Goals for Statistics and Data Science Collaborations

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Abstract
Statisticians have a long history of consulting and collaborating with experts from a variety of fields. Now with the rise of data science, collaborating across disciplines is both more important and more prevalent than ever before. This paper examines the goals of statistics and data science collaborations and uses the ASCCR (Attitude-Structure-Communication-Content-Relationship) Framework for Collaboration to connect these goals. Specifically, we propose that a useful way of guiding consultations and collaborations is for statisticians and data scientists to work toward two terminal goals of a collaboration: to make a deep contribution to the field and create a strong relationship with the domain expert. To help in achieving these goals, statisticians and data scientists should strive to achieve three instrumental goals: adopt an attitude of collaboration, provide effective structure for the collaboration, and communicate to create shared understanding. We show how these five goals map onto the ASCCR Frame, how they are connected to each other, and how to have conversations about these goals. The goal of this paper is to show statisticians and data scientists how they can become more effective collaborators by providing motivation for using the ASCCR framework to improve their practice of statistics and data science.

Key Words: Consulting, ASCCR Frame, impact, structure, communication, relationship

1. Introduction

Statisticians have a long history of consulting and collaborating with experts from a variety of fields to make substantial impacts in those fields: for example, consider Florence Nightingale's impact on nursing and public health (Stinnett 1990), R.A. Fisher's impacts in the fields of agriculture and genetics (Hall 2007), and W.E. Deming's impact on Japanese manufacturing (Salsburg 2001). Now with the rise of data science, collaborating across disciplines is both more important and more prevalent than ever before.

Vance and Smith (2019) developed the ASCCR framework of five essential components of collaboration to help students and practitioners of statistics and data science become more effective collaborators and for educators to help teach essential collaboration skills. ASCCR is an acronym pronounced "ask'er" created from the components: Attitude, Structure, Content, Communication, and Relationship. Vance et al. (2020) describes a framework for assessing collaborations using the ASCCR Frame. Halvorsen et al. (2020) use the ASCCR Frame to structure their advice to statistical consultants and collaborators. In their ASCCR framework paper, Vance and Smith (2019) describe what a collaborative statistician or data scientist should do. However, they do not provide

much motivation about *why* a statistician or data scientist should engage in collaboration, what the goals of a collaboration should be, how each component of their framework relates to each other, or how these components relate to the goals of a collaboration.

This paper, based on a talk at the 2020 Joint Statistical Meetings online and the author's 12+ years of experience directing the Laboratory for Interdisciplinary Statistical Analysis (LISA)—originally at Virginia Tech (Vance and Pruitt 2016) and now at the University of Colorado Boulder (Vance 2020)—and the LISA 2020 Program (Awe and Vance 2014; Msemo and Vance 2015; Vance 2015a), fills these gaps to provide a richer understanding of the ASCCR framework and the purpose of its use to improve collaborations in statistics and data science. Section 2 reviews each component of the ASCCR Frame. Section 3 provides motivation for why a statistician or data scientist should engage in collaboration and what the goals of a collaboration should be. Section 4 describes how the ASCCR Frame maps onto these goals of a collaboration, section 5 discusses how this theory can be put into practice, and section 6 concludes this paper.

2. A Review of the ASCCR Frame

The ASCCR framework (see Figure 1) describes five components of a collaboration. One could say that the first four components (Attitude, Structure, Content, and Communication) describe the Who, When, What, and How of collaboration and the fifth component (Relationship) touches upon the Why of collaboration. We review each of these five components below.

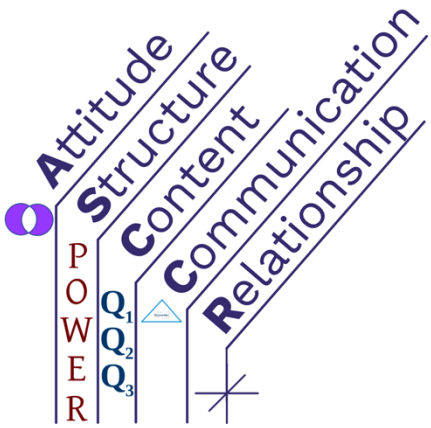

Figure 1: The ASCCR framework for collaboration describes five essential components of collaboration: Attitude, Structure, Content, Communication, and Relationship.

