HHS Public Access

Author manuscript

*Agric Human Values*. Author manuscript; available in PMC 2018 April 09.

Published in final edited form as:

*Agric Human Values*. 2018 January ; 35(1): 131–147. doi:10.1007/s10460-017-9810-z.

# Beyond polarization: using Q methodology to explore stakeholders' views on pesticide use, and related risks for agricultural workers, in Washington State's tree fruit industry

**Nadine Lehrer**[1] and **Gretchen Sneegas**[2]

[1]Food Studies, Falk School of Sustainability and the Environment, Chatham University, Eden Hall Campus, 6035 Ridge Rd., Gibsonia, PA 15044, USA

[2]Department of Geography, University of Georgia, 210 Field Street, Room 204, Athens, GA 30602, USA

## Abstract

Controversies in food and agriculture abound, with many portrayed as conflicts between polarized viewpoints. Framing such controversies as dichotomies, however, can at times obscure what might be a plurality of views and potential common ground on the subject. We used Q methodology to explore stakeholders' views about pesticide safety, agricultural worker exposure, and human health concerns in the tree fruit industry of central Washington State. Using a purposive sample of English and Spanish-speaking agricultural workers, industry representatives, state agencies, educators, and advocates (n = 41), participants sorted 45 statements on pesticide use and perceived human safety risks in the tree fruit industry in 2011. We used PQMethod 2.33 statistical software program to identify viewpoints, based on differences between how participants sorted the statements. The results revealed three distinct viewpoints among 38 sorters that explained 52 percent of the variance. The viewpoints included the: (1) skeptics (n = 22) who expressed concern over the environmental and human health impacts of pesticide use; (2) acceptors (n = 10) who acknowledged inherent risks for using pesticides but saw the risks as known, small and manageable; and (3) incrementalists (n = 6) who prioritized opportunities to introduce human capital and technological improvements to increase agricultural worker safety. We then brought representatives with these different viewpoints together to analyze the results of the Q study, and to brainstorm mutually acceptable improvements to health and safety in tree fruit orchards. In describing and analyzing this case study, we argue that Q methodology can serve as one potentially effective tool for collaborative work, in this case facilitating a process of orchard safety improvements despite perceived stakeholder polarization.

### Keywords

Q methodology; Pesticide safety; Polarization; Stakeholders

---

Correspondence to: Nadine Lehrer.

Nadine Lehrer http://orcid.org/0000-0001-6201-6487

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

## Introduction

Controversies abound within the study of food and agriculture, from the legality of raw milk to the safety of genetically modified crops (Ashley et al. 2004). Many of these issues play into questions of risk and health, and tend to become highly polarized as binary viewpoints develop around them. With both sides supported by “experts,” controversy develops where there appear to be no potential solutions or compromises (Karcher et al. 1981, p. 95; Martin and Richards 1995; Aerni 2005; Aerni and Bernauer 2006; Best 2012). Such opposing and polar viewpoints on controversial subjects are often portrayed and (re)produced in venues ranging from mass media to politics to private conversation, and, accompanied by minimal interaction between opposing groups, tend to prevent collaboration or even identification of commonalities (Tesser and Conlee 1975; Evans and Need 2002; Evans 2003; Nisbet 2005; Nisbet and Goidel 2007; Fiorina 2010; Stroud 2010; Kaltenthaler and Miller 2012).

However, social constructionist perspectives posit that such controversies are embedded within social and power relations, and are not necessarily evidence of intrinsic difference. While there are many reasons that debates can become polarized, and many cases in which conflict among opposing views can be a necessary force for change, there are also times when the extreme visibility of the far ends of a debate’s spectrum can obscure a multiplicity of other views. This in turn can conceal possibilities for productive compromise. A common approach within the social sciences for analyzing polarized or controversial issues is to critically engage with such subjects as socially constructed phenomena, unpacking roots of knowledge and layers of assumptions (e.g. Berger and Luckmann 1966; Said 1978; Julier 2008; Guthman 2011; Biltekoff 2013).

This study focuses on one such controversial topic—the use of pesticides in agriculture—as it plays out in Washington State’s tree fruit industry. The Washington State tree fruit industry generates well over $7.5 billion annually from almost 243,000 acres of apples, cherries, pears, and stone fruit, and employs about 187,000 permanent and seasonal workers (Washington 2008; NASS 2012; Globalwise and Belrose Inc. 2014). Tree fruit crops are typically subject to greater pesticide use per unit area than most other crops because, as high value export crops, their markets tolerate little in terms of blemish or pest problems. While the use of more toxic organophosphate pesticides has dropped by 59% over a decade (NASS 1998, 2008) due to regulatory action and grower adoption of alternative pest control methods, pesticide use in general continues to pose a concern for farmworkers, pesticide handlers, and environmental groups.

## Pesticides and polarization

In the public sphere, consumer and media concern about pesticides often revolves around the contested health benefits of consuming of organic produce grown without synthetic chemicals (EWG 2015). But in agricultural circles, controversy around pesticide use focuses more on the impacts of pesticide use on farmer and farm worker health and safety—in other words, whether or not pesticide use is an occupational hazard. In particular, there are concerns over the deleterious neurological, oncological, and developmental effects of pesticide exposure in workers (Arcury et al. 2002; Alavanja et al. 2004; Hofmann et al.

2009; Rohlman 2010). This is especially concerning as regards migrant workers who face cultural and linguistic barriers to understanding U.S. safety regulations, work seasonally, are financially vulnerable, and in many cases do not have legal status to work in the U.S. All this can make workers hesitant to complain to or question employers, or even to seek treatment for health concerns, for fear of work termination or deportation (Arcury et al. 2002; Halfacre-Hitchcock et al. 2006; Kandel and Donato 2009; Keifer et al. 2009; Hohn 2010; Liebman and Augustave 2010; Mayer et al. 2010).

But while some see pesticide use as posing excessive hazards, especially to vulnerable populations, others see it as a tool, managed responsibly, for growing food and fiber (Washington Friends of Farms and Forests 2013; Hansen 2014; Marquez and Schafer 2016). Many farmers argue that if modern pesticides are used appropriately, they are much safer than those used in the past. Others contend that while they provide pesticide safety training to workers to mitigate any risks, more extensive training could cause misplaced concern among farmworkers. Thus, while many workers feel vulnerable to pesticide exposure, many farmers feel that any problems are a result of a few poorly run operations rather than a symptom of a broader issue (Quandt et al. 1998; Thompson et al. 2001; Kandel and Donato 2009).

There are also differences between farmers, farm workers, and support personnel in assessing the particular contours of risk. In studies conducted by University of Washington in 2010, pesticide handlers in tree fruit orchards noted that sometimes pesticide applicator suits were not adequately decontaminated due to lack of time. Hispanic male pesticide handlers further reported a cultural preference for women to wash clothes, leaving them feeling unequipped to clean their protective suits. Educators, on the other hand, attributed the same problem to lack of knowledge about the importance of decontamination. In a similar scenario, handlers described not washing their hands as a way to prevent pesticide contamination because supplies were missing. In contrast, some managers said handlers were simply ignoring regulations, and that they did not follow rules or training guidelines unless continually reminded and monitored. Both of these views contrasted with health and safety professionals' view that a lack of hand washing was about a lack of knowledge, and that education and training were the best ways to increase awareness of pesticide safety (UW 2010). At the same time, research from Washington State University found that handlers felt that they already knew how to protect themselves from the pesticides they were using, and therefore did not need more training (WSU 2010). Thus, interpretations of even relatively small problems in pesticide safety can vary widely by stakeholder.

These kinds of differences in viewpoint, however, present challenges to reducing the number of occupational injuries experienced in agriculture, as the people most able to improve health and safety do not agree on the nature of the problem, and in some cases, that a problem even exists. This means that improvements are unevenly distributed, dependent on how individual farms institutionalize safety measures, how individual workers use them, and how regulators enforce them (EPA n.d.; CDC 1999; Murphy-Greene and Leip 2006; Liebman et al. 2007). As such, the task of minimizing health and safety risks in tree fruit orchards requires a broader examination of risk perception and the nature of risk itself. In this paper, we evaluate how different members of the tree fruit community perceive health and safety risks from pesticides, and extend our findings to identify mutually acceptable risk reduction strategies that could improve health and safety in orchards. In doing so, we are attempting to overcome roadblocks to creating shared understandings of and solutions to occupational or environmental health risks that may come from seeing only extreme viewpoints.

Our study goals were (1) to systematically identify the diverse views of pesticide safety held by tree fruit industry stakeholders through a Q study, and (2) to work through these results in a stakeholder process targeted to identify common solutions. We used Q methodology to highlight perspectives on food and agriculture that can be difficult to access within seemingly polarized debates, then applied these results to inform a collaborative process that might help sidestep ideological gridlock. Essentially, we asked if highlighting alternate views of orchard pesticide safety and bringing them into a structured participatory process could be used to improve health and safety protections in tree fruit orchards. While the use of Q methodology for describing different stakeholder views and identifying areas of agreement is well-established, it has not been much employed in the field of farmworker health and safety.

