinent questions. *I1–I3* are the impertinent questions of Lurie (1958); *I4–I6* are these questions rewritten (see Table 1). *D1–D4* are questions from Derr (2000), with *D5* a rewrite of *D4*. *G1–G4* are examples of great questions. *B1–B5* are examples of bad questions (see Table 2).

These ratings generally conform to the authors' intentions for and their own evaluations of these questions. For example, the rewritten questions *I4–I6* were rated 2.3 points higher on Task and 3.3 points higher on Relationship on average than *I1–I3*. Similarly, applying the strategies in this paper to rewrite *D4* resulted in question *D5* rating 1.1 points higher on Task and 2.4 points higher on Relationship.

Figure 2 shows the mean question ratings for the Highly Experienced (HE) subgroup from CNSL (n=33) and the F2021 Students (n=21), which were similar. The median difference in Task rating between the two subgroups over all questions was 0.34; for Relationship the median difference was 0.36. *B1* had the largest differences; the HE subgroup rated this question 1.81 points lower than the Students on Task and 1.09 lower on Relationship. Another notable difference was that the HE subgroup rated *I3* 1.53 points lower on Task than the Students.

The survey was designed so that a participant's rating of Task would be independent of their rating of Relationship. It is notable, therefore, that responses were positively correlated for every question (see Table 3). Respondents who rated a question high in Task (relative to other respondents) also tended to rate that question relatively high in Relationship. The overall median correlation was 0.42.

6. DISCUSSION

Our results demonstrate four important findings. First, questions can be assessed for their impact on the task and relationship in a statistics or data science collaboration. Second, statisticians can learn to

ask great questions. Third, our students consider asking great questions to be a valuable skill in their careers. Fourth, respondents correlate the impact of a question on the task to its impact on the relationship and vice versa.

While initially unexpected, the correlation demonstrated in this paper lends support to Vance's (2020) theory of collaboration, which argues that the ultimate goals for a collaborative statistician or data scientist should be to accomplish the task of the project and to create a strong relationship with the domain expert, and that these goals are interrelated. The correlations we observed between task and relationship could be explained by considering a question's direct and indirect effects on accomplishing the task and strengthening the relationship. By helping to accomplish the task, a question can indirectly strengthen the relationship because a professionally satisfied domain expert will have high regard for the statistician. Conversely, a question that directly strengthens the relationship will indirectly help accomplish the task because strong relationships facilitate successfully completing collaborative tasks (Vance & Smith, 2019). The inverse is also true; a low rating on one dimension will (indirectly) lower the rating on the other dimension. For example, question *B2* "Are you sure you're qualified to carry out this research," was the lowest rated question for relationship (-4.6). One could argue that asking this question might help accomplish the task of the project, yet the average task rating was also very low (-3.3). We conclude that the destructive impact of this question on the relationship led to lower ratings on the task dimension.

Relatedly, no mean question ratings were in the "Bonding" or "Impertinent" zones of Figure 1. Question *B4* was designed to rate very low on task and high on relationship. While respondents did rate it very low on task (-4.5), they also rated it low on relationship (-2.7). Opposite this, question *B5* was designed to rate high on task and very low on relationship. While respondents did rate it very low on relationship (-4.3), they also rated it low on task (-2.6). This may be due to the indirect effects described above and is worthy of further study.

Our experiment also revealed limitations in assessing questions via a short survey. The context of the questions is missing and the tone of the questions and other important non-verbal communication cannot be easily conveyed.

This paper contributes to the consulting and collaboration literature by detailing the Asking Great Questions component of Vance et al.'s (2022) theory of communication in statistics and data science collaborations, which is itself one of five components of Vance and Smith's (2019) ASCCR framework for collaboration. Asking great questions can positively impact an individual's practice of collaborative statistics and data science. Intentional focus on the questions statisticians ask will improve their contributions to the fields in which they work and will strengthen their relationships with domain experts. Greater individual impact will mean that the field of statistics will become better appreciated (Halvorsen et al., 2020; Love et al., 2017; Vance, 2015) and help improve the perceived value of statistical consulting and collaboration (Sharp et al., 2016).

For increased impact to occur at scale, the statistics community needs to teach these methods of communication and collaboration to students and to statisticians on the job. Recent activities by the ASA's Committee on Applied Statisticians (Bhattacharyya, 2017), the Conference on Statistical Practice (Love, 2020), and others (Gamerman et al., 2022) align with this paper's effort to improve the collaborative skills of statisticians and data scientists.

7. CONCLUSION

The questions we ask and how we ask them can make a difference in how successful we are in meetings, in collaborations, and in our careers as statisticians and data scientists. In this paper, we explained how a *good* question elicits information necessary to successfully accomplish the tasks of the project or strengthens the relationship between the statistician and domain expert and how a *great* question does both.

