Introduction

Social scientists in the agricultural communications, education, extension, and leadership (ACEEL) disciplines create valuable, credible, and relevant scholarship, often using content analysis or the Delphi method to collect data. In content analysis, the data from communications (e.g., news stories, advertising campaigns, students' reflection journals) are analyzed by independent coders selected by the research team. Coders can be anyone from the social scientists themselves to individuals selected and trained to follow a clear and precise coding scheme. An unambiguous coding scheme ensures the independent coders are coding the materials in the same way. Similar coding results yield a higher level of intercoder reliability—the extent to which multiple independent coders agree on the coding of the content of interest using the same coding scheme (Krippendorff, 2013; Neuendorf, 2002).

Likewise, in studies employing the Delphi method, a level of agreement is achieved from a panel of experts (Hasson et al., 2000; Winzenried, 1997; Yang, 2003). After a panel of experts answers multiple rounds of questions, the answers are combined into "one useful statement" (Saucier et al., 2012, p. 139). In studies using content analysis or the Delphi method to gather data, external reliability—the extent to which a study can be replicated with similar results to a preceding study—can be established, in part, using the expertise of the coders and panelists (Bryman, 2012; Dalkey, 1969; Krippendorff, 2013; Linstone & Turoff, 1975). Within the Delphi method, expert panelists are selected to answer multiple questionnaires based on pre-determined criteria stipulated by the research team. As such, panelists should possess professional proficiency, knowledge, experience, and/or familiarity with the phenomenon of interest (Dalkey, 1969; Krippendorff, 2013; Neuendorf, 2002).

When considering a requirement that a person possess expertise to serve as a coder in an analysis of content, there is a divergence of opinion. For example, Krippendorff (2013), who is considered a forerunner in content analysis development, emphasized the value coders with expert knowledge and experience bring to the content analysis process. Clearly describing why coders were selected was emphasized as a way for future social scientists to achieve external reliability—knowing why coders were chosen would provide future researchers protocol to follow in their own selection of coders (Krippendorff, 2013). Additionally, Krippendorff recommended selecting coders who could be easily found in the general population and possessed high cognitive abilities and familiarity with the phenomenon of interest.

Offering a different perspective, Bryman (2012) believed thorough coder training, not expertise, was the key requirement for ensuring external reliability—if the coder was thoroughly trained on how to code the content, and a high enough level of inter-coder reliability was established, *anyone* could serve as a coder. Fraenkel et al. (2012) concurred:

> For all their study and training, what experts know is still based primarily on what they have learned from reading and thinking, from listening to and observing others, and from their own experiences. No expert, however, has studied or experienced all there is to know in a given field, and thus, even an expert can never be totally sure. All any expert can do is give us an opinion based on what he or she knows, and no matter how much this is, it is never all there is to know. (p. 5)

Similarly, Neuendorf (2002) said recruiting experts exclusively for content analysis coding was problematic, as experts may not be readily found in a population and a coding scheme usable only by experts could limit the study.

Both sides of the debate on whether experts should be recruited for content analysis coding make valid points. However, obtaining experts to serve on a Delphi panel is straightforward and non-negotiable: A panel comprised of experts is required to achieve consensus (Dalkey, 1969).

Presently, the only way to know what qualifications, credentials, experience, or knowledge coders or panelists bring to a study is the way the social scientist describes those aspects in the methods or procedures section of a manuscript. Certainly, the expertise of the coders and panelists selected to assist with ACEEL research complements the expertise of the social scientists tasked with addressing the complex problems associated with food, agriculture, and natural resources systems (Roberts et al., 2016). Considering the volume of research conducted about expertise (i.e., Bereiter & Scardamalia, 1993; Camerer & Johnson, 1991; Chi, 2006; Collins & Evans, 2002; Feltovich et al., 2006; Germain & Tejeda, 2012; Goldman, 2015; Winch, 2010), there is not a widely accepted or noted benchmark for expertise, particularly in agricultural-related applied social science research.

Because a widely accepted or noted benchmark for expertise does not exist in ag-related applied social science research, Costello and Rutherford (2019) analyzed 126 published manuscripts that used content analysis as the primary research method and 56 published manuscripts that used Delphi as the primary research method to determine how social scientists in ACEEL disciplines were describing the qualifications and expertise of coders and panelists. The studies analyzed were published between 2007 and 2017 in the premier social science agricultural journals (Edgar & Rutherford, 2011): *Journal of Applied Communications (JAC), Journal of Agricultural Education (JAE), Journal of International Agriculture and Extension Education (JIAEE), Journal of Extension (JOE), Journal of Leadership Education (JOLE),* and *North American Colleges and Teachers of Agriculture Journal (NACTA)*. Of the JIAEE (*n* = 9), JOLE (*n* = 4), and NACTA (*n* = 5) manuscripts analyzed where content analysis was the primary research method, the coders' qualifications were not described. In the analysis of manuscripts where content analysis was the primary research method published in JOE, 92% (*n* = 49) of the articles lacked a description of coders' qualifications. Similarly, 80% (*n* = 32) of the articles published in JAC did not describe the coders' qualifications, and 60% (*n* = 9) of the articles published in JAE did not describe the coders' qualifications. In summary, 86% (*n* = 108) of the total number of articles analyzed where content analysis was the primary research method did not include a description of the coders' qualifications (Costello & Rutherford, 2019).

The opposite was true of the articles analyzed that used the Delphi method to collect data. All articles reviewed (*N* = 56) in the six premier journals contained a description of the panelists' qualifications and/or the criteria used to select the people who served on the panel (Costello & Rutherford, 2019). The percentage of articles published in the premier agricultural journals that did not include a description of coders and panelists qualifications is presented in Table 1.

Table 1
Percent of Articles Lacking a Description of Coders'/Panelists' Qualifications by Journal

	JAC		JAE		JIAEE		JOE		JOLE		NACTA		Total	
Method	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Content Analysis	32	80	09	60	09	100	49	92	04	100	05	100	108	86
Delphi	11	0	23	0	11	0	10	0	1	0	7	0	56	0

Note. JAC = *Journal of Applied Communications,* JAE = *Journal of Agricultural Education,* JIAEE = *Journal of International Agriculture and Extension Education,* JOE = *Journal of Extension,* JOLE = *Journal of Leadership Education,* NACTA = *North American Colleges and Teachers of Agriculture Journal*.