## Methods

We used Q methodology in this study to systematically identify stakeholder perspectives in a way that was transparent to study participants, and that could be applied by a multi-stakeholder working group to negotiate areas of agreement in a field that is often hotly contested. In a group made up of participants with each of the views identified, we examined the results of the Q study. We sought to understand the different perspectives and use them to brainstorm, research and implement mutually acceptable improvements to pesticide safety concerns.

### Q methodology

Q methodology, first developed by British psychologist and physicist William Stephenson in the 1930s, is a research technique designed to analyze first-person perspectives about a given subject (Stephenson 1953). Q methodology uses a fairly small number of study participants to identify multiple ways of viewing a particular subject, and the ways in which those perspectives diverge from one another or cluster together. In a Q study, each factor represents a major viewpoint that exists within the group of study participants. Q methodology allows these perspectives to be analyzed holistically, with a high level of both quantitative and qualitative depth (Brown 1980; Watts and Stenner 2012). Employing Q methodology to examine highly polarized topics can provide a systematic and comprehensive view of these perspectives, and identify, in particular, additional viewpoints outside of dominant binaries.

In a sense, Q methodology represents a merging of quantitative and qualitative techniques, taking “subjective” viewpoints or opinions and examining them with the statistical lens of factor analysis (Eden et al. 2005). This is accomplished through a tool called the Q sort. In a Q sort, a list of subjective statements called the Q set, previously sampled by the researcher from all of the available opinions about the topic of study, is sorted by participants on a forced-choice frequency distribution board. The board has one space for each statement in the Q set and requires the participants to rank each statement in the Q set from "most like my view" to "most unlike my view" (see "Appendix 1"). The number of potential ways to order the sort of 40–60 statements is vast (Watts and Stenner 2012), and a forced choice board allows comparisons to be made between entire completed Q sorts. Completed Q sorts are recorded by the researcher along with field notes from sorters during the sorting process. They are later evaluated using statistical analysis software to apply by-person factor analysis. In this way, the Q sorts are compared across participants to identify patterns, with Q sorts that cluster together indicating statistically similar perspectives. Using both quantitative and qualitative tools, researchers perform the work of interpreting results, identifying clusters of perspectives that are statistically different from one another and also meaningful within the context of the given controversy. As a result, researchers can identify a number of primary outlooks about the subject being studied, clarifying the subjective viewpoints of the participants and revealing commonalities and divergences in beliefs.

Q methodology has been used in both academic and nonacademic settings. The literature is rich on use of Q methodology in psychology, political science, and marketing (Eden et al. 2005; Previte et al. 2007). It includes research for tailoring product development and advertising to relevant groups (Rozalia 2008; Angelopulo 2009; Oekel 2009; Gabor 2013); identifying and communicating between differing modes of risk perception (Johnson and Waishwell 2014; Zhang et al. 2015); and comparing perspectives and attitudes towards different industries (Fairweather and Swaffield 2002; Hunter 2013). Further, Q methodology has also been paired with methods designed to reach or engage with those on opposing sides of contentious topics, in order to move beyond polarization, understand other viewpoints, identify areas of consensus and divergence, and negotiate conflict (Steelman and Maguire 1999; Mattson et al. 2011). In other words, while not always incorporated into Q studies, Q methodology can be a stepping stone for creating shared guiding principles, managing conflict, understanding non-participation, identifying areas of consensus, or bridging between practitioner and academic approaches (Kramer et al. 2003; Huggins et al. 2015). Used in these ways, Q methodology can enable greater stakeholder input by adding layers of participation and verification into the research process (Robbins and Krueger 2000).

Q methodology typically includes six steps: developing a research question, compiling a list of items to sort, selecting respondents, conducting Q sorts, analyzing data, and interpreting results (Davis and Michelle 2011). Some researchers seek to make Q methodology more participatory and iterative by adding a seventh step: consulting the research participants to review the final stages of analysis and interpretation (Robbins and Krueger 2000).

## Instrument development and data collection

This paper focuses on a Q study assessing perceptions of pesticide safety in tree fruit orchards in Washington State. Specifically, it asks how different stakeholders see pesticide safety concerns. To develop the study concourse, or the list of available opinions about the topic at hand, statements were selected from books, previous surveys, and research reports on pesticide safety perceptions and concerns, as well as from 18 interviews and focus groups conducted in 2012 in Spanish and English with a total of 34 people: pesticide applicators, orchard managers, farmers, pest management consultants, health care workers, researchers and extension personnel, educators/trainers, fruit pickers, lawyers, pesticide safety activists, and government conservation specialists. An initial set of approximately 800 statements was categorized according to 28 sub-topic themes, then reduced to 120 statements that best represented these themes. The 28 categories were then combined into four meta-categories: education/information, industry practice, risk/danger, and regulations. Forty-five statements were selected, in approximately equal numbers from these four categories, to best represent the diversity of views around orchard pesticide safety. The statements and materials were translated into Spanish so that Q sorts could be conducted in either Spanish or English (see "Appendix 2" for the list of statements). The Q set was piloted to ensure it successfully represented current perspectives on the issues at hand.

Purposive and snowball sampling methods were used to identify and select study participants to represent as wide a variety of stakeholders as possible. The goal was to select participants from all types and levels of positions involved in the tree fruit industry, including a mix of those working directly in the industry hierarchy with those working in sectors that support, regulate, or critique the tree fruit industry. Sampling was based on a broad range of contacts from the first author's prior work in tree fruit research and extension, attendance at classes geared towards agricultural middle managers, conferences where groups of relevant stakeholders meet (occupational health and safety, tree fruit industry), and visits to migrant labor housing camps in central Washington State. Ultimately, half of the participants in the study worked directly inside the tree fruit industry, roughly evenly divided among six major levels of industry hierarchy: industry organization representatives, pest management consultants, farmers, managers/supervisors, pesticide applicators, and fruit pickers. The other half worked in support, regulatory, or critique roles, roughly evenly divided among another six categories of participants: researchers, educators/trainers, public health professionals, conservation professionals, legal advocates on worker rights, and farmworker health advocates.

Because having an inclusive set of participants is crucial to generating reliable results from a Q study like this one, the authors consulted with colleagues, advisors, and all the participants they approached to ensure that no groups of stakeholders were being left out of the sample. Informed consent was obtained from all individual participants included in the study. Forty-nine individuals participated, of which 41 (those who completed the entire Q sort, worked individually rather than in a group, and had a stake or interest in the tree fruit industry) were included in the data set. Note that Q methodology is designed to identify the substance of unique viewpoints, not the prevalence of the viewpoints in a representative population. Therefore, large numbers of sorters are not needed, as they would be for statistical analysis in R studies (Watts and Stenner 2012). Demographic information for participating stakeholders is found in Table 1.

Participants were given a blank sorting grid and 45 laminated cards, each containing one Q statement. They were instructed to consider each statement relative to how they viewed the topic at hand, and place it into one of three roughly equal-sized piles: those most unlike their views, those they felt neutral about, and those most like their views. Next, the sorters were instructed to take their piles and place individual cards in each space on the grid, noting that in the sorting grid there was only one space available for each statement. The grid was constructed as an 11-point normal distribution, with the left-most column labeled "least like my view" (−5) and the right-most column "most like my view" (+5), with "neutral" (0) as the central column. A pre-patterned normal distribution such as this one standardizes the ranking process so that grids from different participants are more easily compared. Finally, after completing the Q sort, participants were instructed to complete a post-sort questionnaire to go over their Q sort answers in greater depth.[1] All steps were vetted through the Institutional Review Boards at the University of Washington and Washington State University in November 2011.

### Data analysis

After data collection was complete, the Q sorts were intercorrelated and analyzed using PQMethod (2.33) analytical software (Schmolck 2013). Eight unrotated factors were initially extracted for analysis, in order to compare three-factor, four-factor, five-factor, and six-factor solutions, all using principal component analysis and rotated using varimax rotation. Ultimately, the three-factor solution explained the largest percentage of study variance with the fewest number of confounded sorts, and was determined to be the best fit of the solutions analyzed. Each of the three factors had an Eigenvalue >2.5 [the *Kaiser-Guttman* criterion requires each to have an Eigenvalue >1.0 (Watts and Stenner 2012)], and together they explained 52% of the study variance. Once the three-factor solution was chosen, we examined which Q sorts achieved a significant load, or relationship, to each extracted factor. Q sorts that load significantly onto one particular factor do so because they share a similar pattern to the other sorts that load significantly onto the factor. As such, each factor indicates a set of similar sorting patterns, where participants sorted the statements in a statistically analogous way. In other words, all of the Q sorts loading onto the same factor have similar viewpoints or perspectives on the topic at hand (Watts and Stenner 2012). In this case, a Q sort was considered to load on a particular factor if its factor loading value was at least 0.38, the commonly accepted threshold used in PQMethod and the threshold that kept the greatest number of Q sorts loaded onto our three-factor solution. At this significance level, 38 of the 41 sorts loaded significantly onto one of these three extracted factors, and three were confounded, meaning they loaded onto more than one factor.

