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Statistical Analysis of the Worker Engagement Survey Administered at the Worker Safety and Security Team Festival



Adam C. Davis
August 2015

Illustration:

Front Cover – The National Security Sciences Building (TA-03-1400) at Los Alamos National laboratory during the 2015 Worker Safety and Security Team Festival (WSST-fest) on 7/24/2015.

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I. Introduction

The Worker Safety and Security Team (WSST) at Los Alamos National Laboratory holds an annual festival, WSST-fest, to engage workers and inform them about safety- and security-related matters. As part of the 2015 WSST-fest, workers were given the opportunity to participate in a survey assessing their engagement in their organizations and work environments. A total of 789 workers participated in the 23-question survey where they were also invited, optionally, to identify themselves, their organization, and to give open-ended feedback.

The survey consisted of 23 positive statements (i.e. “My organization is a good place to work.”) with which the respondent could express a level of agreement. The text of these statements are provided in Table 1. The level of agreement corresponds to a 5-level Likert scale ranging from “Strongly Disagree” to “Strongly Agree.” In addition to assessing the overall positivity or negativity of the scores, the results were partitioned into several cohorts based on the response meta-data (self-identification, comments, etc.) to explore trends. Survey respondents were presented with the options to identify themselves, their organizations and to provide comments. These options suggested the following questions about the data set.

- 1) Were survey scores negative or positive across the sample?
All questions were asked in a positive manner. Thus, a score of “Strongly Agree” is considered very positive and a score of “Strongly Disagree” is considered very negative.
- 2) Did self-identification matter?
Were respondents who reported their identity more likely to have positive or negative responses relative to anonymous respondents?
- 3) Were commenters and non-commenters significantly different?
Were respondents who provided optional comments more likely to provide positive or negative feedback relative to those who did not?
- 4) Were respondents with negative comments positive or negative in their response to questions?
Scores from respondents with negative comments were tested to determine whether their answers to the survey questions were significantly positive or negative. This can be viewed as a measure of the bias in the survey questionnaire.
- 5) Were respondents with positive comments negative or positive, in their response to questions
This is the opposite of Question 5. Scores from respondents with positive comments were tested to determine whether their answers to the survey questions were significantly positive or negative.
- 6) How do these results compare to those from the annual Safety Conscious Work Environment (SCWE) Survey?

The results of this study were compared to those from the Safety Conscious Work Environment (SCWE) surveys¹ conducted in 2013 and 2014 to determine if there were any areas of significant concern or improvement.

Table 1. Question numbers and text for WSST-fest worker involvement survey.

Question Number	Question Text
Q1	The work training I need is available to me.
Q2	My work makes me feel like I am part of something meaningful.
Q3	I understand how my work is measured.
Q4	I have a safe workplace.
Q5	I feel comfortable raising safety and security concerns to my immediate supervisor.
Q6	I feel comfortable raising safety and security concerns to my group leader.
Q7	I am aware of other avenues for raising safety and security concerns, such as the WSST and the Employee Concerns Program.
Q8	I feel I can raise safety and security concerns without fear of retribution.
Q9	In my workplace, pre-job briefs include all workers performing the work and participation of all workers during these briefings is actively encouraged.
Q10	I believe that the IWDs in my organization help me perform my job more safely.
Q11	My manager cares about my input and concerns.
Q12	Management encourages me to make decisions to solve problems for my customers.
Q13	My leaders create a work environment that helps me to do my job.
Q14	I believe management actively encourages sharing of good practices throughout my organization.
Q15	My management continually encourages reporting of errors/mistakes and actively promotes a team approach to avoid future mistakes/errors.
Q16	My organization operates by strong values and ethics.
Q17	My organization removes obstacles that get in the way of progress.
Q18	I know what my organization is trying to accomplish.
Q19	I know how my organization is progressing.
Q20	I understand how my work fits into the goals and objectives of the organization.
Q21	As it plans for the future, my organization asks for my ideas.
Q22	I believe workers team effectively in my organization.
Q23	My organization is a good place to work.

