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Operant Subjectivity
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Content Validation in Q Methodology: A Roadmap to Developing Transparent Data-Collection Tools Based on a Multi-Region Pilot Process

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Abstract: In the last two decades, the use of Q methodology has expanded across disciplines, raising new debates around its theoretical and practical principles. While qualitative researchers have stressed the importance of pilot studies to ensure the content validity and rigor of data collection tools, many Q methodology studies do not mention whether and how this work is accomplished. Questions and comments on this topic are also recurrently raised on the Q methodology Network listserv, demonstrating an interest within the research community. Drawing on lessons learned in developing a data collection tool for a multi-region study using Q methodology in the context of US agriculture, we demonstrate how a thorough and clear pilot study can strengthen both the quality and transparency of the research process. Furthermore, our work provides a roadmap for piloting and validating data collection tools and procedures that, applied within the framework of Q methodology, improves the rigor of the research more generally.

Keywords:, agriculture, content validation, mixed methods, pilot study, Q methodology

Introduction

Q methodology seeks to capture a person's subjectivity, or point of view, through their organization of statements (or pictures, or objects) regarding a topic, in response to a prompt (Watts & Stenner, 2012, p. 26). It allows researchers to generate a typology – a set of worldviews or perspectives – based on the subjectivities of those whose opinions on a certain topic are closely related. The methodology bridges quantitative and qualitative research through a series of statistical and qualitative steps to collect and interpret data gathered for the study (Brown, 1996; Ramlo, 2016; Watts & Stenner, 2012). As a complete set of principles, Q methodology encompasses theory, providing the framework in which the research process is constructed and defining the central concepts of the methodology, as well as technique for data collection and method for data analysis (Brown, 2009; Rieber, 2020; Shemmings & Ellingsen, 2012, p. 417; Watts & Stenner, 2012). In the last two decades, the use of Q methodology has expanded across disciplines, raising new debates around its theoretical and practical principles (Cross,

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2005; Previte et al., 2007; Ramlo, 2023; Sneegas, 2020; Zabala et al., 2018). As researchers using Q methodology, we are intrigued by those discussions which prompt us to continue to critically explore the methodology while applying it to our own research.

In *Political Subjectivity: Applications of Q Methodology in Political Science*, Dr. Steven R. Brown writes that the "selection of statements or other stimuli for inclusion in a *Q* sample[1] is of utmost importance" (Brown, 1980, p. 186). In subsequent literature, other researchers using the methodology stressed the importance of a pilot phase "to achieve optimum balance, clarity, appropriateness, simplicity and applicability" of the statements (Cross, 2005, p. 209), and "to ensure that statements are comprehensible for the respondents and to identify other unforeseen problems" (Zabala et al., 2018, p. 1188).

More recently, in a special section of *Operant Subjectivity, The International Journal of Q Methodology* on concourse development and Q sample selection, Sylvester (2020) suggested that researchers conduct a small pilot to ensure that the Q sample includes approximately the same number of positive and negative statements, as well as some neutral ones. In the same volume, Mohr's (2020) results demonstrated "the importance of rigorous piloting of Q samples when working with non-native speakers and in general" (p. 78). And Shearman presented how the inclusion of two pilot studies supported the creation and refinement of the Q sample statements, while also "ensuring that the condition of instruction and Q sort administration appropriately facilitate a successful participant sort" (Shearman, 2020, p. 129). Beyond Q Methodology, van Teijlingen and Hundley (2001), Malmqvist et al. (2019) and many others advocate for the importance of pilot studies to increase the quality of social research. Gudmundsdottir and Brock-Utne (2010) argue that pilot studies are critical to both "avoid methodological surprises" as well as to "improve and increase the validity of research results" (p. 360).

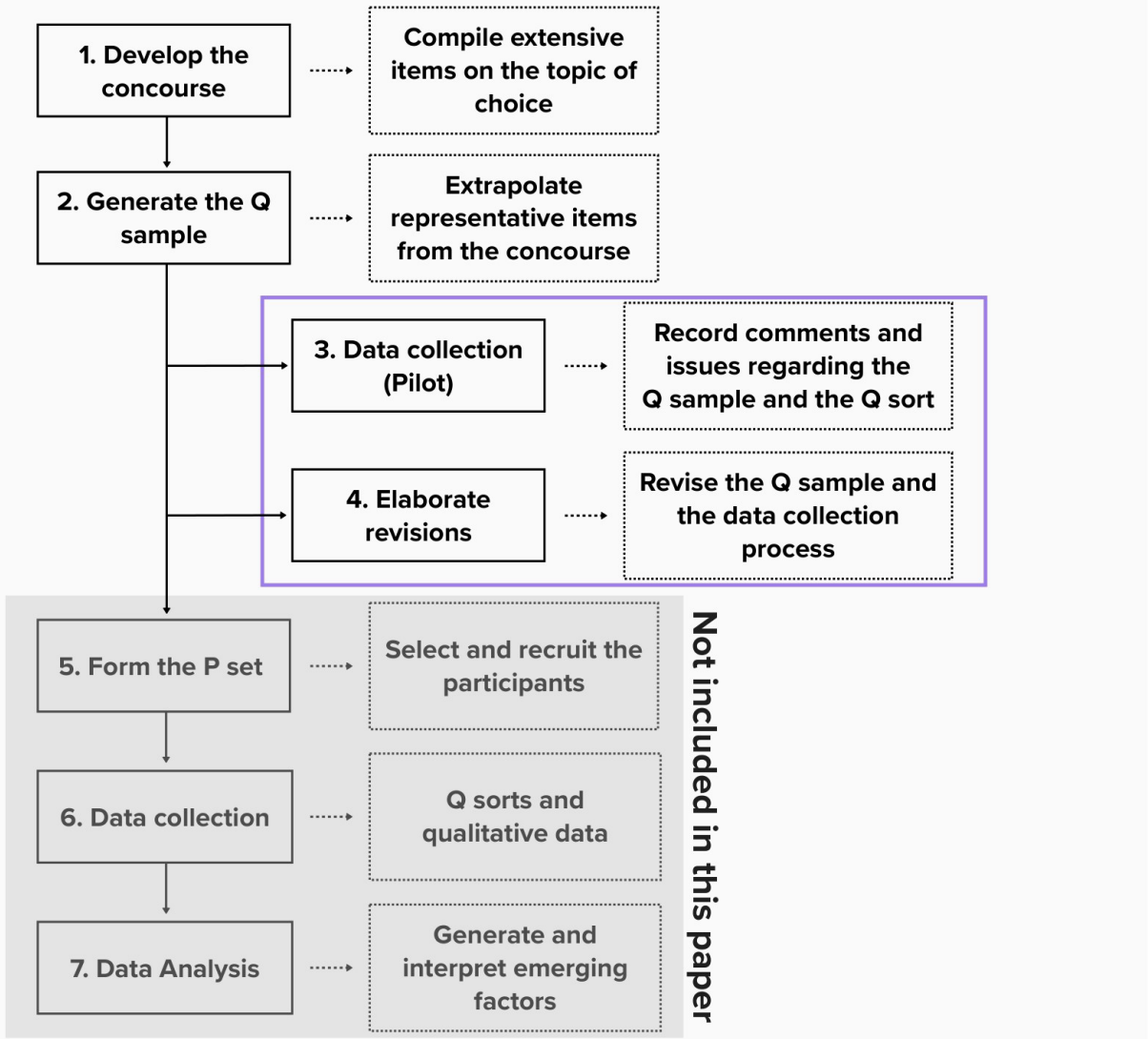
Nonetheless, the debate over whether piloting the Q sample is necessary or even useful is far from settled, and it is common to find studies that don't include any mention of such phase. In a review of Q methodology education research studies, from a total of 74 studies drawn from 20 countries, almost a third did not specify whether the authors had employed any "validation procedure to create the Q sets" or conducted "pilot studies to validate Q sets" (Lundberg et al., 2020, p. 9). Questions and comments around this topic are also recurrently raised on the Q methodology listserv, demonstrating an interest within this research community (Conlin, 2022; Urquhart, 2012).