Because of the lack of description of the coders' qualifications, it was recommended a thorough description of coders' qualifications be included in peer-reviewed articles published in the premier agricultural journals. A uniform method for describing the qualifications or expertise in agricultural-related applied social science research would make it easier for social scientists in ACEEL disciplines to report expertise consistently and concisely. It would also enhance the consistency, transparency, and replicability of future research (Costello & Rutherford, 2019).

Purpose of the Study

A uniform method for describing the qualifications or expertise of a content analysis coder or Delphi panelist would make it easier for social scientists in ACEEL disciplines to report qualifications or expertise consistently and concisely. It would also enhance replication of the study by other social scientists. Creating a uniform method for describing the qualifications or expertise of a coder or panelist begins with identifying the components needed to measure expertise (Gorsuch, 2015). Factor analytic and psychometric procedures can assist in identifying the appropriate constructs that would guide the development of a uniform method for describing the expertise a content analysis coder or Delphi panelist possesses. Therefore, the purposes of this study were: (1) to create an instrument to measure expertise, (2) to administer the instrument to ACEEL social scientists to collect perceptions and insight regarding the characteristics of an expert, and (3) to introduce potential constructs that could be used by social scientists in ACEEL disciplines to describe the qualifications and expertise coders and panelists may contribute to an analysis of content or a Delphi panel.

Conceptual Framework

Psychometric theory (Nunnally, 1967) and strategies for developing measurement scales (DeVellis, 2012) provided the conceptual framework for this study. Psychometrics is a field of study centered on the theory and technique of psychological measurement. Psychometrics can be used to measure abstract concepts and phenomenon that cannot be directly observed (e.g., knowledge, attitudes, personality characteristics; Nunnally, 1967), which was why using psychometric theory in the creation of an instrument to measure expertise was particularly useful. The definition of measurement in the social sciences has been a topic of interest for many years. Stevens (1946) offered one of the first definitions of scale measurement that many social scientists continue to use today: "measurement, in the broadest sense, is defined as the assignment of numerals to objects or events according to rules" (p. 667). Subsequent definitions have been broadened to include the use of statements to "represent the quantities of attributes" (Rayfield, et al., 2014, p. 40) in attempts to measure specific concepts. Many social scientists in agricultural education have used the tenets of psychometric theory (McKim et al., 2013; McKim & Saucier, 2011; Rayfield et al., 2014) as a primary or secondary study framework to bring procedural and analytical guidance to the analysis.

Method

This study was part of a larger body of work designed to assess expertise as it related to research conducted in agricultural communications, education, extension, and leadership disciplines. The population consisted of 731 social scientists from across the United States who were invited to complete a psychometric instrument. The instrument used in this study was researcher developed. The development of the instrument and data collection methods were guided by DeVellis (2012) and included: (1) defining the phenomenon of interest, (2) generating items, (3) creating the instrument, (4) item pool evaluation, and (5) administering the instrument to a development sample.

Step 1: Defining the Phenomenon of Interest

The first step of scale development is defining the phenomenon of interest. In this study, step 1 was accomplished by conducting a thorough review of the literature and secondary sources to determine how expertise was defined. Merriam-Webster (2017) defined expert as "having, involving, or displaying special skill or knowledge derived from training or experience." Businessdirectory.com (2018) defined expert as a "professional who has acquired knowledge and skills through study and practice over the years, in a particular field or subject, to the extent that his or her opinion may be helpful in fact finding, problem solving, or understanding of a situation." And Oxford Learner's Dictionaries (2019) defined expert as "a person with special knowledge, skill, or training in something."

In reviewing academic publications, expertise was described as both the content-specific knowledge about a certain subject matter, as well as necessary procedural knowledge about certain processes (Chi et al., 1988). According to Ericsson and Smith (1991), "the study of expertise seeks to understand and account for what distinguishes outstanding individuals in a domain from less outstanding individuals, as well as from the population in general," (p. 2). Seminal research in expertise substantiates the categorization of expertise in two ways: epistemic, or knowing *that,* and performative, or knowing *how* (Ryle, 1946). Epistemic expertise is a person's deep understanding of a construct, and performative expertise is the person's ability to perform a task with impeccable skill and accuracy (Weinstein, 1993). Similarly, Chi (2006) proposed two general ways to study the nature of expertise. The first research approach was to study "truly exceptional" people to gain an understanding of how they perform in their "domain of expertise," (p. 21). The second research approach was to study experts in comparison with novices in term of their proficiency level and their ability to achieve the expert status:

> Proficiency level can be grossly assessed by measures such as academic qualifications (such as graduate students vs. undergraduates), seniority or years performing the task, or consensus among peers. It can also be assessed at a more fine-grained level, in terms of domain-specific knowledge or performance tests. (p. 22–23)

It is true expertise is founded in both individuals' knowledge of a subject or issue and in some cases their ability to apply certain skills in a professional or vocational context (Goldman, 2016; Winch, 2010). However, Scardamalia and Bereiter (1991) hypothesized expert knowledge was a product of striving beyond one's comfort zone:

> Experts acquire their vast knowledge resources not by doing what falls comfortably within their competence but by working on real problems that force them to extend their knowledge and competence. That is not only how they become experts, we suggest, but also how they remain experts and avoid falling into ruts worn by repeated execution of familiar routines. (p. 173–174)

Camerer and Johnson (1997) asserted an expert is "a person who is experienced in making predictions in a domain and has some professional or social credentials" (p. 196). To understand expertise in relation to cognitive development, Hoffman (1998) believed it could be understood in terms of the ways in which the expertise was developed, as well as experts' knowledge structures and reasoning processes. Feltovich et al. (2006) posited the accumulation of experience alone was not sufficient for the development of expertise; experts must possess high levels of motivation, credibility, talent, and reflective proficiency. Reflective proficiency is the product of reflecting *in* action and reflecting *on* action (Schön, 1984). Experts reflect in the moments when events are occurring and retrospectively using knowledge and experience gleaned from previous contexts and situations (Schön, 1984; Winch, 2010).