Groupings of Q sorts that load significantly onto only one factor (i.e. those that are not confounded) are used to create an ideal Q sort for each factor by calculating z-scores for each statement within each factor. This is done by using a procedure of weighted averaging where the higher loading exemplars are given more weight in the process, as they typify the factor more than others. When completed, the factor array looks like a single complete Q sort with one statement in each section of the grid (see "Appendix 2" for the statement rankings by factor). To interpret the factors, one then analyzes these factor arrays, as well as any other data about the defining sorters, such as the post-sort questionnaires, field data, and demographic descriptors, to look for explanatory patterns among the sorters loading onto each factor. Through interpretation, the researchers aim to understand and capture the

[1]Readers can email the corresponding author for a copy of the post-sort questionnaire.

viewpoint of the participants that loaded significantly on each factor (Watts and Stenner 2012).

To begin interpreting the results we created crib sheets as described by Watts and Stenner (2012). We looked at each factor independently, noting which statements were given the highest ranking (+5), the lowest ranking (−5), those ranked higher in that factor than by any other factor, and those ranked lower in that factor than by any other, to organize the process and ensure broad-based interpretation.[2] We also created large drawn versions of each factor array, added demographic and other relevant information to these drawings, and used them to further analyze the patterns found among the Q sorts (method suggested by Diane Montgomery, personal communication).

Interpreting each factor is a process of holistic examination of all the statements within the factor array, including how they relate to one another, as well as how these patterns relate to the patterns within the other factors. The purpose of factor interpretation is to fully understand and explain, in as comprehensive a sense as possible, the perspective which has been encapsulated by the factor arrays, and which is shared by the participants who load significantly onto that factor. The factor array provides the foundation for each factor interpretation, with descriptions for each factor presented as full narrative interpretations. These descriptions for the current study are presented below, with rankings of specific items provided. For example (1: +5) signifies that statement 1 was ranked at +5 ("most like my view") in the factor array of the factor being discussed (see "Appendix 1" for a visual of the −5 to +5 rankings on the Q sort board and "Appendix 2" for a numbered listing of the statements ranked). Participants' comments from the post-sort questionnaires are also presented to illustrate and clarify our interpretations.

## Stakeholder working group

As part of the post-sort questionnaire, each Q-study participant was asked if they would be interested in participating in a stakeholder working group to discuss and analyze results, and use them to brainstorm potential improvements for pesticide safety concerns. All those who indicated interest were invited to a series of five meetings held during 2014–2016: one in February 2014 (eight attendees), one in March 2014 (four attendees), one in May 2014 (six attendees), one in August 2014 (five attendees), and one in July 2016 (six attendees). Each meeting was discussion-based and facilitated by a professional facilitator, and the first two meetings were simultaneously interpreted in Spanish and English by a professional interpreter (the last three meetings were not interpreted because all participants who were able to attend spoke English fluently). At the end of each meeting, participants completed an evaluation form so that feedback could be garnered about the meeting to help improve subsequent meetings.

[2]Readers can email the corresponding author for a copy of the factor interpretation crib sheets.

## Results

### Q study

The three factors extracted in the Q study were: “the skeptic,” who feels that current regulations are generally not sufficient to protect workers from pesticide-related health risks; “the acceptor,” who feels that by and large, the risks involved in pesticide use are known, small, and well-managed; and “the incrementalist,” who suggests investing in technology and human capital to mitigate any health and safety risks involved in pesticide use.

### Factor 1: the skeptic (n = 22)

The skeptic expresses concern over the environmental and human health impacts of pesticide use (8: +4; 16: +4; 14: −5), and feels that current regulations are not sufficient to protect people from pesticide exposure. She (most of our skeptics were women—see Table 1 for participant demographics) worries that people accept the message from industry and government that pesticide use is well regulated and fairly safe without questioning it adequately (1: +5). This is because she doubts the ability of human beings, or at least our knowledge so far, to fully understand ecosystem and human health impacts enough to mitigate the dangers of pesticide use (2: +5; 41: +5; 11: −4; 40: −4). As one skeptic puts it, “Long term effects aren’t always known until 40+ years after.” The skeptic also doubts the willingness or ability of industry (37: +3; 34: −5) or government (40: −4) to really protect peoples’ health. One skeptic working in pest control and monitoring for an orchard felt that “many people go outside the regulations a lot, and don’t appropriately inform people or implement real safety.”

As such, the skeptic sees a real need for education and structural changes that can help farmworkers be safer around pesticides (20: +4; 17: +4; 32: −5; 24: −4), and highlights as a problem the variability of safety regulation enforcement from orchard to orchard (29: +4). For improving pesticide safety, she focuses on training and regulation in the shadow of uncertainty. As one sorter puts it, “Many people are poorly trained and because of their situation they are discouraged from asking questions.” In the words of another skeptic, “Regulation is necessary to live in a safer environment.”

### Factor 2: the acceptor (n = 10)

The acceptor agrees that there is an inherent risk in using pesticides (41: +4), but feels strongly that these risks are both known and small, and are very well controlled and managed. As such, he (all acceptors in our study were men—see Table 1 for participant demographics) feels they do not present significant health hazards (12: +4). He feels that quality affordable fruit cannot be produced without pesticides (15: +5), and that people are afraid of pesticides primarily because they don’t have an adequate understanding of pesticides or of agriculture as a whole (4: +5; 5: +5). As one sorter states, “the general public is removed from agriculture and fear what they don’t understand.” In post-sort questionnaires, acceptors seem to distrust the public’s ability to judge risk more than do the skeptics. Where skeptics suggest that the public needs to be better informed, acceptors view industry experts as knowing better, while feeling that the public overreacts to misinformation.

The acceptor stresses how much safer orchards have become over the last 5–10 years (33: +5), and exhibits a level of trust unseen in the skeptic (10: −4; 7: −3). As one acceptor put it, “I do trust the current registration process that pesticides go through…the focus on emotion versus science makes this debate larger than it should be.”

Nevertheless, the acceptor agrees with the skeptic that orchards vary greatly in terms of their implementation of safety protocol (29: +4), but points to a need for improved communication in orchards, rather than improved regulation or safety practices, to improve work environments (28: +4). In post-sort questionnaires, acceptors saw language barriers to pesticide management on farms; however they believe that training helps bridge these communication obstacles. The acceptor, on the whole, believes that levels of pesticide safety in orchards are quite high (16: −4), and does not recommend adding new layers of precaution for regulating pesticides (3: −5, 36: −5). As one acceptor puts it, “We have a well-educated workforce with solid industry support.” This is not to say that the acceptor is cavalier about issues of risk (11: −1; 13: −1); rather that he feels that the risks involved in pesticide use are sufficiently mitigated, and the benefits are important enough, to make the status quo of pesticide use in orchards very appropriate.

### Factor 3: the incrementalist (n = 6)

While the skeptics and the acceptors match up to some degree with the positions on pesticide safety we saw in the literature, the incrementalist’s view is somewhat different. In some ways, it bridges the skeptic’s and the acceptor’s views, but it also focuses more on opportunities to make human capital and technology improvements in the workplace. Like the skeptic, the incrementalist worries about human health impacts of pesticides and about people being exposed to risk (1: +5; 14: −5; 32: −5; 45: −4). But he (all the incrementalists in our study were men—see Table 1 for participant demographics) agrees with the acceptor that orchards are much safer than they used to be (33, +4). And like the acceptor, he locates the solution to pesticide safety concerns much more strongly in improved communications than in any changes to regulation or structure, believing the existing system to provide adequate protection to workers (28: +5; 26: +4; 35: +4). In other words, unlike the skeptic, he trusts government regulation as an adequate form and level of health and safety protection (40: +5; 7: −4; 8: −4).

Unlike the acceptor, however, the incrementalist sees an opportunity for improvement that would be based in increased industry funding for safety and in making technological changes to orcharding practices, such as using robotics to take workers out of harm’s way (42: +5; 43: +4; 31: −4). He has a higher regard for industry and for the level of existing pesticide safety training than does the skeptic (10: −3; 17: −5), but notes several workplace practices— providing pesticide labels in Spanish and improving communications within orchards—that could significantly improve pesticide safety (19: +3; 21: +3; 25: +3; 27: +3).