Here, we contribute to the discussion about the value of a pilot phase in Q methodology, and provide a model for the development and testing of data collection tools early in the research process (Figure 1). Drawing on an example of research developed in the context of U.S. agriculture, we demonstrate the value of a pilot phase both for content validation of the Q sample, which can strengthen the purposeful, balanced selection of items drawn from the concourse (Brown et al., 2020; Watts & Stenner, 2012), and to refine data collection procedures to increase the quality of data and interpretation of results (Gudmundsdottir and Brock-Utne, 2010; Malmqvist et al. 2019; van Teijlingen and Hundley, 2001). We hope that this article can catalyze continued conversation around this topic because, as Shearman (2020) concluded, we also believe that clearly outlining all the decisions made throughout the research process, from concourse creation to factors interpretation, "would both increase the academic credibility of each individual paper and make a valuable contribution to the increased understanding of Q methodology as a rigorous and effective research methodology" (p. 129).

[1] The term Q set is sometimes used instead of Q sample, as in Rieber (2020).

Figure 1

Graphical Representation of the Steps in a Study Using Q Methodology.



Note. This article explores boxes 1 to 4, with a particular focus on boxes 3 and 4 constituting the pilot phase and the subsequent elaboration of revisions, highlighted in violet. Boxes 5 to 7, shaded in grey, are not included in this work.

Before moving into the details of our study, we want to clarify our use of *validation*. In this article we don't intend to question whether the results of studies conducted using Q methodology are reliable or generalizable; we believe that this has been thoroughly explored in the literature (e.g., *Operant Subjectivity* Vol 16 1/2 (1992); Brown et al., 1999; Ramlo, 2024). Rather, we focus on *content validation*, which refers to the processes of ensuring that an instrument accurately or adequately covers the "real or hypothetical universe of situations which together constitute the area of concern" (Lennon 1956, p. 295). In other words, content validation examines whether the items included in an instrument are fully representative, relevant, and appropriate for the topic of investigation, and whether related procedures (i.e., an instrument's format and instructions for completion) are understood by participants (Almanasreh et al, 2019; Brod et al. 2009). Content validation is commonly used in the health sciences to ensure

the quality of instruments aimed at capturing patient subjectivity, most notably for patient reported outcomes (Brod et al. 2009; FDA 2009; Sánchez-Guardiola Paredes et al., 2021; Thompson et al. 2011). Given Q methodology's similar focus on subjectivity, we believe that content validation has the potential to increase the quality of data and improve our ability to capture participants' subjectivities through the completion of the Q sort. Notably, this process does not standardize participants' *interpretations* or responses to individual items in the Q sample; rather, content validation focuses on ensuring that the Q sample is "sufficiently diverse as to approximate the diversity of the concourse – i.e., to achieve *representativeness* of the stimulus domain" (Brown et al., 2020, p. 95, emphasis in the original) and that it "should enable participants to respond to the question in an effective fashion" (Watts & Stenner, 2005, p. 75) .

Study Framework

Our study was developed in the context of a broader a research collaboration called Precision Sustainable Agriculture (PSA), a transdisciplinary project aimed at increasing and facilitating the effective use of cover crops in U.S. commodity agriculture in the Northeast, South, and Midwest regions of the United States. According to the U.S. Department of Agriculture (USDA), cover crops are "crops, including grasses, legumes, and forbs, [planted] for seasonal cover and other conservation purposes. Cover crops are primarily used for erosion control, soil health improvement, and water quality improvement" (Wallander et al., 2021, p. 6).

Despite the numerous benefits attributed to cover crops and the increased interest among farmers, policymakers, and researchers (Lu et al., 2000; Scholberg et al., 2010; Wallander, 2021), the most recent USDA Census of Agriculture indicates that cover crops were only planted on 5.1% of harvested cropland (Wallander et al., 2021). In this context, our research aims to understand US commodity farmers' perceptions of cover crops from a holistic perspective. Instead of focusing solely on perceived benefits and barriers to cover crop adoption, we use Q methodology to investigate how farmers think about cover crops in the context of their broader farming operation, and how this intersects with their motivations, priorities, and values in relation to cover cropping.

Materials and Methods

Concourse and Q Sample

To develop our concourse, between July 2019 and April 2020, we gathered information, opinions, and facts about the use of cover crops in commodity agriculture from a combination of:

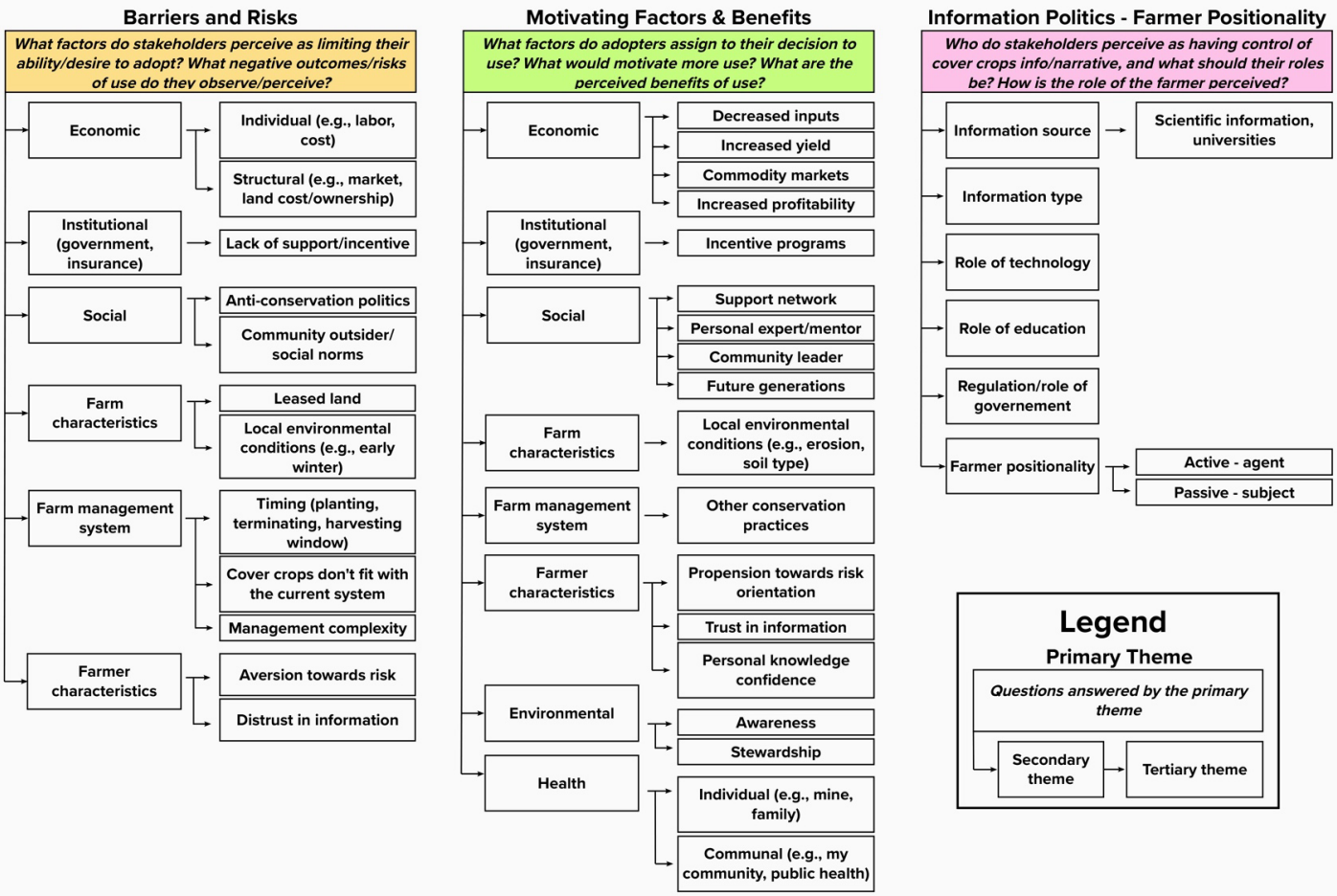
1. Participant observation of in-person and virtual education and networking events related to cover crops, and the PSA project team meetings.
2. Informal conversations with cover crop experts and farmers.
3. Document analysis of online and printed media aimed at commodity farmers, and public message boards on agriculture-focused websites.
4. Peer-reviewed articles about cover crops and related agricultural topics.

Through this process, we identified 230 quotes, which we analyzed via a process of closed and open coding in four iterative stages (Figure 2). The first cycle of the coding process drew on themes from extant literature on cover crop and conservation management practice adoption, framed by *barriers and risks* versus *motivating factors and benefits* to cover cropping. Statements that did not fit into these two major categories were inductively coded, forming a third major theme: *information politics and positionality*.

These three themes represent primary themes. In the second cycle of coding, we identified sub-themes again drawing from the literature (i.e., a barrier might be coded as an economic, social, or environmental barrier), as well as constructed from the statements themselves (i.e., the motivating factor of health). A third cycle of coding was conducted to further parse the secondary themes, the results of which were not ultimately used in the construction of the Q sample but further enhanced the researchers' intimacy with the Q concourse data. A fourth and final cycle of coding identified each statement as either positive, negative, or neutral in its relationship to cover cropping. Drawing on this extensive coding process, we selected and adjusted statements to create an initial Q sample without positive or negative bias (which could deter a participant if they felt ostracized by an implicit bias of the tool itself), in which all primary and secondary themes were represented. The resultant Q sample comprised 51 statements (Appendix A), including a combination of direct quotes and summarized concepts. To further balance the proportion of positive, negative, and neutral ideas, some of the statements were rephrased or inversely worded.

Figure 2

Codebook Used to Analyze the Concourse, Presented in a Tree-like Diagram.



Note: The image shows how, through an iterative process, we identified three primary themes and two levels of respective sub-themes.

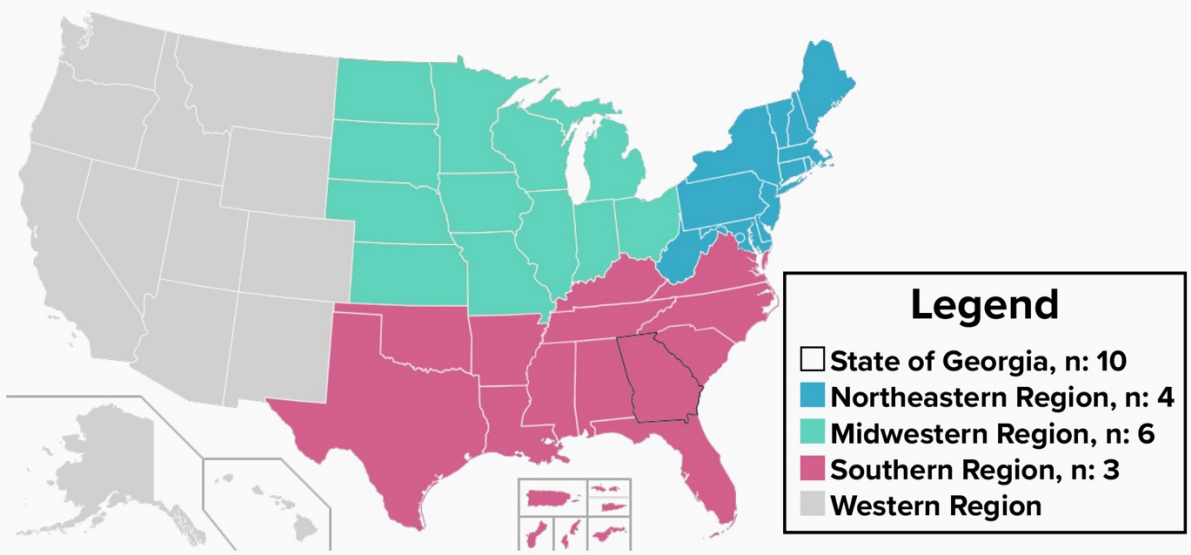
Data Collection

As mentioned above, some researchers using Q methodology recommend conducting a pilot study prior to data collection (Cross, 2005; Mohr, 2020; Paige & Morin, 2016; Shearman, 2020; Zabala et al., 2018). This stage allows researchers to evaluate if the Q sample captures the "universe" of ideas related to the topic of study, to verify the clarity of the statements contained in the Q sample, and to test the sorting procedure (Paige & Morin, 2016).

Our pilot process took place in two phases: a local pilot study conducted in Georgia (United States), and a multi-region pilot with participants from the Southern, Northeastern, and Midwestern regions of the United States, as designated by the USDA – Sustainable Agriculture Research & Education (USDA-SARE, (2023); see Figure 3).