Looking at expertise in a different way, Collins and Evans (2002) proposed expertise existed at three distinct levels: no expertise, interactional expertise, and contributory expertise. Individuals with no expertise lack any knowledge of, or experience with, a construct or practice, and those who have interactional expertise have expert-level knowledge of the construct or practice through linguistic cultural immersion. The third level of expertise is contributory. People with contributory expertise possess the knowledge and skills required to weigh in on the science or scholarship of the construct of interest.

Additionally, theories and models have been presented regarding the role of experience in the development of expertise. Dreyfus (2004) proposed the Adult Skill Acquisition Model—a visual representation of the journey one takes to move from novice to expert. Novice is the first stage in the model. In the Novice stage, beginners lack experience with the situations in which they are expected to execute, so they will purposefully seek out rules to follow or behavior to model. Advanced Beginner is the second stage. The Advanced Beginner stage is achieved when learners have accumulated enough relevant experience that they are able to perceive similarities across situations. In other words, the learner's actions in this stage are based on knowledge gained from *previous* experience applied in a similar *present* context. Competence, the third stage of the Adult Skill Acquisition Model, is characterized by the acquisition of considerable situational experience, giving learners the ability to fully understand and analyze problems and create logical solutions. Learners moving into stage four—Proficiency—rely on their intuition and ability to think analytically when making decisions. In this stage, learners immediately recognize situations as contextually similar or different, resulting in behavior indicative of successful outcomes achieved in the past. Lastly, the fifth stage of the Adult Skill Acquisition Model is Expertise. In this stage, learners no longer look to rules or analytical principals to guide their understanding of the situation to an appropriate action. Because learners now have high amounts of experience and deep levels of understanding, they use their intuition to solve problems and recommend solutions (Dreyfus, 2004).

Likewise, Ericsson and Smith (1991) contended expertise is the result of skills obtained through stages of deliberate practice under the guidance of individuals who are regarded as experts. Deliberate practice involves high levels of effort, intensity, and concentration. Expert status takes a minimum of 10 years to achieve, which is why proponents of the theory recommend deliberate practice begin as early as possible (Ericsson & Smith, 1991). Further, those who acquire expertise require adequate time to complete the four developmental phases of becoming an elite performer. Phase one is a discovery period within a certain domain. The second phase occurs when individuals show talent or promise in that domain. Following the assertion of aptitude, the individual begins participating in structured lessons and minimal amounts of practice until regular practice habits are formed. Throughout the second phase, individuals seek instructors or mentors who can aid in their continued progression and performance improvement. Phase three begins with the individual making a major commitment to reaching the top levels possible in the domain. People seek the best instructors and mentors to ensure their continued performance mastery, and once they achieve mastery, they may continue to the fourth phase. However, not all individuals enter the fourth and final stage of eminent performance. Eminent performance goes beyond the existing knowledge in the domain to making a significant contribution to the existing knowledge. Major innovations required for the fourth phase exceed the skills and knowledge the master instructors and mentors possess and could impart to the learner (Ericsson & Smith, 1991).

Bereiter and Scardamalia (1993) also believed the acquisition of expertise was a process. However, they did not believe expertise was achieved within a set time frame nor period of years. Instead, they believed expertise could be detected based on how individuals approached new problems. Progressive problem solving occurs when individuals attempt to solve increasingly complex problems. Once a simple problem is mastered, more difficult problems are presented and solved. The premise of progressive problem solving is that the level of skill acquisition needed to achieve expertise is not based on time, but on tackling problems that increase expertise rather than reducing problems to previously learned routines (Bereiter & Scardamalia, 1993).

The Generalized Expertise Measure was developed by Germain and Tejeda (2012) to measure expertise in the workplace. The procedures used to develop the scale and the sample used to conduct a preliminary validation of the scale items included employees from a variety of occupations and fields including education, management, and medicine. The results separated expertise characteristics into two categories: subjective and objective (Germain & Tejeda, 2012). Subjective items included being ambitious and driven, having inductive and deductive skills, having self-assurance and the ability to assess the importance of certain situations, and others. Objective items included having specific knowledge, education, qualifications, training, conducting research related to the field of interest, and others (Germain & Tejeda, 2012).

Step 2: Generating the Items

The second step of scale development is generating the items. Robinson (2018) said item generation in scale development "is the foundation of the entire process, so it is vital that it is theoretically driven," (p.742). Social scientists can use several methods to identify item content, including literature reviews, focus groups, and content analysis of data sets and resources (DeVellis, 2012; Hinkin et al., 1997; Robinson, 2018). Statements containing the characteristics of expertise informed by various definitions and descriptions of expertise from the literature were constructed. To ensure proper construction, these guidelines were followed:

- Each item addressed only one construct (DeVellis, 2012; Hinkin et al., 1997; Robinson, 2018).
- Statements were simple and concise, using language that participants could easily understand (DeVellis, 2012; Hinkin et al., 1997; Robinson, 2018).
- Negatively worded and reverse-scored items were not used, as using them within a measure might negatively affect its psychometric properties (DeVellis, 2012).
- Items were purposefully redundant to establish internal consistency reliability (DeVellis, 2012; Germain & Tejeda, 2012; Hinkin et al., 1997).

Step 3: Creating the Instrument

To create the instrument, the items resulting from step 2 were pooled into a pilot questionnaire that consisted of 135 items. The statements used to create the generalized expertise measure (Germain & Tejeda, 2012) were revised for conceptual fit and served as the foundation of items for the instrument. Conceptual fit is the extent to which the scale matches the variable that the social scientist intends to measure (DeVellis, 2012). Because we were interested in social scientists' perception of expertise relating to the selection of experts to serve as a content analysis coder or Delphi panelist, additional items were added using the characteristics of experts gleaned from the literature review.