### Consensus statements

While divergent, these three factors did view several of the Q statements similarly. All saw pesticide safety concerns as somewhat important (14: −5, −4, −5; 31: −2, −2, −4; 45: −4, −3, −4). All three moderately agreed that more label information in Spanish could be helpful

(19: +1, +2, +3) and that re-entry interval signs are not reliable, given that many orchards keep signs up all year (38: +1, +2, +1). Furthermore, all three factors disagreed that one could determine pesticide safety by a chemical's odor (9: −5, −5, −5). In addition, there were three statements where two of the three groups felt similarly while the third felt neutral. These are thus statements that may also represent potential "common ground" options for orchard pesticide safety improvements. First, both the skeptics and the acceptors agreed that there is inherent risk in working with pesticides (41: +5, +4, +2), and that pesticide safety can vary from orchard to orchard (29: +5, +4, 0). Acceptors and incrementalists also agreed with one another that overall, orchards are safer now than they used to be (33: 0, +5, +4). Thus, there are areas of common understanding among the factors —that pesticide concerns matter, that pesticides have their inherent risks, that one cannot tell toxicity from pesticide odor, and that safety practices vary among orchards, even as orchard safety has improved overall. There are also areas of common recommendations among the factors—that making label information available in Spanish and improving the reliability of pesticide spray notification (re-entry interval signs) could help improve orchard pesticide safety.

Interestingly, as Table 1 indicates, the three factors in this study strongly align with gender, cultural differences, and to a slightly lesser extent age, education, and employment. First, all the women participants in the study (15 of 41) loaded as skeptics, while acceptors and incrementalists were all men. Note, however, that this gendered difference also mapped somewhat onto a difference in employment—most of the women who participated (11 of 15) worked outside the tree fruit industry, while most of the men who participated (19 of 26), worked inside the industry. Second, among acceptors, only one out of 10 was bilingual, while the rest were English-only speakers. This is compared to the incrementalists, who were all native Spanish speakers, one of whom was bilingual; and the skeptics, 15 out of 22 of whom were bilingual or Spanish-only speakers, with three of the remaining seven English speakers having some ability in Spanish. Incrementalists were the youngest group and acceptors the oldest. And likely correlated with age, acceptors had been working in their respective industries for longer, although both incrementalists and acceptors reported extensive experience working with pesticides. Skeptics and acceptors both were fairly highly educated—between two-thirds and three-fourths had completed college or above—and incrementalists tended to have less formal education—two-thirds had a high school degree or less.

While there were farmers or growers who loaded onto all three factors, there were other employment-related differences. Acceptors tended to work in higher level tree fruit industry or industry-support positions. Some orchard managers, farmworkers, and educators loaded as skeptics and others loaded as incrementalists, but none loaded as acceptors. The remaining skeptics were all in support, regulatory, or critique roles as government representatives, public health employees, lawyers, and other farmworker advocates. Acceptors had slightly more direct experience working with pesticides than did incrementalists, and both groups had much more direct experience with pesticides than did skeptics. Importantly, while there were differences among groups' levels of education and experience in the industry, differences in their perspectives on risk could not simply be predicted or mapped by how "educated" or "informed" they were; nevertheless, groups who reported more direct experience using pesticides did tend towards lower perceptions of risk associated with pesticide use.

While the demographic information collected did not allow us to assess whether all these differences were statistically different from what might be expected, certainly gender and language differences were striking. While women made up 40% of the total Q study participants, they were 60% of skeptics, 0% of acceptors, and 0% of incrementalists. While those with Spanish as their first language made up 50% of Q study participants, they made up 60% of skeptics, 0% of acceptors, and 100% of incrementalists (see Table 1). These findings suggest that gender and cultural differences, as well as age, education, and employment, may be important components in etching the differences among these groups' worldviews and perspectives on pesticide safety.

### Stakeholder working group

Stakeholder working group meetings built on these Q study results. During the first stakeholder working group meeting in February 2014, researchers presented preliminary results of the Q study and opened up a discussion of them. Participants discussed what they thought of the results, whether they resonated with their experiences in the tree fruit industry, and aired any thoughts or concerns they had. For the most part, participants were not surprised by the Q study results; rather they seemed to represent, fairly accurately, their experiences with tree fruit industry stakeholders. After this discussion, participants used the Q study results as a platform for brainstorming a list of potential projects that they thought might be both useful and also mutually acceptable, given the nature of the viewpoints identified, for improving pesticide safety in orchards.

During the second meeting in March 2014, participants honed in on one of those ideas to pursue—a training certificate program for supervisors—and began discussing what might be needed to bring it to fruition. Given the common understanding among groups that pesticide safety varies from orchard to orchard, working group members postulated that much of the safety climate in an orchard depended on supervisors—how they set the tone of the work, what resources they provided to their crews, and how they communicated with upper management. Participants noted that many supervisors are promoted to supervisory roles because they are good workers, but do not necessarily have skills or training in how to manage employees. Helping them learn to navigate hiring/firing, communications, ethics, safety, leadership, and motivation was seen as a way to strengthen the safety culture across orchards and provide strong and conscientious leaders to help motivate and also protect workers from risks associated with pesticides and other workplace hazards.

During the third meeting in May 2014, participants added more depth to the chosen idea and began to pursue partnerships to assist it. They developed a preliminary proposal for a training center that could provide comprehensive series of courses that supervisors could complete. During the fourth meeting in August 2014, the group embarked on research they deemed necessary to move forward with their proposal. They began an assessment of existing training courses and a study of current training practices among tree fruit companies in order to decide whether or not a training center and certificate program would be used by the industry. During the fifth meeting in July 2016, the group assessed findings from the study of existing training practices and charted a course for building curriculum, finding partners, and securing funding to establish a supervisor training certificate program for agricultural supervisors in Washington State. The work of this group is still ongoing at the time of this writing.

## Discussion

### Q study: pesticide use and occupational risk

While Q studies can highlight any number of distinct worldviews on a given topic (common factor solutions range from 2 to 6 factors), this study found that viewpoints clustered around three particular worldviews. Factors 1 and 2 (the skeptic and the acceptor) represented the viewpoints we commonly see in a generic understanding of the polarized nature of pesticide safety debates. Factor 1 was the viewpoint resisting the notion that current industry standards for pesticide use are safe, and questioning the regulatory mechanisms in place, while Factor 2 was the viewpoint largely defending current practice and policies. Factor 3 (the incrementalist) represented a somewhat different voice, a perspective that pulled components from each of the others and yet was not strictly a compromise view.

Each of the factors identified different causes for pesticide safety problems, and each preferred different solutions. The skeptic (Factor 1) mistrusted both government and industry, feeling there was too little regulation in place to protect agricultural workers from pesticide exposure, and suggested a need for more education and improved regulation. Individuals loading on Factor 1 were employed in diverse fields, and were largely female and Spanish-speaking. The acceptor (Factor 2) saw pesticide use as necessary for growing crops, and trusted government and industry estimates and management of risk. He focused on a need for better internal communications to address any concerns, rather than more education or enforcement. Individuals loading on Factor 2 consisted largely of industry “experts” employed in the tree fruit industry, and were all male and mostly English-speaking. The incrementalist (Factor 3) echoed both the skeptic’s concerns about pesticide exposure and also the acceptor’s conviction that orchards are relatively safe. The incrementalist, like the acceptor, trusted government and industry, but also saw room for improvement, primarily in the area of technology, human resources, and capacity building. As such, Factor 3 combined elements of Factor 1 and 2’s views, but also stood apart from them especially in their identification of solutions. Individuals loading onto Factor 3 were largely male and Spanish-speaking.

Ulrich Beck coined the term “risk society” to conceptualize the perceptions of risk and insecurity that have been co-produced alongside industrial and technological modernization (Beck 1992). Further research on risk has shown that demographics, especially gender, race, and ethnicity, play into how individuals perceive risk in this environment. The white male effect, coined by Flynn et al. (1994), describes men as perceiving less risk from a given situation than women (e.g., Carney 1971; Slovic et al. 1989; Gwartney-Gibbs and Lach 1991; Sjoberg and Drottz-Sjoberg 1993) and whites perceiving less risk than people of color (Savage 1993; Flynn et al. 1994; Cabrera and Leckie 2009). Slovic (1997) suggests that the white male effect is a product of white males’ advantageous position in society and power to control their environment. This thesis is supported by Olofsson and Rashid (2011) who found that in Sweden, unlike in the United States, men and women perceived risk similarly, in line with more egalitarian power levels and social roles. Research in farm work supports these findings, as differences in risk perception have been found to vary by gender; race, and ethnicity; work, personal, cultural, and other demographic attributes; and especially by level of perceived control over the work environment (Arcury et al. 2002; Snyder 2004; Hohn 2010; Rohlman 2010).