Figure 3

Map Showing Number of Participants (n) from Each Area of the United States



Note: The State of Georgia is highlighted in black. United States Regions are as designated by SARE. The Western region was not included in this study.

The multi-region pilot was conducted after deciding to scale-up the research project to encompass all three SARE regions. Because of the expanded footprint of our research, and our awareness that farming conditions and experiences can vary widely across the U.S., we decided to test our Q sample again—to ensure that it would reflect the boundaries of our work and effectively capture the experiences of farmers across all three regions. In the sections below, we present our content validation process in detail and explain how it informed the revision of the Q sample, the interview guide, and the data collection procedures.

In both pilot studies, the participants engaged in a card sort activity and an interview, and completed a demographic survey. The main purposes of the pilots were to:

1. Ensure that, across all three regions of the United States, all relevant aspects related to cover crops and commodity agriculture were represented in the Q sample.
2. Confirm that the Q sample statements were easily understandable for participants

with a range of expertise and experience using cover crops.

To achieve those objectives, we included interview questions investigating the content (i.e., whether additional topics should have been included in the Q sample) and clarity (i.e., whether a statement was confusing to participants) of the Q sample. Those questions served to prompt feedback from participants, which helped us identify statements that needed revision before initiating data collection for our subsequent study.

Participants

The Georgia pilot involved a total of 10 participants (Appendix B), who were identified through a mixture of stratified and snowball sampling. Both approaches purposefully target "information-rich cases for in depth study:" Stratified sampling selects individuals based on characteristics of interest, whereas in snowball sampling participants recommend others for the research (Patton, 1990, p. 182). It was our intention to include at least two participants representing the following stakeholder categories: farmer (one positive and one negative or neutral toward cover crops), Extension agent, USDA-Natural Resources Conservation Service (USDA-NRCS) employee, and agricultural industry. We initially reached out to three key informants involved with cover crops through research and extension activities in Georgia and asked them to recommend participants for the pilot who had some knowledge or expertise with cover crops and held different attitudes (positive, neutral, or negative) toward the practice. Participants were in turn asked to suggest additional participants, especially those who might have different opinions or management approaches to cover crops than their own.

For the multi-region pilot, we also used a purposeful stratified sampling to recruit key informants who worked with regional Cover Crop Councils, industry, non-governmental agencies, Extension, or academia from across the three USDA-SARE regions of interest (Appendix B). They were further identified based on their knowledge and experience with cover crops and other conservation agriculture practices, as the objective of this pilot was to ensure that our statements were relevant and comprehensive of the main aspects related to cover crop use and commodity agriculture across each region. Ultimately, we recruited 13 additional participants: four from the Northeast, six from the Midwest, and three from the South.

Data Collection for the Georgia Pilot

The Georgia pilot took place between September 2020 and March 2021. Because of the Covid-19 pandemic, we could not meet with the participants in person; therefore, we conducted this pilot study remotely. After confirming their willingness to participate by phone, participants were mailed a set of materials and directions to sort the statements in a v-shaped grid based on their agreement/disagreement with the prompt, "My view on cover cropping and commodity agriculture." The columns on the grid were labeled from -5 ("Least like my view") to +5 ("Most like my view"). Participants were asked to take a picture of the completed grid and, if possible, email it to the researcher. They were also asked to mail back their materials and schedule a follow-up interview. Participants could complete the follow-up interview either by phone or Zoom. During the interview, we asked participants for feedback on both the activity and the content of the cards (we use *statements* and *cards* interchangeably throughout the article to indicate the statements composing the Q sample and shown on cards, both physical and virtual, during the study). We also tested interview questions to help with the interpretation of the data obtained with the card sort. The follow-up interviews were recorded, and thorough notes were taken.

Data Collection for the Multi-Region Pilot

The multi-region pilot took place between January and October 2021. Due to continued limitations to in-person activities from Covid-19 and participants' diverse locations, data collection took place remotely. Based on lessons learned in the Georgia pilot (explained below), we asked participants to schedule a 90- to 120-minute Zoom call during which they completed the Q sort activity while sharing their screen with the researchers. Two researchers co-facilitated data collection, with one researcher assisting the interview and card sort process, and the other primarily taking notes. The Zoom call was audio-recorded to support data analysis. The Q sort was administered through a web-based software, Easy HTMLQ Version 2, iterations from 2.0.0 to 2.0.3 (Banasick, 2015). The software allows researchers to custom program the instructions and structure of the Q sort. The Q sample items included in the Q sort were the same as those used for the Georgia pilot.

For the multi-region pilot, the Q sort took place in the context of a semi-structured interview, which enabled a broader conversation about the role of cover cropping in agriculture and conservation. To better interpret participants' feedback, we also inquired whether their jobs put them in direct contact with farmers and whether they had first-hand experience with farming and growing cover crops.

After connecting with participants via Zoom, we shared the link to the Q sort, then asked them to open it in their browser and share the screen with us. The Q sort followed the process shared by many studies using Q methodology: participants were first guided to divide the statements into three piles: "Disagree," "Neutral," "Agree," based solely on their first impression. Next, participants sorted the statements in a v-shaped grid from 0 ("Least Like My View) to 10 "(Most Like My View"). Participants were asked to "think aloud"[2] while placing the statements in the grid. Through this process, we were able to note any possible issue or confusion related to the meaning of the cards, as well as understand how participants were interpreting the statements and how they came to their opinion (e.g., personal experience, talking with farmers, from literature, etc.). Because our goal was to validate our Q sample and test our data collection approach, after the Q sort we asked the participants for feedback using questions such as:

1. "Were there any topics or statements about cover cropping and agriculture that you think should have been included, but weren't?"
2. "Were there any cards that surprised you? Particularly challenging to place [on the board]?"
3. "In your opinion, is there any topic or aspect about cover cropping and agriculture that is overly stressed in our set of statements?"

Finally, we asked for suggestions to recruit other key informants and farmers.

Analysis and Revisions

Content validation was conducted as an iterative process. We used the feedback offered by participants and the notes from our semi-structured interviews to generate proposed changes to the Q sample and interview guide. Following each interview, the two researchers shared their initial take-aways and compared notes, which were used to develop a working list of Q sample items and interview questions that needed

[2] Through this "think-aloud process," participants were asked to share with the researchers their reactions to and thoughts about the statements as they were completing the Q sort.

clarification or revision. The researchers discussed insights with the senior author and brainstormed revisions to be implemented in four ways:

1. New topics raised by large numbers of participants would be added to the Q sample.
2. Topics suggested by few participants or reported as important only in specific situations would be explored during the follow up interview, but not added to the Q sample.
3. Unclear statements would be revised.
4. Themes considered redundant by large numbers of participants would be consolidated into single statements.

Minor changes to the interview guide were beta-tested during the multi-region data collection, but Q sample statements were kept consistent throughout both pilot studies and revised only after data collection. Finally, we shared feedback and revisions with other members of the PSA Social Science Team and with a local Q methodology expert to discuss possible improvements. We took note of any comments or suggestions emerging from those advisors and continued to revise until we had expert consensus that the edits addressed participants' initial feedback, and that the final revisions would make sense to those not directly involved with their creation.