Step 4: Item Pool Evaluation

A pilot test was used to evaluate the pool of items for face validity, clarity of expression, and understandability to the audience. A pilot questionnaire was electronically delivered to 407 social scientists at a southern land-grant university. The sample of social scientists represented the following departments: agricultural economics; communications; recreational parks and tourism sciences; educational administration and human resource development; educational psychology; health and kinesiology; and teaching, learning, and culture. The departments were chosen because the social scientists within the departments were highly experienced, possed the breadth of knowledge, skills, and abilities needed to assist in the initial development of a psychometric scale to measure expertise and were familiar with the designs and methods used in conducting social science research. Using the randomization feature in Qualtrics® online survey software, each participant was randomly assigned 25 of the original 135 items, as well as detailed instructions and examples to prepare them for completing the questionnaire.

The first step in the pilot study was to capture participants' personal beliefs about a statement related to the characteristics generally attributed to experts. A screenshot of the questionnaire was provided so participants could see what they would see if they completed the study. This was provided to build understanding and ensure participants knew what to expect as they moved through the process. Participants were instructed to read each statement and select the option that best described their personal level of agreement with the statement. A 6-point rating scale was provided with each item. Participants were asked to rate each statement based on their level of agreement with the statement from 1 (Strongly Disagree) to 6 (Strongly Agree). If participants' agreement with the statement was neither very low nor very high, they were instructed to select one of the other four options that best reflected their level of agreement with the statement.

The second step in the pilot study was to give participants an opportunity to determine if the statement was understandable and made sense. After participants determined their level of agreement with the item statements, they were asked the question "Does this statement make sense?" Participants were given the dichotomous choice of "Yes" or "No". And if participants could not determine if the statement made sense, they could select the "Maybe" option. If participants selected "Yes," they progressed to the next statement. If the participants selected "No" or "Maybe," they were provided a subsequent prompt designed to solicit input on ways the expertise questionnaire statements could be rewritten to be clearer, to be more easily understood, or to make more sense. The revised expertise questionnaire items were then sent to a group of agricultural communications, education, extension, and leadership educators at a southern land grant university for pretesting and refinement. After this review, the number of expertise questionnaire items increased from 135 items to 149 items. Although it is not typical to see an increase in the number of items at this stage in the process, the suggestions of the educators invited to assist with this step were accepted, and these statements comprised the resulting psychometric instrument.

Step 5: Administering the Instrument

Social scientists from 25 universities were invited to participate in the study. The 25 universities were selected based on the following criteria: (a) the university offered undergraduate and graduate degree programs or areas of emphasis in one or more of the following agricultural disciplines: communications, education, extension, and/or leadership, (b) the social scientists engaged in research in communications, education, extension, and/or leadership, (c) the social scientists' scholarship had been published or had the potential to be published in the premier agricultural education journals (Edgar & Rutherford, 2011): *JAC, JAE, JIAEE, JOE, JOLE,* and *NACTA*, and (d) the social scientists were highly experienced and possessed the breadth of knowledge, skills, and abilities needed to assist in the development of a psychometric scale to measure expertise.

Participants were invited to participate in the study using a modified version of Dillman et al.'s (2014) five compatible contacts system. Dillman et al. (2014) recommend a pre-notification announcement to potential participants as the first point of contact. In lieu of a pre-notification announcement to potential participants, a letter was sent to the respective department head of each of the 25 universities identified asking them to use their social influence (Kelman, 1958) to endorse our study to their faculty and graduate students as an effort to increase potential participation. Being cognizant of the department heads' time, a template for the endorsement was provided to help alleviate their time commitment.

The second point of contact was an electronically mailed invitation to the social scientists at the 25 universities identified to participate in the study. The invitation included a personalized link to the electronic questionnaire, a link to a document containing a formal description of the study, and a link to a document containing a summary of the study for those individuals who required less detailed information. Because the protocol for scale development could have been unfamiliar to some social scientists, the invitation included a link to a short video describing scale development procedures. The authors of the articles content analyzed by Costello and Rutherford (2019) were also included in the study. Any duplications—individuals who were both social scientists at the 25 selected universities and authors of studies from the content analysis—were removed.

The questionnaire invitation was sent to 731 unique potential participants at the 25 selected universities. Email addresses were obtained from the departmental websites of the 25 selected universities and from the biographical information included in the published studies content analyzed by Costello and Rutherford (2019).

The third and fourth points of contact included reminders sent to the participants on the third and sixth days after the initial email invitation was sent. To increase the response rate, an additional reminder was sent to participants who had partially completed the questionnaire. Of the 731 invitations, 180 responses were received (n=180), yielding a 24.6% response rate. Of the 180 responses, 69 questionnaires were filled out completely, yielding a 9.4% response rate of usable questionnaires for factorial analysis. The fifth point of contact was a follow-up thank you to individuals who completed the questionnaire.

Instrumentation

The primary goal of the instrument was to capture participants' agreement about what factors constitute expertise. Like the pilot study, an example that depicted what the participant would see as they progressed through the questionnaire was provided to build understanding and to ensure participants knew what to expect as they moved through the process. Participants were instructed to read each statement and select the option that best described their personal level of agreement with the statement. A 6-point rating scale was provided with each item. Participants were asked to rate each statement based on their level of agreement with the statement from 1 (Strongly Disagree) to 6 (Strongly Agree). If participants' agreement with the statement was neither very low nor very high, they were instructed to select one of the other four options that best reflected their level of agreement with the statement.

The second step in administering the questionnaire was to give participants an opportunity to provide additional feedback. After participants determined their level of agreement with the item statements, they were posed the question "Additional feedback?" If participants selected "Yes", the statement was presented again, and a text box was provided so that the participant could provide additional input. If participants selected "No" or did not answer the question, they moved on to the next statement. This process continued until the participant finished the questionnaire.