2.1 Attitude

In a talk at the 2020 Conference on Statistical Practice (CSP) in Sacramento, CA, Vance and Smith (2020) partition attitudes a statistician or data scientist may have into three categories of "who":

- Me: attitudes statisticians and data scientists may have about themselves
- You: attitudes about the domain expert
- We: attitudes on how the statistician/data scientist will work with the domain expert.

In the experience of the author, the following three attitudes provide an excellent foundation for developing a collaborative attitude:

- Me: “I am excited to grow as a *collaborative statistician* on this project.”
- You: “The *domain expert* is an expert in his field who knows more about his problem than anyone else.”
- We: “We intend to be *collaborators* on this project and for it to develop into a true collaboration.”

These three attitudes begin to create the identity of who is engaging in the collaboration (see Figure 2).

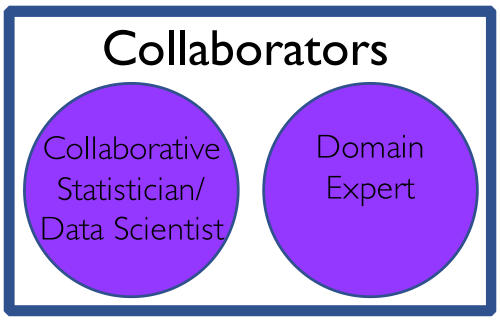

Figure 2: Three foundational attitudes describe a collaborative statistician or data scientist and a domain expert working together as collaborators.

Another “me” attitude that establishes a strong foundation for making an impact is the attitude that the primary task of the project is not to answer a statistics or data question, nor to produce a statistical analysis or report, but rather to help the domain expert solve problems and make decisions and then—going two steps further—create a plan for action to benefit society and implement it. In other words, if a statistician or data scientist has the attitude that her main task-related goal of the project is to help implement some positive action, she will be much more likely to make a positive impact through her collaborative work.

2.2 Structure

Meetings are a complex dance. In a collaboration, there are complicated domain issues, statistical issues, and data issues (i.e., the Content) to discuss with the domain expert. On top of that, the collaborative statistician or data scientist should demonstrate behaviors consistent with an attitude of collaboration, run an effective meeting, employ effective communication strategies (Derr 2000), and build a strong relationship with the domain expert. The POWER Structure, developed by Doug Zahn (Zahn 2019) to encompass the five stages of collaboration meetings (Prepare, Open, Work, End, and Reflect), facilitates effective and efficient meetings; reduces the cognitive load of the participants so they can focus on the domain, statistics, and data issues; and thereby supports effective collaboration (Vance and Smith 2019).

A personal anecdote from the author that extends the story told in Vance (2013):

> I was beginning my second year as director of LISA when I realized that I could be a much better statistical collaborator and I could better teach collaboration to my students if I got advice from a mentor. I invited Doug Zahn to visit my department and LISA, during which he showed me how to effectively review a video-recorded meeting with a domain expert. We watched the first 5 minutes of a meeting that I thought had gone relatively well, and Dr. Zahn asked me, “Why didn’t you verify how much time the client had available?” and “Why didn’t you ask the

> client what he wanted to accomplish during the meeting?" Then we watched the last 5 minutes of the meeting, during which I was attempting to summarize the next steps of the project while the domain expert literally walked out of my office mid-sentence—he had to run across campus to attend a meeting with his research advisor. The upshot was that Doug then introduced to me the POWER Structure, which simplified for me—by orders of magnitude—how to run an effective and efficient meeting! And this structure worked extremely well for my students. After learning and practicing the POWER Structure, I ceased treating each meeting like a puzzle in which I was trying to solve a mystery about what the domain expert actually wanted to accomplish. Instead, using the POWER Structure, I would verify how much time the domain expert had available for the meeting and then would ask directly, "What would you like to accomplish in the time we have available?"