Results

Q Sort and Interview Content Revisions

Overall, participants endorsed the content of the Q sample and the organization of the interviews and Q sort. Since none of the participants noted redundancy of themes, we did not remove any statements. Participants in the Georgia pilot did not suggest any additional topics, while participants in the multi-region pilot suggested that the following topics could be added to the Q sample or the interview (Table 3):

1. Effect of the carbon markets on farmers' interest and willingness to adopt cover crops.
2. Interest in economic incentives other than direct payments (i.e., crop insurance discounts) for using cover crops.
3. Increase in organic matter and potential carbon sequestration from the use of cover crops.
4. Interest in grazing cover crops as an additional benefit from the practice.
5. Experience and interest in using mixes of different cover crops rather than single species.
6. Role of trusted information sources.

Table 3

Participants' Multi-Regional Pilot Feedback and Revisions Implemented in Response.

Feedback from Multi-Regional Pilot	**Content Revisions**
Suggested Topics	*Integrations to the Interview*
Carbon markets.	Added question: "While placing card 21 – Cover crops should be better incentivized financially – what kinds of incentives did you have in mind?" Added rank order item (Table 4)
Economic incentives other than direct payments.	
Organic matter and carbon sequestration.	
Grazing the cover crop.	Added question: "Do you harvest or graze the cover crops?"
Cover crop mixes vs single species.	Added question: "What cover crops do you usually plant? Why?"
Trusted information sources.	Added questions 1. "When you want information on cover crops, where/to whom do you turn to for information that you feel is accurate and trustworthy?" 2. "How about other information, not specifically on cover crops. Do you use different sources of information?"

Because the Q sample already included a large number of statements (51) and no additional topic was reported by a large number of participants, we integrated participants' suggestions into the interview guide. The first two suggestions relate to financial incentives for cover cropping, and the third is closely related to ongoing discussions about carbon markets in agriculture. We had also noticed that participants most frequently commented on federal and state incentive programs while placing statement 21 ("Cover crops should be better incentivized financially"). Thus, we made two changes to better understand their views on financial incentives for cover cropping: first, we added an interview question asking what kinds of incentives they had in mind while placing statement 21. We also developed a list of state, federal, and private incentives for participants to rank, based on the likelihood that the incentive would increase their interest in cover cropping (Table 4). This follow up activity was beta-tested with several participants during the multi-regional pilot.

Table 4

Incentive Ranking Table Added to the Follow-Up Interview

Type of financial incentive (e.g., cost share, incentive payments, grants, loans, discounts)	**Ranking**
Natural Resources Conservation Service (USDA-NRCS) programs	
USDA Farm Service Agency programs	
State funded programs	
Non-profit/Non-governmental programs	
Carbon market payments through state/national government programs	
Carbon market payments through private entities and/or industries	
Industry incentives other than carbon market payments	
Insurance discounts	
Tax credits	

Note: Participants were asked to rank items (from 1 = least likely, to 9 = most likely) based on the likelihood that each incentive would increase their interest in cover cropping.

Suggestions mentioned in topics 4 and 5 (see above) related to additional cover cropping practices (e.g., grazing and seed mixes). We integrated these topics as interview questions for farmers who already use cover crops, asking them "Do you harvest or graze the cover crops?" and "What cover crops do you usually plant? Why?"

The last suggestion, listed as point 6, relates to understanding farmers' trusted information sources. In response to this important topic, we added several information-related interview questions for all farmers: first, "When you want information on cover crops, where/to whom do you turn to for information that you feel is accurate and trustworthy?" This question was followed by a series of prompts to solicit more specific information (e.g., "Where did you learn about this resource? How do you use it? If you can't find what you are looking for, what do you do? Who do you turn to?"). We also asked, more generally, "How about other information, not specifically on cover crops. Do you use different sources of information?"

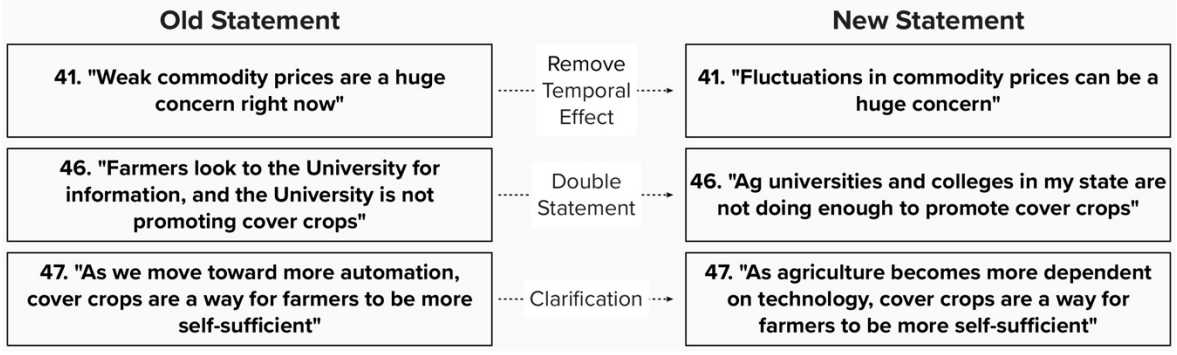
Beyond these additional topics, we identified three statements that needed revision for clarity (Figure 4). First, we observed that participants' interpretations of statement 41 ("Weak commodity prices are a huge concern right now") was strongly affected by shifts in the agricultural economy. Our goal with statement 41 was to understand the general relationship between commodity markets and farmers' decision making; however, the words "right now" induced a temporal effect that influenced how participants ranked the statement. During the Georgia pilot, when commodity prices were low, all participants ranked the statement highly, but during the multi-region pilot,

when commodity prices were high, most participants disagreed with the statement, ranking it low. The issue was made explicit by multi-region participants' comments to the statement. An industry representative from the Midwest said, "I mean right now they're pretty good so that gets a pretty strong disagreement." A USDA-SARE representative from the Midwest said, "That's definitely zero [least like my view] right at the moment." A member of a non-governmental organization from the Northeast commented, "They're not a very huge concern right now, [but] sometimes they're a huge concern." Two comments were even more explicit about the unique situation that influenced their decision to disagree with the statement. One faculty member from the Southeast said, "Normally, I would probably agree with that, except that right now we've been through this crisis in the supply chains and everybody who's got something to sell is making money today. America is on a binge of recovery and so right now it's a moment in history when it looks pretty rosy." A farmer and member of a non-governmental organization from the Midwest explained, "I think that that changes so often, and right now I'd come out, at least for corn, the prices are pretty, pretty good, so I think in general over the longer term that's a barrier to just having thin margins makes it hard to take perceived risks in changing your operation, but right now I don't think it's as quite as big of a concern on farmers' minds, this year."