This literature on risk perception may give us some insight as to the nature of our three factors' views on pesticide safety. First, all the acceptors in our study were industry insiders and white males, and most of them worked as consultants or in other such high level positions in tree fruit, with more power to control their workplace environment. Among skeptics, more than half were women, Spanish-speakers, and/or worked outside the industry in support, regulatory, or critique roles; with somewhat less power to control the orchard workplace, their perceptions of pesticide risk were much higher than those of the acceptors. Second, the incrementalists were all men who worked inside the tree fruit industry, leading them towards lower perceptions of pesticide risk than the skeptics, in line with the literature. On the other hand, they were also all Spanish-speakers employed at somewhat lower levels in the tree fruit hierarchy, pushing them towards higher perceptions of risk than acceptors. As such, the incrementalist could be taken as a "middle of the road" view—seeing pesticide use as risky, but orchards in general as relatively safe. Or perhaps the incrementalist could be viewed as taking a qualitatively different view—almost opting out of the polarized debate, less interested in taking a stand on the inherent safety or danger of pesticides, and more interested in looking at how to improve orchard management. This can be seen in the incrementalist's stronger responses to statements about potential changes in the tree fruit industry, as compared with the skeptic's and acceptor's stronger responses to statements about the nature of risk.[3]

The existence and nature of the incrementalist's view thus provides several insights into our previously polarized debate. For one, while the extreme views cited in popular discussions of pesticide use are clearly borne out as important ones in the given debates, they are also not the only views. Rather, there is at a minimum one other view present that can be characterized as lying outside of the extremes. This view encapsulates aspects of *both* of the more polarized counterpart views, implying that while the more extreme views are quite different, they are not completely irreconcilable. In certain ways, this provides a tool for more clearly visualizing the social constructionist contention that binary oppositions are often false dichotomies that narrow our view of what is natural or possible, rather than representations of an objective "truth." Perhaps more importantly, having a factor present that seemed to care less about defining how much risk there was from pesticide use in orchards, and more about how to change orchards for the better, helped us create a conversation that could negotiate around perceived dichotomies. While no more of a "correct" view than either of the other factors, the incrementalist offered us the option of focusing on solutions more than problems. For our purposes, the erasure of that voice through a focus on polarization alone would have been particularly problematic.

[3]Readers can email the corresponding author for a copy of the factor interpretation crib sheets showing these comparisons.

Author Manuscript
Author Manuscript
Author Manuscript



We argue that in this case, this third perspective offers us a conviction that mutual agreement is possible. The mutual agreement, however, does not have to imply compromise. Instead, it can imply places where disagreements are muted enough to be able to make progress towards common goals, or where common solutions exist despite divergent views. This finding echoes the notion that stakeholders can at times agree on solutions without ever agreeing on the problem (Bryson and Crosby 1992; Roberts 2000). And in our case, consensus statements seen similarly by all three factors can point the way towards the more concrete, mutually acceptable actions hinted at by the existence of Factor 3. For example, representatives of all three worldviews agreed that pesticide safety is important, as there is inherent risk in pesticide use; that having more information on the label in Spanish and more reliable re-entry signs in orchards would be helpful; and that risk can vary by orchard. Thus, the consensus statements suggest that at their most basic level, representatives of all three factors understand the potential dangers of pesticides and the need to ensure safety, and all three agree on several venues for safety improvements.

## Stakeholder working group: benefits and complementarities

In the stakeholder working group meetings, these consensus statements pointed towards areas where controversies over basic approaches to risk could be sidestepped. While analysis of the different viewpoints did not serve to reconcile them—these views diverge for important reasons, and our goal was to understand them individually rather than suggest they be merged—it did seem to provide a space for participants to think outside the typical binaries invoked in discussions around pesticide safety. In particular, the Q study results provided a useful way for members of the working group to see, concretely, one another's opinions. Acceptors were forced to acknowledge that even if they did not see great risk themselves in pesticide use, they would be unlikely to garner loyalty from many of their (skeptic) employees if they did not address their concerns about safety. Similarly, skeptics were confronted with the idea that even if they see the status quo use of pesticides as risky, they might be able to gain traction by working with those (acceptor) stakeholders who set the default terms of practice for pesticide use in the tree fruit industry, and who feel that they are mitigating risk acceptably.

While these are insights that stakeholders presumably were already aware of, experiencing them in concrete terms and struggling with them in a mixed group seemed to require a more explicit acknowledgement of them. This sense is supported by comments made by participants in their evaluations of the working group meetings—some noted for example that the group included "good representation from…diverse backgrounds" (evaluations, meeting 1). Others appreciated the "open, honest discussion style" (evaluations, meeting 4) where "everyone freely shares their ideas" (evaluations, meeting 3). Still others valued the fact that "we came to a shared goal" (evaluations, meeting 2). In other words, even without any working knowledge of factor analysis or the technicalities of Q methodology, stakeholders were able to use the Q study results to create space for conversation. Because the Q study results formally acknowledged groups' differences and commonalities to one another, stakeholders could perhaps temporarily set aside these differences and focus on mutually acceptable improvements that could be made in the tree fruit industry.

Author Manuscript

Author Manuscript

Author Manuscript

Interestingly, once participants started to focus on mutually acceptable improvements, their first suggestions were for small changes, some of which came directly from the Q study's consensus statements—a proposal to translate pesticide labels into Spanish, to improve personal protective equipment for pesticide applicators, or to encourage farmers to limit posted warnings to recently sprayed orchard blocks rather than keep them up longer to discourage trespassing. But ultimately, the group chose not to address any of these smaller, albeit important, fixes. Instead, they focused on supervisor training, a project seemingly outside the scope of pesticide safety but one which they felt could have larger implications for worker safety, satisfaction, and treatment within the industry. While the group's focus on improving supervisor training outwardly avoided many of the questions of pesticide safety that had prompted this study, it may actually represent a broader way to address those concerns. In the words of one participant, "elevating the status" of supervisors through a training certificate program could improve working conditions for farmworkers across the board.

Thus, we argue here that the use of Q methodology to inform the efforts of this stakeholder working group helped the group brainstorm solutions beyond those that could be construed as either trivial or prohibitively contentious. The process did not dictate a compromise position located strictly in between more extreme views; instead, it opened a space outside the polarity to think more broadly about health and safety in the tree fruit industry. It allowed stakeholders to address the concerns of one group without asserting that another group's view was wrong. Further, they did so in a way that would not be blockaded and might even be supported by other groups. In this case, stakeholders converged on supervisor training as a way to both improve orchard operations and also potentially address the vulnerabilities of a migrant workforce—conditions that include but are not limited to health and safety risks of pesticides. Notably, this is a solution located outside of the smaller compromises or fixes that could have resulted directly from implementation of the Q study's consensus statements. Again, this suggests that the process was not so much about implementing common solutions calculated through factor analysis, but rather enabling stakeholders with different views and levels of power to acknowledge one another and work together outside of their areas of disagreement.

In this case, it was Q methodology that provided a certain amount of leverage for digging into a polarized issue. While it is not the only tool that can do this, Q methodology possesses certain clear benefits. First, it engages with data qualitatively, providing a descriptive richness that allows for a deeper understanding of the worldviews it highlights. Second, even with this qualitative bent, Q methodology also provides a quantitative statistical solution that helps clarify the nature of each factor in isolation and in comparison to the other factors. This numerical solution provides leverage for academic and non-academic audiences alike to understand the implications of the factor solution and its meanings. In addition to the benefits associated with seeing Q study results, the process of participating in a Q sort itself—ranking statements by physically moving and sorting cards onto a board—provides a concrete and accessible way of emphasizing that viewpoints (even one's own) are not necessarily shared truths, and that there can be some common benefit to engaging with, rather than dismissing, alternate views. As such, we argue here that using Q methodology together with a stakeholder process is a valuable tool for operationalizing the social constructionist task of blurring dichotomies. Further, it may do so in a way more accessible to non-academic audiences than some of the other methods commonly used for this task.

We argue, further, that using Q methodology in conjunction with a stakeholder process to analyze and build on study results can be an elegant way to approach controversial issues. Because our working group was built on the heels of a Q study, we could quite clearly identify the kinds of stakeholders we wanted to see included in the working group, and ensure that representatives of all three factors were present at all meetings. We were also able to begin the process of working together as a group with a shared understanding of the existing differences in our worldviews, so that those differences did not become the subject of the working group's activities. Freed of the need to defend worldviews, as these were already concretely acknowledged and accepted as real, stakeholders could focus on the work of building solutions.