Returning to the analogy of the components of the ASCCR Frame describing the Who, When, What, How, and Why of collaboration, the POWER Structure provides a system for *when* specific conversations should take place during a collaboration meeting. Specifically, statisticians or data scientists should **P**repare *before* a meeting by reviewing materials sent by the domain expert. **O**pen conversations, such as clarifying the time available and asking what the domain expert wants to accomplish during the meeting, should take place at the *beginning* of the meeting. Understanding the domain, statistics, and data issues and having one's statistical or data science solutions be understood comprises the **W**ork conversations and should occur *throughout* the meeting. **E**nd conversations to summarize the key issues discussed, decisions made, next steps, and timeline should occur in the *last 10–20%* of the meeting. Finally, *after* the meeting one should **R**eflect on what went well and what could be improved.

2.3 Content

The content or the "What" of a collaboration can be modeled with three segments: a qualitative (Q_1) component followed by a quantitative (Q_2) component and concluded by a qualitative (Q_3) component (Leman et al. 2015; Vance and Smith 2019). Q_1 encompasses all of the qualitative aspects of a project necessary to know before building a statistical model or conducting a data science analysis; see (Vance 2019) for more information on the $Q_1Q_2Q_3$ process. Q_1 can be summarized by, "What is the research, business, or policy *question*?"

Q_2 encompasses all of the technical statistics and data science analyses and can be summarized by, "What is the statistics or data science *solution* to the research, business, or policy problem?"

Q_3 is the *contribution* a statistician or data scientist makes to the domain problem. It can be summarized by, "What is the answer to the original research, business, or policy question? What is the plan of *action* to implement this solution or decision?"

2.4 Communication

Effective communication is "How" collaborative statisticians or data scientists make deep contributions to the domain and create strong relationships with the domain expert. Specifically, a statistician or data scientist can create shared understanding with the domain expert by asking great questions (Vance and Smith 2018b); listening, paraphrasing, and summarizing the responses (Vance and Smith 2018a); and explaining

technical concepts in ways the domain expert understands using the ADEPT method (Azad 2015).

2.5 Relationship

In a talk at the 2020 CSP in Sacramento, CA, Smith and Vance (2020) proposed several models for the relationship between a collaborative statistician/data scientist and a domain expert. They proposed a model based on the study of the doctor/nurse relationship with patients (Mead and Bower 2000; Ridd et al. 2009) that has four dimensions:

1. Environment of collaboration: What are the expected and agreed upon roles? Have the goals been identified and are they shared by both parties? How will the benefits or outcomes of the collaboration be shared?
2. Collaboration process: What the statistician/data scientist and domain expert do inside and outside of meetings strengthens or weakens the relationship
3. Quality or nature of the relationship: How well do the statistician and domain expert work together?
4. Time: Relationships build over time.

Some factors or variables that characterize a collaborative relationship include: perceived competence of both parties, level of trust, degree of loyalty or commitment to shared goals, how much each party values or regards the other party, degree of teamwork when engaging in activities.

Smith and Vance (2020) provide the following tips for creating and sustaining productive relationships:

- Express authentic interest in developing and building a strong relationship with the domain expert initially and as the relationship grows
- Ask the domain expert for feedback on what is going well and what can be improved
- Respect the skills and value the domain expert brings to the collaboration; learn and use the language of the domain
- Practice effective communication to create shared understanding
- Building strong relationships requires time, patience, and trust; act trustworthy to gain trust.

3. Goals, Collaborations, and Goals of Collaborations

3.1 Instrumental Goals Help Achieve Terminal Goals

Instrumental goals are intermediate outcomes that help achieve an ultimate objective. Such goals are a means to an end, but not the end itself. On the other hand, *terminal goals* are the ultimate objectives of an activity. They are ends in themselves. Terminal goals have intrinsic value. Each individual decides for herself what her terminal goals are. Achieving terminal goals is the motivation for engaging in an activity or series of activities; it is the reason for action and for striving to achieve instrumental goals along the way. An analogy is that an instrumental goal is like the road or path and a terminal goal is the destination.

An example of an instrumental goal in a statistics or data science collaboration is to have an effective and efficient structure for a meeting. Learning about and practicing how to

structure collaboration meetings is not an end in itself. Structuring effective meetings is a means toward achieving the terminal goals of a collaboration.