Since our next round of data collection was to take place over many months, it was essential to rephrase the statement to be more resilient to the impact of changing economic conditions on participants' opinions in the moment. As such, we rephrased statement 41 to read, "Fluctuations in commodity prices can be a huge concern." In our subsequent study conducted with farmers using the Q sample developed through this process, the new statement 41 elicited responses that focused on participants' general attitudes towards the market, rather than the situation of the moment, thus supporting our decision to rephrase the item. For example, a farmer from Vermont reacted to the card saying "That's all over. Things go up and down. I mean, if a farmer can't pay for his grain in his regular bill, he's not gonna put more money into cover cropping. I mean, he's gonna maintain what he has and you can't operate on a, you need to make … money." Conversely, a farmer from South Carolina said, "The commodity price shouldn't be a concern 'cause you're trying to increase your yield." A farmer from Iowa commented, "Absolutely … the bottom dollar fluctuation just makes it hard to manage all of your input costs and payments." Notably, as these examples demonstrate, the rephrased statement did not limit the variety of participants' subjective responses.

Figure 4

Revised Q-sort Statements: The Initial Statement (Left), Revised Version (Right), and Rationale (Middle)



Several participants also expressed confusion with statement 46 ("Farmers look to the University for information, and the University is not promoting cover crops"), explaining that they had different attitudes about the first and the second part of the statement (e.g., agreement with the first part and disagreement with the second, or vice-versa). For example, commenting on the statement, a USDA researcher from the Northeast noted, "You have two statements here and they conflict. Farmers, I do think look to extension to a greater or lesser extent; the universities actually are promoting cover crops, or at least my perception is that they are." Similarly, a faculty member from the Southeast said, "I think the first part of the statement is true, but the second part isn't." A farmer and member of a non-governmental organization from the Midwest said, "I like agree with parts of it and I don't agree so I might end up moving this one down to neutral somewhere."

In revising the statement, we first had to decide which of the two concepts to focus on – either farmers' reliance on universities as information sources, or the promotion of cover crops by universities. Looking back at the concourse, we determined that the core concept should be universities' promotion of cover crops. We also determined that we needed to maintain the "negative" valence of the statement for balance in the Q sample overall. We elaborated a few possible alternatives (i.e., "University extension is not doing enough to promote cover crops," "Public colleges and universities are not doing enough to promote cover crops," "State colleges and universities are not doing enough to promote cover crops"), discussed how each might be perceived by farmers, and shared them with the PSA Social Science Team for additional feedback. Recognizing that universities can promote cover crops through multiple efforts (i.e., extension meetings, dedicated courses for students, research projects) and that farmers are most likely interacting with institutions in their area, we settled on "Ag universities and colleges in my state are not doing enough to promote cover crops" as the final phrasing of this statement.

Again, in our next round of data collection, we found that farmers were able to focus on the single concept expressed by the statement and reveal their subjectivity toward the topic, rather than having to negotiate a split response to the statement. Comments on the revised statement varied, as expected, but they revealed participants' experience with and opinions about the promotion of cover crops by local agricultural colleges and universities. In fact, a farmer from Missouri shared, "I don't know that I have an opinion on that […] I'm not out there looking for information on cover crops, so I don't know – I don't even know what's out there. I don't even know what they're doing to promote it or not promote it." On the other hand, a farmer from Ohio shared, "For a long time they didn't, and then in the last three years … they've started to ramp that up. So they've – I think they're doing better than what they were, but I still don't see a lot out of like Purdue or some of the other ones." While a farmer from Vermont shared an opposing view, saying, "I think we're very strong, in Vermont, very fortunate to have [our local agronomy and soils extension specialist] and her crew.")

Finally, although most participants commented that statement 47 ("As we move toward more automation, cover crops are a way for farmers to be more self-sufficient") was confusing, a small subset found it relevant to their experience. Looking back at the section of the concourse from which we derived this statement, we determined that the word "automation" excluded technologies such as industrial fertilizers and pesticides that were also relevant in the concourse. To better represent the range of themes in the concourse, we rephrased the statement to read, "As agriculture becomes more dependent on technology, cover crops are a way for farmers to be more self-sufficient." This revised statement still elicited a divergent response in our next round of data collection, with

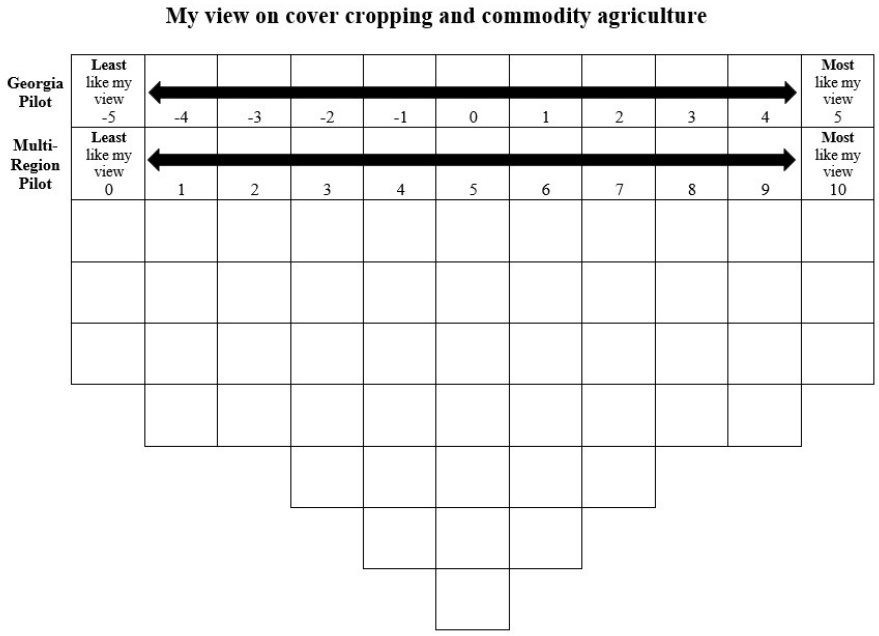
many farmers finding it irrelevant to their experience; Nevertheless, the concept strongly resonated with a small group of growers, revealing the importance of this theme for a subset of participants.

Data Collection Process Revisions

Although our primary objective was to validate the content of the Q sample, we also identified a few opportunities to improve our data collection process along the way. We instituted two revisions between the Georgia and the multi-region pilot. The first revision focused on the scale used for the card sort. As noted in the methods, during the Georgia pilot, participants ranked statements from -5 ("Least like my view") to +5 ("Most like my view"), while for the multi-region pilot we used a scale from 0 ("Least like my view") to 10 ("Most like my view") (Figure 5). This change was prompted by comments received during the Georgia pilot, when participants reported that the presence of negative values on the scale was confusing or misleading given their perspective on the issue. Specifically, participants felt that a column with a negative value indicated disagreement with the statement; therefore, they were not comfortable ranking statements they slightly agreed with or felt neutral about in a column with a negative number (i.e., -1, -2, etc.). For this reason, we decided to use a scale with more neutral values (i.e., 0, 1, etc.) indicating their increasing level of agreement. While the scale changed, both the qualitative descriptors at the end of the spectrum ("Least like my view" and "Most like my view") and the v-shaped distribution (i.e., the number of cards "allowed" under each column) were kept consistent during both pilots and the subsequent study.