A great question can be deconstructed into three parts: the question, the answer, and the paraphrasing of the answer to create shared understanding. By prefacing questions with the intent behind asking the question, paraphrasing the answer, and modeling a collaborative relationship, one can turn good questions into great ones. Asking great questions is a skill that can be learned and practiced to improve our overall communication and collaboration skillset, thereby increasing our potential impact to help address societal challenges.

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Table 1: Examples of making impertinent questions more collaborative

Impertinent Question	Great Question
I1: With respect to the experiment you are performing, just what are your ideas?	*I4:* **How did you get started on this research and what motivates you about it?**
I2: With respect to the scientific area to which these ideas refer, just what are they about?	*I5:* **Fascinating! And how will answering these research questions advance your domain?**
I3: How sure do you want to be of the correctness of these ideas?	**The types of analyses we do and how we report results depends on if we are testing hypotheses or exploring the data looking for interesting relationships. So, is this a pre-specified hypothesis you want to test, or would you rather explore what the data say about this?**
	I6: **Ultimately, who will be using these results and how? What impacts do you hope they have?**

Table 2: Examples of bad questions for sabotaging tasks and relationships

Bad Questions
B1: So that we don't waste any more time, what is the exact statistics question you need my help answering?
B2: Are you sure you're qualified to carry out this research?
B3: I know that last meeting we agreed to analyze the data in Excel, but rather than doing that, how about I try to teach you R instead?
B4: I know that our initial results had $p = 0.43$, but your professional success is important to me. Would you like me to work my statistics magic to find a way to make $p<0.05$ so we can publish our results?
B5: You're just p-hacking at this point and your results are garbage. To avoid being a disservice to your field and get back on track, what were your original research questions?
How much statistics do you actually know?
Rather than discuss your overall modeling strategy, let's first investigate the detailed statistical assumptions. Are your data normally distributed?
Before we move on to interpreting these results, I want to make sure you understand *all* of the technical details of the analysis. Can you explain in your own words how I conducted these analyses?
Before I begin my analysis of the data, can you triple-check with your lab technician that you actually have 152 samples, not 153?
Before we discuss the overall context of your research, I want to be sure I heard you correctly, because I'm not familiar with the statistical term you used. Are you interested in fitting a linear mixed "*affect*" model?

Table 3: Mean ratings (with standard error) of 20 questions on the Task and Relationship dimensions (n=69) and the correlations between dimensions

Label and Question	Task mean (SE)	Relationship mean (SE)	Corr.
I1 (Part 1) With respect to the experiment you are performing, just what are your ideas?	0.3 (0.28)	1.0 (0.27)	0.67
I2 (Part 2) With respect to the scientific area to which these ideas refer, just what are they about?	0.2 (0.27)	0.6 (0.25)	0.66
I3 (Part 3) How sure do you want to be of the correctness of these ideas?	-0.2 (0.32)	-0.5 (0.28)	0.53
I4 (Part 1) How did you get started on this research and what motivates you about it?	2 (0.24)	3.7 (0.16)	0.22
I5 (Part 2) Fascinating! And how will answering these research questions advance your domain?	2.4 (0.23)	3.6 (0.17)	0.22
I6 (Part 3) Ultimately, who will be using these results and how? What impacts do you hope they have?	2.9 (0.23)	3.3 (0.17)	0.41
D1 What type of investigation is this?	0.2 (0.27)	-0.4 (0.22)	0.30
D2 At what stage is this investigation?	1.6 (0.27)	0.1 (0.19)	0.43
D3 What limits and constraints govern the study?	2.3 (0.22)	0.8 (0.23)	0.39
D4 [In an agricultural experiment on livestock] How did you assign the test diets to the animals?	3.0 (0.19)	0.5 (0.2)	0.14
D5 [In an agricultural experiment on livestock] The statistical models we will use to compare the effectiveness of the animal diets depend on details of the experiment, and I want to be sure we use the most appropriate model. So how did you assign the test diets to the animals?	4.1 (0.14)	2.9 (0.18)	0.24
G1 My goal for this initial meeting is to understand your research questions, which will help me think about the specific statistical issues. What would you like to accomplish in this meeting?	3.7 (0.2)	3.7 (0.21)	0.45
G2 Understanding your motivations and your reasons for researching this area helps me get excited about the research and really helps my brain think better statistically. So I'm curious, why do you want to answer this research question?	2.5 (0.28)	3.8 (0.21)	0.68
G3 What could we change to make our future meetings more productive?	1.9 (0.25)	2.8 (0.25)	0.44
G4 Your research sounds so interesting. Can you tell me more?	1.1 (0.26)	3.7 (0.17)	0.36
B1 So that we don't waste any more time, what is the exact statistics question you need my help answering?	-1.8 (0.37)	-3.1 (0.27)	0.45
B2 Are you sure you're qualified to carry out this research?	-3.3 (0.28)	-4.6 (0.13)	0.62
B3 I know that last meeting we agreed to analyze the data in Excel, but rather than doing that, how about I try to teach you R instead?	-1.3 (0.35)	-1.9 (0.32)	0.61
B4 I know that our initial results had $p = 0.43$, but your professional success is important to me. Would you like me to work my statistics magic to find a way to make $p<0.05$ so we can publish our results?	-4.5 (0.15)	-2.7 (0.32)	0.30
B5 You're just p-hacking at this point and your results are garbage. To avoid being a disservice to your field and get back on track, what were your original research questions?	-2.6 (0.36)	-4.3 (0.2)	0.39