3.2 Collaborations

There are many definitions of collaboration. Here we will consider three. According to Wikipedia ("Collaboration" 2020), *collaboration* is the process of two or more people or organizations working together to complete a task or achieve a goal. Building upon definitions provided by Vance (Vance 2015b), Love, et al. (Love et al. 2017), and Vance and Smith (Vance and Smith 2019), a more specific definition of collaboration in statistics or data science is: *working cooperatively with domain experts to create data-driven solutions to research, business, and policy challenges and achieve research, business, and policy goals.* A third definition combining ideas from the first two is: ***collaboration is two or more people creating something that could not be created alone***.

These definitions imply that a necessary condition of a collaboration is that it results in a creation—some content or some output—that helps to achieve a goal. A second necessary condition of a collaboration is that it results in a relationship between two or more interdependent people (or organizations). Both conditions together help explain why a statistician or data scientist might engage in a collaboration. Domain experts provide statisticians and data scientists opportunities for impact they often could not avail of themselves. Domain experts can provide an interesting question and relevant context, funding and impetus for designing an experiment or study, access to existing datasets, domain expertise to help interpret results, access to stakeholders who care about the results, and infrastructure to make and implement plans for action. In short, collaborating with domain experts provides statisticians and data scientists opportunities to make impacts for the benefit of society. Figure 3 shows a workflow for statistics and data science leading to impact.

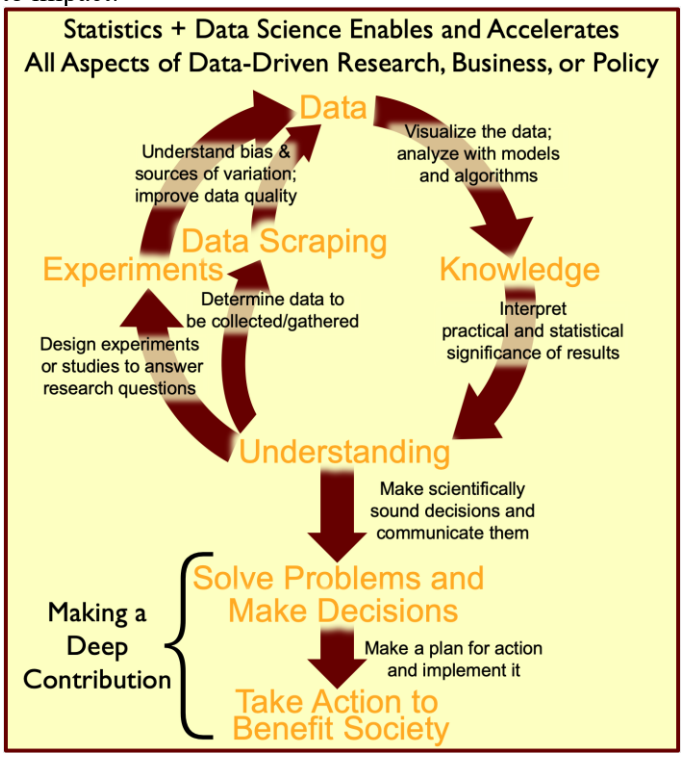

Figure 3: This schematic of the phases of data-driven research shows how statisticians and data scientists can make deep contributions to the domain.

3.3 Two Terminal Goals of Collaborations

The two terminal goals of statistics and data science collaborations are to ***make deep contributions*** (impacts) to the domain and to ***create strong relationships*** with domain experts. Statisticians and data scientists collaborate with domain experts to make contributions to the domain by answering research questions or providing recommendations for business or policy decisions. These contributions can be made deeper by extending them into impacts, which are positive consequences for society of actions that the statistician or data scientist helps to implement.

Correlated with but separate from the goal of making a deep contribution is the terminal goal of creating a strong relationship with the domain expert. By definition, terminal goals need no extrinsic justification; they are reasons in and of themselves. Personally, the author finds tremendous value in recognizing the importance of relationships in statistics and data science collaborations. From his point of view, a collaborative statistician or data scientist can focus on the task of the project and/or the relationship with the domain expert(s). Earlier in his career, the author was much more focused on the task of the project, without even realizing that creating a strong relationship was also a terminal goal. The author believes now that the most effective collaborative statisticians and data scientists focus on both making a deep impact AND creating strong relationships.