Results

Responses to the expertise questionnaire items were analyzed using the Principal Component Analysis (PCA) function in IBM® SPSS® statistical software. PCA is a dimension-reduction tool that can be used to reduce a large set of variables into a smaller set of variables that still contains most of the information from the larger set. Unlike common factor analysis, which explores the underlying latent structure of data and assumes variability can be partitioned into common and unique components, PCA makes no assumptions about unique or error variance in the data (Raven, 1994). Therefore, the first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible (Samuels, 2016). The principal components are linear combinations of the original variables weighted by their contribution to explaining the variance in particular orthogonal dimension to determine how the variables may relate to each component (Field, 2009; Rayfield et al., 2014).

To maximize high correlations between factors while reducing low correlations between factors, the 149 original scale items from the questionnaire were included in the PCA with varimax rotation (as described by Rayfield et al., 2014). SPSS® offers three methods of orthogonal rotation to maximize variance. Varimax was chosen for this study because of the way it disperses loadings among factors, resulting in more interpretable clusters of factors (Field, 2009). Factors with a minimum of three loadings greater than .40, and not cross loaded with any other factors, were retained (Field, 2009; Raven, 1994; Stevens, 2012). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .538; .5 is the acceptable minimum KMO score for factor analytic procedures (Field, 2009; Kaiser, 1974; Rayfield et al., 2014; Samuels, 2016).

A list of the PCA results (e.g., scale items listed by factor loading) was presented to social scientists with experience in the fields of agricultural communications, education, extension, and leadership at a southern land-grant university. The social scientists were asked to review the proposed items in each construct and identify what the items collectively measured, which yielded the label for each construct. The labeled constructs and the construct loadings from the PCA are presented in Table 2.

Table 2
Construct Loadings from Principal Component Analysis with Varimax Rotation

Item	Loading
Construct 1: Academic/Professional Credentials	
An expert has academic degrees.	.857
An expert has an academic degree.	.837
An expert has a professional degree.	.810
An expert has both experience and an academic degree.	.799
An expert has a doctoral degree.	.796
An expert has experience, knowledge, and an academic degree.	.791
An expert must have at least a master’s degree.	.789
An expert must have a terminal degree.	.787
An expert has at least a master’s degree level of education.	.764
An expert has completed education beyond high school.	.749
An expert has written articles or books in their field of expertise.	.633
An expert shows others that they have the formal education necessary to be an expert in their field.	.615
An expert has professional credentials.	.542
An expert has more professional credentials than the average person.	.526
Construct 2: Cognitive Abilities	
An expert is a problem-solver.	.732
An expert is good at asking the right questions to find solutions to problems in their field of expertise.	.727
An expert is able to reflect on action.	.720
An expert is able to solve problems.	.675
An expert can reflect after the fact.	.672
An expert is a skilled practitioner.	.648
An expert is able to reflect in action.	.614
An expert has well developed reasoning processes.	.614
An expert is able to reason.	.567
An expert possesses practical knowledge.	.552
An expert thinks logically about things related to their field of expertise.	.542
An expert is able to apply knowledge.	.532
An expert can identify solutions to problems in their field of expertise.	.508
An expert is results-driven.	.491

An expert has reflexive proficiency.	.451
Construct 3: Depth of Specialized Knowledge	
An expert has a substantial depth of knowledge about a specific subject.	.748
An expert has knowledge that is specific to a chosen field.	.745
An expert has a high level of knowledge in their field of expertise.	.704
An expert is able to judge what is not important when it comes to their area of expertise.	.679
An expert can assess whether something is important related to their field of expertise.	.659
An expert is good at assessing problems related to their field of expertise.	.651
An expert can identify problems in their field of expertise.	.645
An expert can assess whether something is not important related to their field of expertise.	.644
An expert is knowledgeable in their field of expertise.	.644
An expert is able to judge what is important when it comes to their area of expertise.	.602
An expert possesses subject matter knowledge.	.559
An expert has knowledge that is specific to a construct of interest.	.550
An expert is credible.	.526
An expert is competent in their field of expertise.	.523
An expert sees patterns in situations found in their area of expertise.	.511
An expert has both knowledge and experience.	.472
Construct 4: Perceptions and Attitudes About Experts	
People believe an expert is more motivated than others.	.748
People believe an expert is more goal-oriented than others.	.696
People believe an expert is more decisive than others.	.689
People believe an expert is more self-assured than others.	.671
People believe an expert is more results-driven than others.	.622
People believe an expert is more self-confident than others.	.617
People believe an expert is more educated than others.	.567
People believe an expert is more respected than others.	.566
People believe an expert is more disciplined than others.	.533
People believe an expert is more intelligent than others.	.519
People believe an expert is more charismatic than others.	.503
People believe an expert is more capable than others.	.503
People believe an expert is more talented than others.	.473
Construct 5: Professional Recognition	
An expert is recognized by colleagues as being an expert in their field.	.806
An expert is recognized by peers as being an expert in their field.	.774
An expert is recognized by others as being an expert in their field.	.705
An expert is respected.	.615
An expert is recognized by superiors as being an expert in their field.	.615
An expert has a good professional reputation among their colleagues.	.549
An expert is recognized by subordinates as being an expert in their field.	.544
An expert has a good professional reputation in their field.	.528
Construct 6: Self-Efficacy	
An expert is self-assured.	.798
An expert is self-confident.	.686
An expert has self-confidence because they are an expert in their field.	.686
An expert is self-confident in their field of expertise.	.602
Construct 7: Training and Development of Others	
An expert can train others in their area of expertise.	.790
An expert can educate others in their field of expertise.	.754
An expert can formally or informally train others to be experts in their field of expertise.	.700
Construct 8: Self-Promotion	
An expert says good things about their achievements.	.722
An expert says good things about themselves.	.667
An expert does things so that the attention of others is drawn to their high level of expertise.	.555
An expert lets others know why they are an expert.	.551
Construct 9: Conceptions of Experts	
People believe an expert is more qualified than others.	.722
People believe an expert is more reputable than others.	.613
People believe an expert is more credible than others.	.610
People believe what an expert has to say.	.501
Construct 10: Reasoning Skills	
An expert uses deductive reasoning.	.724

An expert uses inductive reasoning.	.567
An expert has strong reasoning skills.	.460

The descriptive statistics, ordered by number, for the 10 constructs that emerged from the PCA are presented in Table 3.