## Study limitations

Of course, there are also weaknesses embedded within Q methodology. First, Q methodology is not a very well-known method, which can at times make finding mentors or publishing study results difficult. Second, the results of a Q study are, as with many other methods of study, constrained by the inputs that go into a Q set. Being certain to cover the full range of views in development of the Q set is key to finding factor solutions that accurately portray the worldviews that emanate from it. When done thoroughly, this can be a time-intensive process. While this study was extremely thorough in the development of its Q set, this is nevertheless worth taking into consideration. Third, as a method that works with small numbers of participants, results of a Q study are not intended to be generalized to a full population of human subjects. Rather than be taken as representative of all peoples' worldviews around a topic, the factors of a Q study are taken to be representative of the constellation of many or most views on the topic. As a result, they may not encompass every possible view (Watts and Stenner 2012). Fourth, in seeking to critique the polarization of controversial debates, it is important to note that we used a method that itself places worldviews into categories. While one strength of Q methodology is insisting that there are typically more than two such views, it nevertheless presupposes the existence of bounded categories that could in turn also limit the visibility of variation among participants.[4] Fifth, because this study used Q methodology to focus stakeholders on mutually acceptable actions going forward, it did not give as much weight to more controversial actions that might also be effective in improving pesticide health and safety, but that might only be implemented over the objections of one or more stakeholder groups. This could be a concern especially if the Q-study-plus-stakeholder-process tends to favor only trivial solutions to chosen problems. While this was not the case with this particular process, it is not hard to imagine a process where potential solutions might tend toward trivial, easily-implemented fixes. As such, this is an important issue to consider in future research. Last, while the deliberations of the stakeholder working group were likely much more open because of stakeholders' interaction with the Q study results, the outcomes of those discussions were also influenced by multiple other factors—not least of which was who was able to attend meetings, what

[4]Particular thanks to an anonymous reviewer for this insight.

participants' relative levels of power were within the industry, and how that particular mix of participants interacted in those smaller group settings.

### Future research

In response to the above limitations, we suggest that future research and analysis consider in more depth the logistical constraints, power dynamics, and consensus-related strategies that in turn influence the nature of solutions developed versus those bypassed—in other words, the bridges between the Q study conducted here and the outcomes of the stakeholder working group discussions that stemmed from it.

## Conclusions

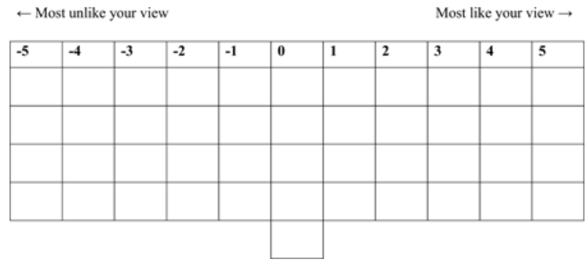
In this study we asked if highlighting alternate views of orchard pesticide safety and bringing them into a structured participatory process could be used to improve health and safety protections in tree fruit orchards. Q methodology was used to help highlight perspectives on pesticide safety that were difficult to discern via media or politics' focus on more extreme views. We found views both in favor of and against current regulatory and industry practice on pesticides, as well as an additional viewpoint that both bridged and diverged from the two extremes. Bringing these voices together into a stakeholder working group, we sought to map the views in relation to one another so as to find points of commonality from which to initiate action or discussion. The use of Q methodology as fodder for a stakeholder working group of representatives from each of our three viewpoints thus helped open a space to move forward on areas of common ground. These common ground areas were not issues that directly confronted the differences among the groups, but rather areas that could provide mutual benefits and improvements despite such differences. As such, we argue that Q methodology, as incorporated into a participatory process, can provide a concrete and accessible tool for working around seemingly polarized controversies in food and agriculture. While not perfect, we see it as a concrete tool to uncover viewpoints hidden from popular discussion and use them to move beyond gridlock.

## Acknowledgments

Thanks go to Maureen Gullen for assistance in data analysis and representation for this study, to Diane Montgomery for assistance in identifying the most appropriate factor solution, to Jerry Shannon, Diane Montgomery, and Alice Julier for comments on an earlier draft of this paper, to four anonymous reviewers for invaluable feedback, and to the pesticide safety stakeholder working group for comments on the pesticide Q study results and analysis. This study was funded by CDC/NIOSH Award 5 U54 OH007544 to the University of Washington Pacific Northwest Agricultural Safety and Health Center (with subcontract to Washington State University).

## Appendix 1

Q sort distribution board




## Appendix 2

Statement rankings by factor

| Statements | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|
| 1. I worry that people don't take the risks of pesticides seriously because they don't understand the long-term effects of pesticides on their health | 5 | −3 | 5 |
| 2. I don't think anybody really knows what all of these pesticides are doing to our environment | 5 | 0 | 2 |
| 3. Unlike many people, I believe that if there is any possibility of a pesticide harming the environment or human health, that chemical shouldn't be used even if it's not yet absolutely proven scientifically to be harmful | 1 | −5 | 0 |
| 4. I am convinced that people are afraid of pesticides basically because they don't know enough about the pesticides themselves | 0 | 5 | 0 |
| 5. It frustrates me that the public simply does not understand how agriculture works today | 0 | 5 | −2 |
| 6. I don't know why people get so worried about pesticide use in orchards—there are good systems in place for monitoring pesticide illness and they indicate really low levels of exposure | −3 | 3 | 1 |
| 7. I don't trust official assessments of pesticide health risks—they're measured by exposure to a single chemical, but pesticides are typically used in formulations (mixed with other chemicals) | 2 | −3 | −4 |
| 8. I'm not naïve enough to believe that all pesticides are safe | 4 | 3 | −4 |
| 9. I can tell by the odor whether or not a pesticide is dangerous | −5 | −5 | −5 |
| 10. I believe that scientists receiving industry funding tend to be biased towards industry interests even in cases where the industry sponsor does not actively pressure the researcher | 2 | −4 | −3 |
| 11. I don't have any questions about which chemicals are safe and which are not—the science of pesticide safety is has been clearly studied | −4 | −1 | −2 |
| 12. Many of the pesticides we use now are very targeted—they're not broad-spectrum neurological toxins so short of being a fungus or bacteria, they're not going to have much effect on you | −3 | 4 | 0 |
| 13. I am tired of all the regulation around agricultural pesticides | −3 | −1 | −2 |
| 14. I don't think it makes sense to worry too much about pesticide drift—pesticides are so diluted by the time they're used that they're not going to hurt you | −5 | −4 | −5 |
| 15. I'm all for workplace safety, but without pesticides, you just can't produce the safe, nutritious, affordable food that consumers deserve | −1 | 5 | 2 |
| 16. I worry about children's exposure to pesticides (even in utero) because it can lower their IQ | 4 | −4 | 1 |
| 17. It frustrates me that literacy, cultural, time, and language barriers get in the way of appropriate pesticide safety training for workers | 4 | 1 | −5 |
| 18. No matter what people say, I know that pesticide drift is very common | 2 | 3 | −2 |
| 19. What pesticide handlers need to be safe in my opinion is more label information in Spanish | 2 | 1 | 3 |

| Statements | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|
| 20. I think there should be a program whereby all pesticide applicators, when they go out to spray, are given refresher explanations on what chemicals they are using, what the labels say, and how they should be used | 4 | 0 | 2 |
| 21. I know that pesticide applicators, because they’re spraying all the time, understand pesticide safety—but not everyone else knows what’s going on, and that can make things risky | −1 | 0 | 3 |
| 22. It frustrates me to no end that the health dangers of pesticides are grossly overstated by politicians using the issue as a political vehicle | −2 | 2 | −1 |
| 23. In my experience, tree fruit workers receive plenty of pesticide safety training | −2 | 1 | −1 |
| 24. I feel very comfortable with how well pesticide handlers know how to read and follow pesticide labels | −4 | −2 | 2 |
| 25. I wish managers would do a better job of reminding pesticide handlers about maintaining a safe workplace | 3 | 1 | 3 |
| 26. If there were clear and open communication within orchards, pesticide safety would be less of an issue | 0 | 2 | 4 |
| 27. I think growers and managers are generally good listeners, responsive to their workers’ concerns—but workers have to be willing to talk to them if they are worried | −1 | 3 | 3 |
| 28. What I think supervisors need is training in human resource management—how to be more effective and more efficient, with the skills and abilities to communicate things to their employees | 3 | 4 | 5 |
| 29. I think a big problem in the system is that pesticide safety varies so much by orchard—some enforce safety procedures really well and implement a culture of safety while others don’t | 5 | 4 | 1 |
| 30. I hate when pesticide handlers don’t get enough time to decontaminate personal protective equipment | 3 | −1 | −3 |
| 31. To me it’s simple—as long as people follow regulations and don’t go into sprayed blocks, there is no safety risk | −2 | −2 | −4 |
| 32. In my opinion, the tree fruit industry overprotects its workers | −5 | −3 | −5 |
| 33. I can hardly believe how much safer orchards are now than they were 5–10 years ago | 0 | 5 | 4 |
| 34. For me, industry self-regulation is the best way to addressing environmental problems like pesticide safety | −5 | 0 | −1 |
| 35. To me, pesticide handling is only risky when applicators don’t wear the proper personal protective equipment | −3 | 0 | 4 |
| 36. I don’t understand why pesticides that can be replaced by less toxic alternatives are still registered | 1 | −5 | 0 |
| 37. I don’t think that growers would train workers on pesticide safety unless it were regulated | 3 | −2 | −1 |
| 38. In my experience, posting signs for re-entry intervals is not effective—many places keep their signs up all year, so you can’t rely on them | 1 | 2 | 1 |
| 39. I’m tired of this overwhelming focus on pesticide safety—there are simply way more pressing safety issues in orchards today | −2 | −1 | −3 |
| 40. I trust that the USDA and EPA wouldn’t allow pesticides to be used that aren’t safe for humans | −4 | 2 | 5 |
| 41. I believe there’s inherent risk involved in working with pesticides, no matter what precautions are taken | 5 | 4 | −3 |
| 42. Improving pesticide safety is simple—all it needs is for the tree fruit industry to step up and put some money behind it | −1 | −5 | 5 |
| 43. I believe that true safety comes not from worker protections but from engineering workers out of the loop | 0 | −4 | 4 |
| 44. I’d like growers to spray less toxic pesticides, but the cost of them is getting out of control, especially for family farmers | 1 | −2 | 0 |