A second personal anecdote from the author:

> At the time of writing this, my first child is nine months old. Almost every day since the day he was born I have read to Max. Why? I want to help him learn to listen, to speak, to read, to think, to imagine. In short, I work every day to accomplish the task of helping my child develop cognitively. I also read to him for another, more important reason. I read consistently to create a strong relationship with my son.

The author invites to reader to determine for herself the intrinsic value of creating strong relationships with domain experts.

4. Achieving the Two Terminal Goals of a Collaboration

The ASCCR Frame describes three instrumental goals and the two terminal goals of a statistics or data science collaboration and can be interpreted as a strategy for achieving the two terminal goals of collaboration. Figure 4 shows how each component of the ASCCR Frame is directly related to the other components.

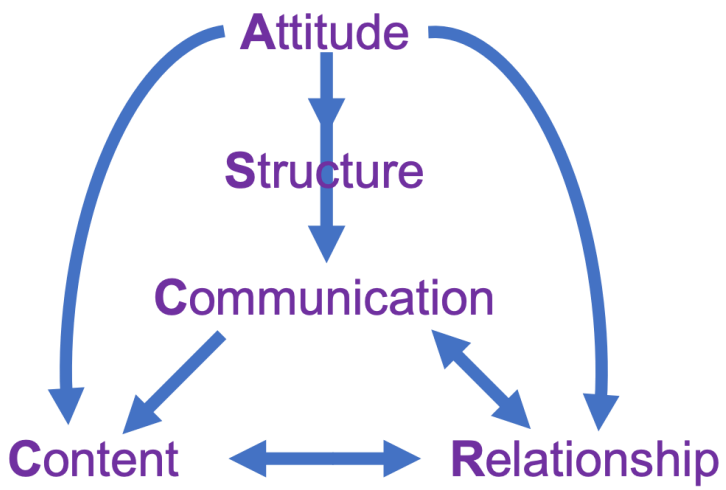

Figure 4: This schematic shows the interrelationships within the ASCCR Frame of the three instrumental goals of Attitude, Structure, and Communication with the two terminal goals of making a deep contribution (Content) and developing a strong Relationship.

Adopting an attitude of collaboration is the first instrumental goal described by the ASCCR Frame and directly affects each of the other four components of the ASCCR Frame.

Structure: Having the attitudes of, "I value my time and the time of the domain expert," "The domain expert is an expert in his field, and I will allow him to tell me what he wants to accomplish," and "I believe that structuring an effective meeting will make our collaboration more productive" will facilitate establishing an effective meeting structure. As mentioned earlier, creating effective structure for one's interactions with domain experts is an intermediate goal. In the author's experience, following the POWER structure makes it more likely to have important conversations. In other words, effective structure is an instrumental goal that leads to a third instrumental goal of collaboration: effective communication.

Communication: The Fundamental Law of Statistical Collaboration as described by Vance and Smith (2019) and repurposed from Covey (1989) is *"seek first to understand, then to be understood."* This is an attitude that helps to achieve the instrumental goal of communicating effectively to create shared understanding.

The goal of communication in statistics and data science collaborations is to create shared understanding, which is an instrumental goal that facilitates both making a deep contribution to the project and strengthening the relationship with the domain expert. In other words, effective communication is a process of exchanging information to create shared understanding, which is a means toward solving the problem (deep contribution) and strengthening the relationship. Shared understanding encompasses the knowledge about the project that comes from the information communicated between parties, the recognition of the relevance of this information toward achieving the project goals, and the mutual understanding between all parties in the collaboration that common knowledge about the project has been achieved. This concept will be fleshed out in a forthcoming paper devoted to detailing communication within the ASCCR Frame.

Content: Vance (2015b) describes the main difference between statistical consulting and collaboration to be the task focus, or attitude, of the statistician. In consulting, the focus is on solving a statistics or data problem whereas in collaboration the focus is on solving the domain problem and implementing the solution. This is an attitude that can directly help achieve the terminal goal of making a deep contribution to the domain.