Table 3
Construct Descriptive Statistics

Construct	*n*	Min.	Max.	*M*	*SD*
01	69	1.00	5.36	2.44	1.10
02	69	2.53	6.00	4.84	0.78
03	69	4.13	6.00	5.36	0.46
04	69	2.75	6.00	4.31	0.82
05	69	1.38	6.00	4.75	0.86
06	69	1.25	6.00	4.15	1.06
07	69	1.00	6.00	4.15	1.30
08	69	1.25	5.25	3.27	0.88
09	69	2.33	6.00	4.92	0.87
10	69	2.00	6.00	4.64	0.99

Note. 1 = Strongly Disagree, 6 = Strongly Agree

The three constructs with the highest mean scores were Depth of Specialized Knowledge, construct 3, (*M* = 5.36; *SD* = 0.46); Conceptions of Experts, construct 9, (*M* = 4.92; *SD* = 0.87); and Cognitive Abilities, construct 2, (*M* = 4.84; *SD* = 0.78). High mean scores on these constructs indicated participants agreed or strongly agreed that the constructs were, indeed, indicative of expertise; the constructs were comprised of items related to experts' depth of knowledge in a specialized field or area, how people perceive experts as credible, qualified sources, and items relating to experts' assessment and judgement abilities. Two other constructs had means of 4.75 (Professional Recognition, construct 5) and 4.64 (Reasoning Skills, construct 10), both of which were indicative of agreement as indicators of expertise. A middle group of three constructs yielded means between 4.31 (Perceptions and Attitudes about Experts, construct 4) and 4.15 (Self-Efficacy, construct 6, and Training and Development of Others, construct 7), indicative of slight or moderate agreement. The two constructs with lowest mean scores were Academic/Professional Credentials, construct 1, (*M* = 2.44; *SD* = 1.10) and Self-Promotion, construct 8, (*M* = 3.27; *SD* = 0.88). Low mean scores on these constructs indicated participants did not have overall positive scores for items related to evidence of higher education as indicative of expertise nor one's personal communication to others about of their professional achievements or expertise.

Recommendations and Discussion

The purpose of this study was to create a uniform method for describing the level of expertise an individual may contribute to a study. We developed a preliminary psychometric scale to measure expertise, which resulted in the development of 10 constructs, informed by social scientists in ACEEL disciplines, to describe expertise. Using constructs with $M>4.0$, we developed a rubric to aid social scientists in describing the qualifications of the coders/panelists selected for a study. The proposed rubric displayed in Table 4 enables researchers to determine the depth to which each construct is needed for the specific study and provides a framework that could be used to describe the coders and panelists qualifications in a manuscript, thereby ensuring transparency, consistency, and ease of replication while also being concise enough for the space allotted in many of the premier ACEEL journals.

Table 4
Proposed Expertise Rubric

Constructs	**Critical; meets all criteria; necessary to recruit**	**Valuable; meets most criteria; should recruit**	**Convenient; recruit if expertise not essential**
Depth of Specialized Knowledge	Substantial depth of knowledge of and experience with the construct of interest High levels of professional competency in their profession or area of experience Can judge what is or is not important when it comes to the construct of interest	Has knowledge specific to the construct of interest Is competent in their profession or area of experience Can judge what is or is not important when it comes to the construct of interest	May not have knowledge specific to construct, but is able to learn Has the ability to be professionally competent
Conceptions of Experts	Qualified – highly educated, certified, trained and/or experienced in the industry, field, or subject Credible – professionally believable; bases decisions on facts and evidence Trustworthy – reliable; demonstrates personal honesty and integrity	Qualified – has education, certification, training and/or experience in the industry, field, or subject Credible – professionally believable; bases decisions on facts and evidence Trustworthy – reliable; demonstrates personal honesty and integrity	Credible – will base decisions on the facts and evidence presented Trustworthy – reliable
Cognitive Abilities	Always thinks logically and applies knowledge effectively Skilled at analysis; will use high-level reasoning to solve problems Refined perception and reflection abilities	Will think logically and apply knowledge Knows how to analyze; will use reasoning to solve problems Possesses perception and reflection abilities	Able to think logically and apply knowledge Learning/practicing reasoning to solve problems Learning/practicing perception and reflection abilities
Professional Recognition	Recognized by most as being an expert in their field	Recognized by some as being an expert in their field	Reputable – has a positive professional reputation
Reasoning Skills	Excellent inductive and deductive reasoning skills	Good inductive and deductive reasoning skills	Able to reason inductively and deductively
Self-Efficacy; Perceptions & Attitudes of Experts	Highly motivated, goal-oriented, results-driven, decisive, and self-confident	Motivated, goal-oriented, results-driven, and decisive	Motivated and goal-oriented
Training & Development of Others	Extensive ability to formally or informally educate/train others to be experts in their field	Ability to educate/train others in their area of expertise	Ability to be educated/trained in an area of expertise

Academic and Professional Credentials

Although study participants did not believe one's academic or professional credentials were a strong indicator of expertise—Academic/Professional Credentials was $M = 2.44$; $SD = 1.10$—social scientists in ACEEL disciplines have historically used only the academic/professional credentials of their coders as the primary descriptor (e.g., an associate professor and a graduate student studying agricultural education, a Ph.D. candidate in agricultural communications, etc.) in the premier journals (Costello & Rutherford, 2019). One potential reason for this practice could be that the process for earning an advanced degree includes significant personal development. This development includes, but is not limited to, accumulating knowledge (Goldman, 2016; Winch, 2010), gaining technical skills (Chi, 2006), establishing professional connections (Cramer & Johnson, 1991), and gaining relevant experience to enable contribution (Collins & Evans, 2002); each of which could be aligned with various aspects of expertise. While it is possible the focus on coders'/panelists' academic credentials as the primary descriptor of expertise ensures transparency and future replication, it could also be indicative of convenience selection.