Figure 5

Grid, Scales, and Prompt Used During the Georgia and Multi-region Pilots to Guide the Card Sort.



The second revision concerned the mode of data collection. As noted in the methods, for the multi-region pilot we did not mail the materials to the participants but asked them to schedule a Zoom call to conduct the interview and the Q sort online. This choice was informed by the quality of data collected in our Georgia pilot: Out of 10 Q sorts from that phase, one was deemed unusable during the follow-up interview when the participant realized they had misread one of the statements and ranked it opposite to their actual opinion. A second had to be removed due to confusion regarding the sorting instructions which lead the participant to randomly fill in the grid without reading the statement cards. In both instances, the issues could have been promptly solved if the researcher were present while the participants completed the Q sorts, leading us to shift to facilitating a real-time sort via Zoom.

A note of caution: While the decision to conduct a guided Q sort via Zoom was a major improvement from the mailed Q sort, we nevertheless encountered some technical difficulties with the Easy HtmlQ software during this phase. Perhaps because of the large number of statements used in our Q sort, the software would occasionally glitch and statements that had been placed in the grid would disappear from the screen. The issue tended to happen when a participant temporarily "dropped" one or more statements outside of the grid while deciding where to place them. Even with cautioning participants to avoid this move, the software would still sometimes present the problem. Elsewhere, members of our research team have explored a third approach which merged the strengths of both strategies and proved a better alternative for remote data collection: mailing physical Q sort materials to participants and conducting the card sort on a Zoom call with the researchers (Weisberger et al., 2024). This way, participants could manipulate physical copies of the statements (avoiding any technical issue due to the software), and researchers could attend and follow the thought process, clarify any doubts, and prevent misunderstandings.

Discussion

Overall, the results from this work demonstrate the value of a robust pilot phase in Q methodology to validate the content of the Q sample and refine data collection procedures. Our content validation yielded multiple revisions, ensuring that our Q sample was comprehensive and clear, thus allowing us to better capture participants' subjectivity around the themes expressed in the concourse. Our work corroborates Shearman's claim that "The pilot studies were an invaluable complement to the concourse generation and statement selection process in reaching the study's final Q sample" (2020, p. 127). Additionally, this work highlights the importance of a semi-structured interview for providing rich context to interpret participants' points of view, a step that has been promoted by Brown and colleagues who argue that "the best Q studies are generally those in which the Q sorting is immediately followed by an intensive interview during which the person fleshes out the skeletal view contained in the Q sort" (1999, p. 625). Our results further demonstrate the value of conducting a pilot with participants who can provide insight into the experiences of the target population. While the Georgia pilot provided useful insights on the data collection procedure, our multi-region pilot allowed us to consider content revisions that became relevant as our study scaled up.

Our pilot phase also yielded several process revisions that enhanced the quality of our data and provided a smoother data collection experience for participants. Specifically, administering the Q sort in real time via Zoom avoided misunderstandings related to the conditions of instruction, provided a "work around" in the case of software malfunction,

and allowed us to capture participants' immediate response to each card. The first takeaway, emerging from both pilot studies, was the need for the researcher to be present during the Q sort activity. During the Georgia pilot we had to discard two Q sorts because of issues that could have easily been avoided had we been present during the activity. Challenges related to the clarity of instructions for remote Q sorts are reported in the literature as well (Alanazi et al., 2021; van Tubergen & Olins, 1979). During the multi-region pilot, a fully remote activity would have prevented several of our participants from completing the Q sort and submitting their responses because of the software glitch. Certainly, there are multiple programs to conduct remote data collection, and the one we used has now been replaced by a newer product (Banasick, 2022); nevertheless, the qualitative data shared by the participants during the Q sort also provide valuable information that would be lost without the interaction between researchers and participants. Alanazi and colleagues (2021) further observe the challenges of completing timely debrief interviews when using an online Q sort. They argue, "The time factor is significant because, if the interview does not happen immediately after participants answer the Q sort, there is a strong possibility that they will forget their answers and rationale for their choices." (Alanazi et al., 2021, p. 4). We also observed this issue with some of the participants in our Georgia pilot, especially when we had to delay the debriefing interview for several days after completing the Q sort. Additionally, when evaluating the use of online software for data collection, it is important to consider that some targeted populations might not have access to reliable internet connection, or they might not feel comfortable or be able to use the necessary technologies (Alanazi et al., 2021). While there may be advantages to remote Q sorts (Lutfallah & Buchanan, 2019; Ramlo, 2021; Walker et al., 2018), we recommend in-person data collection whenever possible. Given the limitations to in-person activities experienced during COVID, and the cost of travel, we argue that when remote data collection is necessary, a hybrid approach of mailed paper materials completed in real-time during a videocall would likely be the next best alternative (Weisberger et al., 2024).

We also learned that the way the Q sort scale is labeled matters and can influence how participants interpret ranking of the items in the sort itself. The construction of the scale has been debated among Q methodologists (Brown & Good, 2010), and alternative approaches have also been explored by other researchers. For example, Shearman (2020) removed the numbers on the scale entirely after participants to her pilot study reported negative feedback "related to the shape and labelling of the distribution" (p. 127), and Stephenson (1953) himself, in *The Study of Behavior*, presented examples with scales ranging from 0 to 10 (p. 119, 132, 144, 212) and 0 to 8 (p. 211). In this study, we learned that configurations that span negative to positive values, with zero in the center, can suggest to participants that there are three predetermined regions in the grid – with negative numbers representing disagreement, zero representing neutrality, and positive numbers representing agreement. In contrast, a configuration beginning with 0 and increasing in values can communicate increasing agreement with the items in the sort. This lesson further made evident that, while we may strive for Q sorts presenting neutrality at the center of the scale, when interpreting Q sort data, we should not automatically assume that the center of the table represents neutral attitudes for all participants. Sylvester (2020) makes a similar point when she recalled that Brenner said, "Subjects should mark on the grid their true neutral statements to determine whether they were falling on or near the neutral column" (p. 51)

While most Q samples include between 30 and 70 items (Rieber, 2020; Watts & Stenner, 2012), we recommend that researchers use as small a Q sample possible for their

work. Our elevated number of statements, 51, may have exacerbated the software problems we experienced, but we also observed that participants could feel overwhelmed by the amount of information they were asked to process and organize. This was one of the reasons why we decided to investigate other possible topics of interest through follow-up questions, instead of adding statements to the Q sample.