While being a terminal goal, making a deep contribution is *also* an instrumental goal because doing so helps to create a strong relationship with the domain expert. From the author's experience of working on more than 500 projects personally and supervising 2600 more as director of LISA, domain experts *love* statisticians and data scientists who enable them to make a deep contribution in their field. This high regard the domain expert has for the statistician or data scientist manifests itself in a strong relationship.

Relationship: A fundamental attitude that statisticians and data scientists may or may not have is that creating a strong relationship with the domain expert is important and is worthy of their time and effort. In short, setting a strong relationship as a terminal goal of a collaboration is an attitude of collaboration.

Creating a strong relationship is also an instrumental goal because it helps a statistician or data scientist make a deep contribution in several ways, only two of which will be mentioned here. First, strong relationships facilitate communication. Mutual trust will make it easier for a statistician or data scientist to ask seemingly impertinent questions (Lurie 1958) and thereby uncover important domain, statistics, or data issues (Derr 2000). More effective communication can lead to deeper contributions and increased impact.

Second, a strong relationship makes it more likely a domain expert will engage in repeated collaborations with the statistician or data scientist over time (i.e., a satisfied "repeat customer"), which provides opportunities for the statistician or data scientist to make deeper contributions in each subsequent project.

5. Talking About Goals with Domain Experts

Knowing the domain expert's goals for the project and for the collaboration are elements of the qualitative (Q_1) content necessary to know before determining a course of action for the quantitative (Q_2) analysis of data (Vance 2019). For example, if the goal of a project were to convince a panel of experts from the National Academies to endorse a scientific finding, perhaps a two-sample *t*-test would be too simplistic. The author recommends discussing goals in three stages with the domain expert during an initial meeting. These conversations could all take place within the first 5–10 minutes of a meeting and could be revisited during the last 10–20% of the meeting when the meeting is being summarized.

The first stage would be for the statistician or data scientist to discuss her instrumental and terminal goals of the collaboration. This could be accomplished by opening the meeting with a conversation about how much time is available and continuing with a succinct preamble to a conversation about what the domain expert wants to accomplish. For example, "I will be asking what your goals are for this project and for this collaboration. My goals for today are to establish an effective structure for the meeting that enables us to have important conversations about the context, the data, the questions you want to answer, and the actions you may take. I also want to communicate effectively, so please interrupt me or ask questions if you feel I'm not understanding or

I'm not being clear. Ultimately, I want to help you achieve your goals and help make an impact while also creating a strong relationship so you will want to collaborate with me in the future. What would *you* like to accomplish in today's meeting?"

The second stage would be asking the domain expert, not just what specific things he wants to accomplish in the meeting, but what his goals are for the project and for the collaboration (which may be the same). For example, "Knowing your goals and why they are important will help me do a good job on this project. What are your goals for this project? […] You want to achieve X. Why is that? What will X enable you to do? […] I see, X will enable Y. And why is Y important? […] OK, let me see if I understand, X implies Y, which is valuable for Z reasons? […] What role do you see for me in this collaboration? For example, I can help you achieve X; would you like for me to collaborate on Y and Z?"

The third stage would be to reiterate and verify that the statistician's or data scientist's goals are to help the domain expert achieve X, Y, and/or Z and create a strong relationship. Example language for this conversation is, "To reiterate, my goals for this project and collaboration are to help you achieve X and Y and set up Z for success. I also want to focus on creating a collaborative relationship between us."

The author encourages statisticians and data scientists who desire to have greater impact in their work to practice having these conversations about goals, and over time, to discover what works best for them.

6. Conclusion

This paper extends the ASCCR Frame for collaboration in statistics and data science by attributing five goals of collaboration to the five components of ASCCR. The three instrumental goals of collaboration—adopting an attitude of collaboration, establishing effective structure, and communicating effectively to create shared understanding—can be means to achieving the two terminal goals of collaboration: making deep contributions and creating strong relationships.

The author's intent is to provide motivation for how a statistician or data scientist can use the ASCCR framework to improve her practice of statistics and data science to create strong relationships and make deep contributions that will positively impact society.

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