Because education occurs in both formal and informal settings, the operational definition of qualifications in the Conceptions of Experts construct should extend beyond the historical use of academic/professional credentials to a more holistic description of qualifications. To reflect this more nuanced and comprehensive approach to operationalizing expertise, we recommend social scientists describe qualifications or expertise holistically, using academic credentials in combination with other relevant descriptors. To do so has the potential to increase the rigor of studies using content analysis or Delphi methodology.

Benefits

Social scientists can realize several benefits from using the proposed rubric. First, the proposed rubric can aid in identifying individuals with the best skills and experience to participate in studies requiring expertise or a high level of specialized knowledge. When having high levels of experience or specialized knowledge is not required, the proposed rubric can be used as a guide to for holistically describing the coders' and panelists' qualifications, characteristics, skills, level of education, and other factors identified as relevant to ensure consistency, transparency, and future replication. The following examples demonstrate how the proposed rubric can be used to describe the coders' qualifications:

Example 1: The coders in this study are highly credible in the field of agricultural education and were chosen based on their knowledge specific to program evaluation and their problem-solving capabilities.

Example 2: The ability to think critically and logically were key to this study of content, and the coders were chosen because of their science communication competency and ability to judge what is important.

Example 3: In addition to being widely recognized as experts in the food safety industry, the coders selected to analyze the content were motivated, results-driven, and possessed excellent deductive reasoning skills.

Example 4: Two motivated and goal-oriented graduate students, one with experience working at an advertising agency specializing in digital communication for agricultural clients and the other an agribusiness doctoral candidate, were selected to code the data.

Limitations, Conclusions, and Future Research

The constructs that emerged from this study may provide social scientists in ACEEL disciplines with the foundation for describing the level of expertise experts and non-experts taking part in social science research may contribute to a study. While this study has meaningful implications, it is limited by several factors. First, we did not collect demographic information about the questionnaire respondents. While the aim of the study was identifying agreement among ACEEL social scientists' as to what characteristics constitute expertise, it is possible bias was introduced by proceeding with the lower number of respondents.

Further, there are two sampling issues associated with psychometric scale development that limit this study. The first issue is related to the sampling of content and the other issue is related to the sampling of people (Nunnally, 1967). The sampling of content is concerned with the generalization of findings to populations of test items and the sampling of people is related to the generalization of findings to populations of individuals. Due to the exploratory nature of this study, the primary focus was given to the development of the psychological measures' internal validity and not to the ability to infer results outside of the confines of this study. Future research could address both sampling issues such that findings could be generalized.

Similarly, data must be collected from an adequate sample size to appropriately conduct any type of factorial analysis (DeVellis, 2012; Hinkin et al., 1997). The expertise questionnaire was distributed to 731 faculty member and graduate students across the country. However, 180 completed questionnaires were received, with 69 questionnaires providing sufficient factorial loadings. Although the minimum Kaiser-Meyer-Olkin measure of sampling adequacy was .538, which is an acceptable minimum score for factor analytic procedures (Field, 2009; Kaiser, 1974; Rayfield et al., 2014; Samuels, 2016), a higher KMO score is the common preference. Therefore, proceeding with the minimum KMO score also limits the generalizability of the study.

Going forward, researchers should continue to refine the scale reported in this study, with particular attention to refining the dimensions of the constructs and development of baseline metrics. For example, three items were included in Construct 10: Reasoning Skills. Although the metric meets the minimum requirements of metric development (e.g., a KMO score greater than .5 and the number of items), each construct should be explored individually. Focus groups or in-depth interviews with the intent to understand expert reasoning could help refine the dimensions and baseline of this construct. Future studies could examine the ongoing use of the proposed rubric to determine whether the rubric meets researchers' needs. Personal interviews with or a survey of those using the rubric would be beneficial to ensure the rubric's ongoing usefulness.

Based on the findings of this study, we encourage ACEEL researchers to use the proposed rubric in their efforts to thoroughly describe the qualifications of their content analysis coders, Delphi panelists, and any people retained for social science studies in agriculture-related disciplines. Journal editors and peer reviewers are also encouraged to give the explanation of qualifications/expertise higher priority as a condition of publication, as a more thoughtful and thorough description of qualifications/expertise, in some cases, may be just as important to future study replication as the description of methodology, instrumentation, and interrater reliability.

Using the rubric is a simple, yet systematic, way to make the description of expertise possible, and doing so demonstrates a commitment to maintaining the quality, integrity, and rigor of social science research in agriculture-related studies. It would also improve the overall consistency in how qualifications/expertise is reported in all the published work in the premier agricultural journals, other journals relevant to a social scientists' area of study, and other types of academic publications. Upholding a systematic approach for reporting qualifications/expertise eases the burden of social scientists who are tasked with succinctly describing the qualifications/expertise of coders and panelists given space limitations in some journals.

References

Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves: An inquiry into the nature and implications of expertise.* Open Court Publishing Company.

Bryman, A. (2012). *Social research methods.* Oxford University Press.

Camerer, C. F., & Johnson, E. J. (1991). The process-performance paradox in expert judgment: How can experts know so much and predict so badly? *Toward a general theory of expertise: Prospects and limits.* Cambridge University Press. 195–217.

Chi, M. T. (2006). Two approaches to the study of experts' characteristics. *The Cambridge handbook of expertise and expert performance*. Cambridge University Press, 21–30.

Chi, M. T., Glaser, R., & Farr, M. J. (1988). *The nature of expertise*. Lawrence Erlbaum Associates.

Collins, H. (2004). Interactional expertise as a third kind of knowledge. *Phenomenology and the Cognitive Sciences*, *3*(2), 125–143.

Collins, H. M., & Evans, R. (2002). The third wave of science studies: Studies of expertise and experience. *Social Studies of Science, 32*(2), 235–296.