| Statements | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|
| 45. To me, pesticide safety has become a non-issue—employers already have to address it for food safety certification | −4 | −3 | −4 |

## References


Aerni P. Attitudes in the public debates on agricultural biotechnology in developing countries. The African technology development forum. 2005

Aerni P, Bernauer T. Stakeholder attitudes toward GMOs in the Philippines, Mexico, and South Africa: The issue of public trust. World Development. 2006; 34(3):557–575.

Alavanja MC, Dosemeci M, Samanic C, Lubin J, Lynch CF, Knott C, Barker J, Hoppin JA, Sandler DP, Coble J, Thomas K, Blair A. Pesticides and lung cancer risk in the agricultural health study cohort. American Journal of Epidemiology. 2004; 160:876–885. [PubMed: 15496540]

Angelopulo G. Q methodology and the measurement of subjectivity in corporate brand perception. South African Journal of Business Management. 2009; 40(3):21–33.

Arcury TA, Quandt SA, Russell GB. Pesticide safety among farmworkers: Perceived risk and perceived control as factors reflecting environmental justice. Environmental Health Perspectives. 2002; 110(S2):233–240. [PubMed: 11929733]

Ashley, B., Hollows, J., Jones, S., Taylor, B. Food and cultural studies. London: Routledge; 2004.

Beck, U. Risk society: Towards a new modernity. London: SAGE Publications Ltd; 1992.

Berger, PL., Luckmann, T. The social construction of reality: A treatise in the sociology of knowledge. London: Penguin Books; 1966.

Best, J. Social problems. New York: W.W. Norton & Company; 2012.

Biltekoff, C. Eating right in America: The cultural politics of food and health. Durham: Duke University Press; 2013.

Brown, SR. Political subjectivity: Applications of Q methodology in political science. New Haven: Yale University Press; 1980.

Bryson, JM., Crosby, BC. Leadership for the common good: Tackling public problems in a shared-power world. San Francisco: Jossey-Bass Publishers; 1992.

Cabrera NL, Leckie JO. Pesticide risk communication, risk perception, and self-protective behaviors among farmworkers in California’s Salinas Valley. Hispanic Journal of Behavioral Sciences. 2009; 31(2):258–272.

Carney, RE., editor. Risk taking behavior: Concepts, methods, and applications to smoking and drug abuse. Springfield: Charles C. Thomas; 1971.

CDC. Morbidity and mortality weekly report. Vol. 48. Centers for Disease Control; 1999. Framework for program evaluation in public health.

Davis CH, Michelle C. Q methodology in audience research: Bridging the qualitative/quantitative ‘divide’? Participations: Journal of Audience and Reception Studies. 2011; 8(2):559–593.

Eden S, Donaldson A, Walker G. Structuring subjectivities? Using Q methodology in human geography. Area. 2005; 37(4):413–422.

EPA. 40CFR170. U.S. Environmental Protection Agency; Worker protection standard. n.d.http://www.access.gpo.gov/nara/cfr/waisidx_10/40cfr170_10.html [Accessed 24 Jan 2011]

Evans JH. Have Americans’ attitudes become more polarized?: An update. Social Science Quarterly. 2003; 81(1):71–90.

Evans G, Need A. Explaining ethnic polarization over attitudes towards minority rights in Eastern Europe: A multilevel analysis. Social Science Research. 2002; 31:653–680.

EWG. EWG’s 2015 shopper’s guide to pesticides in produce. Environmental Working Group; 2015. http://www.ewg.org/foodnews/summary.php [Accessed 8 April 2015]

Fairweather JR, Swaffield SR. Visitors’ and locals’ experiences of Rotorua, New Zealand: An interpretative study using photographs of landscapes and Q method. The International Journal of Tourism Research. 2002; 4(4):283–297.

Fiorina, MP. Culture war? The myth of a polarized America. 3. Harlow: Pearson Longman; 2010.

Flynn J, Slovic P, Mertz CK. Gender, race, and perception of environmental health risks. Risk Analysis. 1994; 14(6):1101–1108. [PubMed: 7846319]

Gabor MR. Q methodology (Q factor analysis): Particularities and theoretical considerations for marketing data. International Journal of Arts and Commerce. 2013; 2(4):116–126.

Globalwise and Belrose Inc. [Accessed 16 July 2014] The Washington apple industry: updated evaluation of contributions to the state economy and the important role of exports. 2014. http://fruitgrowersnews.com/downloads/2012/WAC_Econ_ImpactReport_Final_082912.pdf

Guthman, J. Weighing in: Obesity, food justice, and the limits of capitalism. Berkeley and Los Angeles: University of California Press; 2011.

Gwartney-Gibbs PA, Lach DH. Sex differences in attitudes toward nuclear war. Journal of Peace Research. 1991; 28:161–176.

Halfacre-Hitchcock A, McCarthy D, Burkett T, Carvajal A. Latino migrant farmworkers in lowcountry South Carolina: A demographic profile and an examination of pesticide risk perception and protection in two pilot case studies. Human Organization. 2006; 65(1):55–71.

Hansen, H. [Accessed 13 April 2016] Talking about pesticides: Responding to myths, rumors, and fears. Washington Friends of Farms and Forests. 2014. http://www.wafriends.org/

Hofmann JN, Crowe J, Postma J, Ybarra V, Keifer MC. Perceptions of environmental and occupational health hazards among agricultural workers in Washington State. American Association of Occupational Health Nurses Journal. 2009; 57(9):359–371.

Hohn E. Survey of residents of northwest orchard community shows high levels of perceived pesticide risk and lack of pesticide training. MCN Streamline. 2010; 16(4):4–5.

Huggins TJ, Peace R, Hill SR, Johnston DM, Muñiz AC. Politics of practical and academic knowledge: A Q-method analysis of gauging community disaster resilience. Journal of Contingencies and Crisis Management. 2015; 23(4):246–256.

Hunter WC. Understanding resident subjectivities toward tourism using Q method: Orchid Island, Taiwan. Journal of Sustainable Tourism. 2013; 21(2):331–354.

Johnson BB, Waishwell L. Q method can identify diverse perspectives on 'helpful' information on cancer clusters and inform risk communication generally. Journal of Risk Research. 2014; 17(9): 1125–1145.

Julier, A. The political economy of obesity: The fat pay all. In: Counihan, C., Van Esterik, P., editors. Food and culture: A reader. 2. New York: Routledge; 2008. p. 482-499.

Kaltenthaler K, Miller WJ. The polarized American: Views on humanity and the sources of hyper-partisanship. American Behavioral Scientist. 2012; 56(12):1718–1734.

Kandel WA, Donato KM. Does unauthorized status reduce exposure to pesticides? Evidence from the national agricultural workers survey. Work and Occupations. 2009; 36(4):367–399.

Karcher BC, Balswick JO, Robinson IE. Empiricism, symbolic realism, and the mystique of the extreme. The Sociological Quarterly. 1981; 22(1):93–103.

Keifer M, Salazar MK, Connon C. An exploration of Hispanic workers' perspectives about risks and hazards associated with orchard work. Family and Community Health. 2009; 32(1):34–47. [PubMed: 19092433]

Kramer, B., de Hegedus, P., Gravidus, V. [Accessed 11 Oct 2016] Evaluating a dairy herd improvement project in Uruguay to test and explain Q methodology. AIAEE Proceedings of the 19th Annual Conference. 2003. https://www.aiaee.org/attachments/article/1205/Kramer341.pdf

Liebman AK, Augustave W. Agricultural health and safety: Incorporating the worker perspective. Journal of Agromedicine. 2010; 15(3):192–199. [PubMed: 20665305]

Liebman AK, Juarez PM, Leyva C, Corona A. A pilot program using promotoras de salud to educate farmworker families about the risks from pesticide exposure. Journal of Agromedicine. 2007; 12(2):33–43.