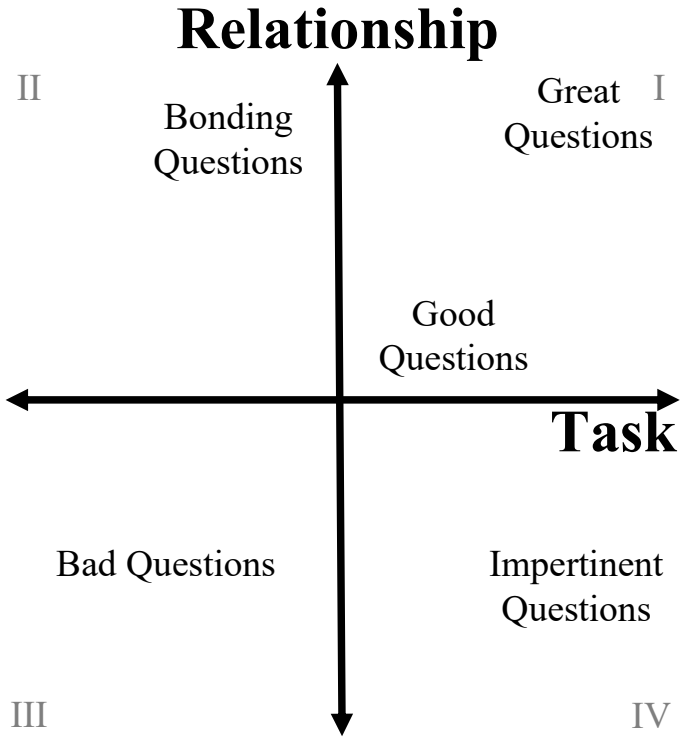

Figure 1: The degree of relationship building and progress toward accomplishing the task determine how bad, good, or great a question is. Great questions help accomplish the task and strengthen the relationship.

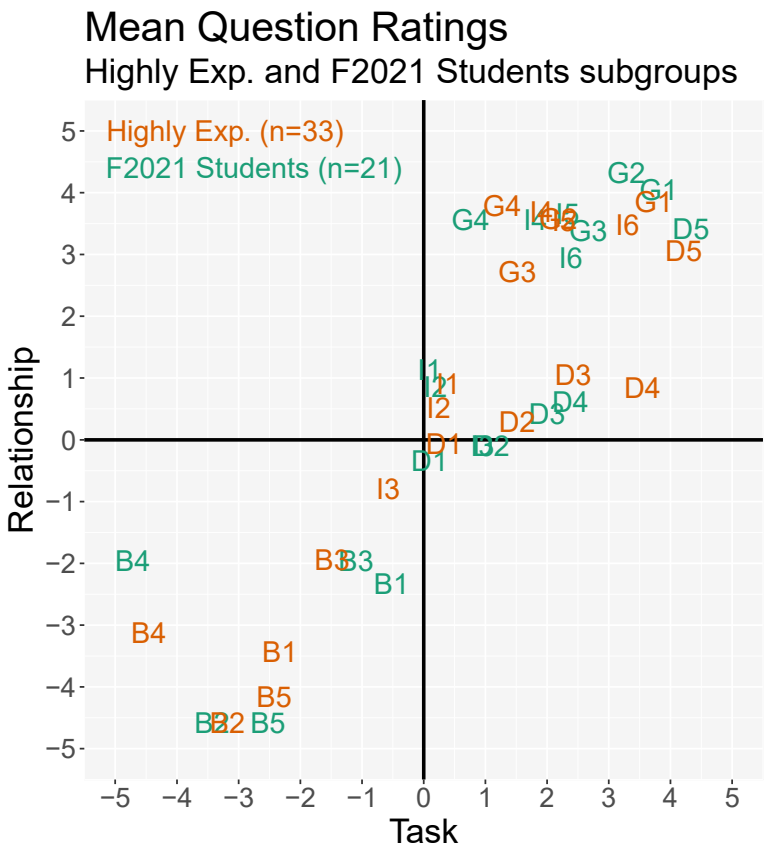

Figure 2: Average ratings for the 20 questions on the Task and Relationship dimensions were similar for the Highly Experienced subgroup of CNSL compared to the F2021 Students.