Costello, L., and Rutherford, T. (2019). "Expert? What does that mean? Describing the term "expert" in agricultural communications, education, extension, and leadership research," *Journal of Applied Communications*, (*103)*1, 1–14. https://doi.org/10.4148/1051-0834.2211

Dalkey, N. C. (1969). *The Delphi method: An experimental study of group opinion* (No. RM 5888-PR). Rand Corporation

DeVellis, R. F. (2012). *Scale development: Theory and applications*. Sage Publications, Inc.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, mail, and mixed-mode surveys: The tailored design method* (4th ed.). John Wiley & Sons, Inc.

Dreyfus, S. E. (2004). The five-stage model of adult skill acquisition. *Bulletin of Science, Technology & Society*, *24*(3), 177–181.

Edgar, L., & Rutherford, T. (2011). Citation structure: An analysis of the literature cited in the Journal of Applied Communications from 1997 to 2006. *Journal of Applied Communications, 95*(2), 34–47. https://doi.org/10.4148/1051-0834.1176

Ericsson, K. A., & Smith, J. (Eds.). (1991). *Toward a general theory of expertise: Prospects and limits*. Cambridge University Press.

Expert. 2018. In BusinessDirectory.com. Retrieved from http://www.businessdictionary.com/definition/expert.html

Expert. 2017. In Merriam-Webster.com. Retrieved from https://www.merriam.webster.com/dictionary/expert

Expert. 2019. In Oxfordlearnersdictionaries.com. Retrieved from https://www.oxfordlearnersdictionaries.com/us/definition/english/expert_1?q=expert

Feltovich, P. J., Prietula, M. J., & Ericsson, K. A. (2006). Studies of expertise from psychological perspectives. *The Cambridge handbook of expertise and expert performance*. Cambridge University Press, 4–67.

Field, A. (2009). Discovering statistics using SPSS: And sex and drugs and rock 'n' roll (3rd ed.). Sage Publications, Inc.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education.* McGraw-Hill.

Germain, M. L., & Tejeda, M. J. (2012). A preliminary exploration on the measurement of expertise: An initial development of a psychometric scale. *Human Resource Development Quarterly, 23*(2), 203–232.

Goldman, A. I. (2015). Expertise. *Topoi*, *37*(3). https://doi.org/10.1007/s11245-016-9410-3

Gorsuch, R. L. (2015). *Factor analysis: Classic edition.* Routledge.

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, *32*(4), 1008–1015.

Hinkin, T. R., Tracey, J. B., & Enz, C. A. (1997). Scale construction: Developing reliable and valid measurement instruments [Electronic version]. Retrieved from Cornell University, School of Hotel Administration site: http://scholarship.sha.cornell.edu/ articles/613

Hoffman, R. R. (1998). How can expertise be defined? Implications of research from cognitive psychology. *Exploring expertise*. Macmillan.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31–36.

Kelman, H. C. (1958). Compliance, identification, and internalization three processes of attitude change. *Journal of Conflict Resolution*, *2*(1), 51–60.

Krippendorff, K. (2013). *Content analysis: An introduction to its methodology*. Sage Publications, Inc.

Linstone, H. A., & Turoff, M. (Eds.). (1975). *The Delphi method. Techniques and applications.* Addison-Wesley.

McKim, B. R., Lawver, R. G., Enns, K., Smith, A. R., & Aschenbrener, M. S. (2013). Developing metrics for effective teaching in extension education: A multi-state factor-analytic and psychometric analysis of effective teaching. *Journal of Agricultural Education*, *54*(2), 143–158.

McKim, B. R., & Saucier, P. R. (2011). Agricultural mechanics laboratory management professional development needs of Wyoming secondary agriculture teachers. *Journal of Agricultural Education, 52*(3), 75–86.

Neuendorf, K. A. (2002). *The content analysis guidebook*. Sage Publications, Inc.

Nunnally, J. C. (1967). *Psychometric theory.* McGraw-Hill.

Raven, M. R. (1994). The application of exploratory factor analysis in agricultural education research. *Journal of Agricultural Education. 35*(4), 9–14. https://www.researchgate.net/publication/253551647_The_Application_Of_Exploratory_Factor_Analysis_In_Agricultural_Education_Research#fullTextFileContent

Rayfield, J., McKim, B. R., Lawrence, S., & Stair, K. (2014). Developing attitudinal metrics for induction-year agricultural education teachers. *Journal of Agricultural Education*, *55*(1), 38–50.

Roberts, T. G., Harder, A., & Brashears, M. T. (Eds). (2016). *American Association for Agricultural Education national research agenda: 2016–2020.* Department of Agricultural Education and Communication, University of Florida.

Robinson, M. A. (2018). Using multi-item psychometric scales for research and practice in human resource management. *Human Resource Management*, *57*(3), 739–750.

Ryle, G. (1945, January). Knowing how and knowing that: The presidential address. In *Proceedings of the Aristotelian Society*, *46*(1), 1–16. Wiley.

Samuels, P. (2016). Advice on exploratory factor analysis. https://www.researchgate.net/publication/304490328_Advice_on_Exploratory_Factor_Analysis#fullTextFileContent

Saucier, P. R., McKim, B. R., & Tummons, J. D. (2012). A Delphi approach to the preparation of early-career agricultural educators in the curriculum area of agricultural mechanics: Fully qualified and highly motivated or status quo? *Journal of Agricultural Education*, *53*(1), 136–149.

Schön, D. A. (1984). *The reflective practitioner: How professionals think in action*. Basic Books.

Stevens, S. S. (1946). On the theory of measurement. *Science*, *103*(2684), 677–680.

Stevens, J. P. (2012). *Applied multivariate statistics for the social sciences* (5th ed.). Erlbaum.

Weinstein, B. D. (1993). What is an expert? *Theoretical Medicine and Bioethics*, *14*(1), 57–73.

Winch, C. (2010). Dimensions of expertise: A conceptual exploration of vocational knowledge. Continuum International Publishing Group.

Winzenried, A. (1997). *Delphi studies: The value of expert opinion bridging the gap—Data to knowledge*. Paper presented at the annual conference of the International Association of School Librarianship, Vancouver, BC, Canada.

Yang, Y. N. (2003). *Testing the stability of experts' opinions between successive rounds of Delphi studies.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.