Marquez, EC., Schafer, KS. Kids on the frontline: How pesticides are undermining the health of rural children. Aldern, G., Vander-Molen, K., editors. Oakland: Pesticide Action Network of North America; 2016. http://www.panna.org/resources/kids-frontline [Accessed 30 May 2016]

Martin, B., Richards, E. Scientific knowledge, controversy, and public decision making. In: Jasanoff, S.Markle, GE.Petersen, JC., Pinch, T., editors. Handbook of science and technology studies. London: Sage; 1995. p. 506-526.

Mattson DJ, Clark SG, Byrd KL, Brown SR, Robinson B. Leaders' perspectives in the Yellowstone to Yukon conservation initiative. Policy Sciences. 2011; 4:103–133.

Mayer B, Flocks J, Monaghan P. The role of employers and supervisors in promoting pesticide safety behavior among Florida farmworkers. American Journal of Industrial Medicine. 2010; 53:814–824. [PubMed: 20623642]

Murphy-Greene C, Leip LA. Assessing the effectiveness of executive order 12898: Environmental justice for all? Public Administration Review. 2006; 62(6):679–687.

NASS. Agricultural chemical usage—1997 fruits summary. Vol. Ch 1. USDA National Agricultural Statistics Service; 1998. Ag [July 1998]

NASS. Agricultural chemical usage—2007 field crop summary. Vol. Ch 1. USDA National Agricultural Statistics Service; 2008. Ag [May 2008]

NASS. 2012 Census of Agriculture. USDA National Agricultural Statistics Service; 2012. Table 35: Specified fruits and nuts by acres: 2012 and 2007. http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Washington/st53_1_039_039.pdf [Accessed 16 July 2014]

Nisbet MC. The competition for worldviews: Values, information, and public support for stem cell research. International Journal of Public Opinion Research. 2005; 17(1):90–112.

Nisbet MC, Goidel RK. Understanding citizen perceptions of science controversy: Bridging the ethnographic survey research design. Public Understanding of Science. 2007; 16:421–440.

Oekel, BK. Q methodology and modern marketing research: Part I: fundamentals of the science of subjectivity. Davis Brand Capital: 2009.

Olofsson A, Rashid S. The white (male) effect and risk perception: Can equality make a difference? Risk Analysis. 2011; 31(6):1016–1032. [PubMed: 21232063]

Previte J, Pini B, Haslam-McKenzie F. Q methodology and rural research. Sociologia Ruralis. 2007; 47(2):135–147.

Quandt SA, Arcury TA, Austin CK, Saavedra RM. Farmworker and farmer perceptions of farmworker agricultural chemical exposure in North Carolina. Human Organization. 1998; 57(3):359–368.

Robbins P, Krueger R. Beyond bias? The promise and limits of Q method in human geography. Professional Geographer. 2000; 52(4):636–648.

Roberts N. Wicked problems and network approaches to resolution. International Public Management Review. 2000; 1(1):1–19.

Rohlman, D. Neurobehavioral assessment of pesticide exposure in children. Unpublished data from pesticide survey. Hood River: Oregon State University; 2010.

Rozalia GM. Q factor analysis (Q-methodology) as data analysis technique. Annals of the University of Oradea, Economic Science Series. 2008; 17(4):871–876.

Said, E. Orientalism. New York: Pantheon Books; 1978.

Savage I. Demographic influences on risk perceptions. Risk Analysis. 1993; 13(4):413–420. [PubMed: 8234949]

Schmolck, P. PQ method software (2.33). General Public License; Munich: 2013. http://schmolck.userweb.mwn.de/qmethod/ [Accessed 15 Oct 2013]

Sjoberg, L., Drottz-Sjoberg, BM. Attitudes toward nuclear waste. Rhizikon research report no. 12. Stockholm: Center for Risk Research; 1993.

Slovic P. Public perception of risk. Journal of Environmental Health. 1997; 59(9):22–24.

Slovic P, Kraus NN, Lappe H, Letzel H, Malmfors T. Risk perception of prescription drugs: Report on a survey in Sweden. Pharm Med. 1989; 4:43–65.

Snyder K. Risk perception and resource security for female agricultural workers. Research in Economic Anthropology. 2004; 23:271–292.

Steelman TA, Maguire LA. Understanding participant perspectives: Q methodology in national forest management. Journal of Policy Analysis and Management. 1999; 18(3):361–388.

Stephenson, W. The study of behavior: Q-technique and its methodology. Chicago: University of Chicago Press; 1953.

Stroud NJ. Polarization and partisan selective exposure. Journal of Communication. 2010; 60:556–576.

Tesser A, Conlee MC. Some effects of time and thought on attitude polarization. Journal of Personality and Social Psychology. 1975; 31(2):262–270.

Thompson B, Coronado G, Puschel K, Allen E. Identifying constituents to participate in a project to control pesticide exposure in children of farmworkers. Environmental Health Perspectives. 2001; 109(S3):443–448.

UW PNASH. Unpublished data from expert working group. Seattle: University of Washington Pacific Northwest Agricultural Safety and Health center; 2010.

Washington Friends of Farms and Forests. Mission: 2013. http://www.wafriends.org/ [Accessed 30 May 2016]

Washington State Farmworker Housing Trust. [Accessed 19 Jan 2011] Key facts: Washington's farmworkers. 2008. http://www.farmworkerhousingtrust.org/needs_fact2.html

Watts, S., Stenner, P. Doing Q methodology: Theory, method and interpretation. London: Sage; 2012.

WSU. Unpublished data from pesticide recertification classes. Washington State University-Tree Fruit Research and Education Center; 2010. http://pmtp.wsu.edu/downloads/TurningPoint_Nov-Mar.pdf [Accessed 24 Jan 2011]

Zhang P, Lingard H, Blismas N, Wakefield R, Kleiner B. Work-health and safety-risk perceptions of construction-industry stakeholders using photograph-based Q methodology. Journal of Construction Engineering and Management. 2015; 141(5):1–13.

## Biographies

**Nadine Lehrer,** Ph.D. is a faculty member in Chatham University's Food Studies program. Her work focuses on understanding challenges to sustainable agricultural systems in areas ranging from U.S. agricultural policy to orchard pest management. Nadine holds a B.A. in psychology from Yale University and a Ph.D. in natural resources science and management from the University of Minnesota.

**Gretchen Sneegas** is a doctoral candidate in geography at the University of Georgia. Her dissertation employs Q methodology to examine the formation of environmental subjectivities among farmers in the Marcellus Shale basin as they navigate the uneven impacts of hydraulic fracturing. She holds a Master's in Food Studies from Chatham University, and a B.A. in Theater and Drama, and German, from Indiana University.

## Table 1

Participant demographics by factor

| Characteristics | Skeptics | Acceptors | Incrementalists | Total |
|---|---|---|---|---|
| Number | 22 | 10 | 6 | 38 (3 confounded sorts not included here) |
| Gender | 15 women, 7 men | 10 men | 6 men | 15 women, 23 men |
| Primary language spoken | 13 Spanish (6 bilingual), 9 English (2 bilingual) | 10 English (1 bilingual) | 6 Spanish (1 bilingual) | 19 Spanish (7 bilingual)<br>19 English (3 bilingual) |
| Age | 36% 20–30 years, 64% 40–60 years | 20% 20–30 years, 80% 40–60 years | 50% 20–30 years, 50% 40–60 years | 25–65 (mean age 46) |
| Education | 63% college or graduate degrees | 77% college or graduate degrees | 17% college degree, 83% less than college | Elementary school through graduate school completion (note that educational information was not available for all participants) |
| Professions | Farmers, orchard managers, farmworkers, health and safety educators, extension educators, government representatives, lawyers, farmworker advocates, public health professionals | Farmers, pest management consultants, senior researchers in tree fruit, orchard industry association representatives | Farmers, orchard managers, farmworkers, health and safety educators | Farmers (4)<br>Orchard managers (4)<br>Pesticide applicators (4)<br>Fruit pickers (3)<br>Pest management consultants (5)<br>Other industry personnel (2)<br>Research/extension personnel (3)<br>Educators and trainers (4)<br>Public health professionals (6)<br>Community health workers (3)<br>Lawyers/pesticide safety activists (2)<br>Conservation specialists (1) |
| Worked in their industry >20 years | 18% | 70% | 17% | 35% |
| Has “lots of” direct experience with pesticides | 27% | 90% | 67% | 61% |