Finally, this extensive pilot demonstrated to us the value of the semi-structured interview in the data collection process. Without participants' comments to the statements during the Q sort, we would have not identified the temporal effect in statement 41 or the problem with the double-statement in statement 46. Participants did not feel the need to explicitly flag those statements as unclear, but the comments they made while interacting with the cards demonstrated that they needed revision. Additionally, we observed participants attributing heterogeneous meanings and explanations to statements while ranking them in the Q sort. Stephenson, who developed Q methodology, noted, "It is important to remember that the statements have no normative meanings" and "statements in concourse shift their meanings with their company – they may have different meanings in different factors" (Stephenson, 1983, pp. 81, 82). We concur and thus recommend that researchers embed the Q sort in a semi-structured interview, as we have done. Through the think-aloud process we encouraged in our pilot, we found that some participants interpreted cards in unexpected – but relevant – ways; capturing and examining these differences during our next phase of data collection and analysis will be essential to ensuring the quality of our results and interpretation.

While our study focuses on the insights from a pilot phase in Q methodology, many of its takeaways complement other studies in the field of mixed methods. As argued by Newman and colleagues, "In this era of accountability, it is essential not only to provide transparency, but also to provide evidence that creates confidence in the assessment instrument" (Newman et al., 2013, p. 244). We argue that content validation of the tool used for data collection strengthens both the transparency and the confidence in the research process, thus contributing to the overall *quality* of the work. Furthermore, our work provides a roadmap for piloting and evaluating data collection tools and processes that, applied within the framework of Q methodology, can improve the *rigor* of the research, which Harrison and colleagues explain as "both the actions of the researcher (i.e., the steps taken in the scientific process) and the reporting mechanisms used to describe those steps to the reader, providing a better understanding of exactly what the researchers did during their study" (Harrison et al., 2020, p. 476).

Conclusions

In this article, we examined the process of creating and piloting the tool and procedures used for data collection in a Q methodology research study. Our extensive work demonstrated the value of pilot studies for ensuring content validation and illustrated how skipping this step can have unintended consequences for the quality of the data collected using the methodology. Our process also indicated that content validation is strengthened by the inclusion of an interview or, at least, a think-aloud process conducted alongside the participant's completion of the Q sort. Finally, the pilots provided us with a rich opportunity to understand the strengths and limitations of the methodology for the context of our study. We advocate for other researchers using Q methodology to consider adopting a similar process.

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Appendices

Appendix A

Statements Derived from the Concourse and Composing the Initial Q Sample.

	Statements
1	The number one question I have about cover crops is, "What will it cost, and will it pay off?"
2	Cover crops are a good tool for battling herbicide resistant weeds.
3	We need more research on cover crops.
4	The best way to sell cover cropping is with scientific evidence, hard facts, and numbers.
5	Family farms in this area are in crisis, with farmers hanging on by a thread.
6	We should focus on getting industry suppliers on board with cover cropping.
7	I worry a lot about extreme weather (heat, flood, drought, etc.)
8	Because cover crops dry up the soil/use too much water, cash crops don't have the water they need.
9	Soil health is linked to economic benefits.
10	Farmers today have a lot of freedom to do what they want.
11	Farmers who succeed are risk-takers.
12	The tools available for farmers are being taken away by regulators one-by-one.
13	I feel like scientists and researchers listen to farmers about what issues and needs are important.
14	Cover crops take up nutrients that the cash crops need.
15	We're spending so much to keep up with technology, both in machinery and inputs, and the gains in efficiency aren't enough to balance the costs.
16	Leased land is a big impediment to cover cropping - some growers won't even lime because they don't know if they'll have that land in a year's time.
17	I think a lot of farmers plant cover crops just to get the cost share payments and terminate them too early to see any real benefit.
18	No one can agree on how to best manage cover crops.
19	Farmers care more about expenses than greenhouse gases.
20	I believe farmers have a responsibility to protect the land they work on.
21	Cover crops should be better incentivized financially.
22	We all want to make sure that our land is healthy and viable over the long-term.
23	Cover crops can have negative impacts on cash crop yields.
24	Farmers don't want people in their community to drive past their cover crop fields and think they're nuts.
25	The biggest money put back into farmers' pockets with cover crops is in the inputs savings.
26	Cover crops are harder to manage in my region than in most other regions in the U.S.
27	There should be more state and/or federal policies and programs to encourage cover crop adoption.

28	Consumers will pay more for commodities produced with certain agronomic practices such as cover crops.
29	Trying to decide when to plant and terminate cover crops is stressful.
30	Conservation for conservation-sake is never going to work in a market-based system; you have to monetize it.
31	Cover crops need a purpose - you shouldn't plant them just because someone says so.
32	Erosion takes a huge economic toll on our farms in this country – that's the main reason to plant cover crops.
33	The media misportrays the impact that agriculture has on the environment.
34	I am excited about what new agricultural technologies are on the horizon.
35	Cover crops reduce the need to irrigate.
36	I don't think it's necessarily the case that average yield will go up with cover, but what we should be after is yield stabilization.
37	Farmers are limited by the selection of available cover crop seed from seed companies.
38	Farmers aren't cover cropping because they simply can't afford to make a mistake.
39	I'm a believer in the benefits of cover crops.
40	Cover crops increase labor needs.
41	Weak commodity prices are a huge concern right now.
42	Cover crops introduce disease/pests into cropping systems.
43	Farmers in my community talk to each other often, share experiences, and learn from one another.
44	It is important for farmers to be well-liked and respected in my community.
45	It takes a long time to see any benefits from cover crops.
46	Farmers look to the University for information, and the University is not promoting cover crops.
47	As we move toward more automation, cover crops are a way for farmers to be more self-sufficient.
48	Cover cropping is simply too complicated for widespread adoption.
49	Farmers need more information about cover crops.
50	Cover crops put farmers how use them at a disadvantage in the short term.
51	Cover crops just don't fit with our current crop management systems.

Appendix B

Demographic Information for the Participants in the Two Pilots.

Participant characteristics	Georgia Pilot *(n=10)*	Multi-Region Pilot *(n=13)*
Gender		
Female	2 (20 %)	9 (69 %)
Male	8 (80 %)	3 (23 %)
Prefer not to answer	-	1 (8 %)
Race and Ethnicity		
Hispanic or Latinx or other Spanish Origin	1 (10 %)	-
White	9 (90 %)	12 (92 %)
Prefer not to answer	-	1 (8 %)
Age (at the time of the interview)		
25-34	1 (10 %)	1 (8 %)
35-44	3 (30 %)	7 (54 %)
45-54	3 (30 %)	3 (23 %)
55-64	2 (20 %)	1 (8 %)
65-74	1 (10 %)	1 (8 %)
Education		
Highschool	1 (10 %)	-
Trade School	1 (10 %)	-
Bachelor's Degree	4 (40 %)	1 (8 %)
Master's Degree	4 (40 %)	6 (46 %)
Ph.D. or higher	-	6 (46 %)
Occupation		
Farmer	4 (40 %)	-
County Extension	3 (30 %)	1 (8 %)
Agricultural Industry	1 (10 %)	1 (8 %)
University Faculty/Researcher/Extension	-	5 (38 %)
Governmental employee (e.g., USDA, NRCS, ARS, etc.)	2 (20 %)	1 (8 %)
Non-governmental employee	-	4 (31 %)
Student	-	1 (8 %)