¹ Davis, Adam C., Booth, Steven, R. "Statistical Analysis of Demographic and Temporal Differences in LANL's 2014 Voluntary Protection Program Survey." Los Alamos National Laboratory. LA-UR-26586

II. Methods

Hypothesis Tests

The previous section identified two types of questions: those concerned with the positivity or negativity of the response scores and those that compare response scores between samples. To measure the positivity or negativity of scores a hypothesis test called a one-sample 2-tailed t-test can be conducted using a t-statistic. A one sample t-test compares an assumption, called the null hypothesis, the average of a data set is equal to some specified value to the alternative hypothesis that the average deviates from that value. In the present case, the null hypothesis states that the average survey response was “neither agree nor disagree” which corresponds numerically to a score of 3. If the average score is determined to be significantly different from 3, it is then examined to determine positivity or negativity.

In the statistical notation this is written as:

$$\begin{aligned} H_0 : \mu_i &= 3 \\ H_1 : \mu_i &\neq 3 \end{aligned} \tag{2.1}$$

Where H_0 is the null hypothesis, H_1 is the alternative hypothesis and μ_i is the mean score for question i.

The result of a t-test, called a p-value, is the probability of falsely rejecting the null hypothesis. In this case, it is the probability of falsely claiming that the average response for a question is not equal to “neither agree nor disagree”. Thus, small p-values imply that the probability of making a mistake is small. In the present analysis the criteria used for rejecting the null hypothesis are $p \leq 0.05$.

The second type of question asked in the previous section compared two subsamples to determine if there are significant differences between them. This is assessed by Welch’s 2-sample 2-tailed t-test for unequal samples. The null hypothesis is that the difference in averages is statistically equal to zero with the alternative being that it differs from zero:

$$\begin{aligned} H_0 : \mu_1 - \mu_2 &= 0 \\ H_1 : \mu_1 - \mu_2 &\neq 0 \end{aligned} \tag{2.2}$$

Research questions 1, 4 and 5 explored the positivity or negativity of a subset of the survey sample. Thus, these questions were addressed by means of a 1-sample t-test for the hypothesis that the mean score on each question was significantly different from “Neither agree nor disagree.” The remaining research questions (2, 3, and 6) compared the average response scores for different subsets. These questions were answered by means of Welch’s two-sample t-test for uneven samples.

Comparison of SCWE data with WSST-Fest survey data.

The annual safety-conscious work environment (SCWE) survey consists of 33 questions relating to safety in the workplace. A number of questions in the SCWE study overlap those in the WSST-fest survey. These overlapping questions were identified and their scores were combined

using an inverse-variance weighted average. The scores for each year were similarly weighted and combined.

The assessment of question similarity between the SCWE and WSST-Fest surveys was conducted by comparing the text of each question and identifying questions that shared themes. In some cases, this was very clear; WSST-Fest survey question 8: “I feel can raise safety and security concerns without fear of retribution” corresponds closely to SCWE-survey question 9: “I can raise safety issues without fear of retaliation.” Some of the WSST-Fest survey questions were more general than the SCWE survey questions, necessitating a combination of results. An example is WSST-Fest survey question 11: “My manager cares about my input and safety concerns.” Determining the correspondence between this question and specific SCWE-survey questions is an exercise in interpretation as it corresponds to elements of several questions. Further, in the case of retaliation, a number of questions were identified during the SCWE analysis that pertained to retaliation; in order to compare these SCWE questions to their relevant WSST-fest survey questions. An inverse-variance weighting scheme was used.

Inverse-Variance Weighting

For the questions where combination of scores was necessary, a weighted average was taken in which the weights were derived from the inverse variance of each score:

$$w_i = \frac{\frac{1}{\sigma^2(d_i)}}{\sum_{j=i}^k \frac{1}{\sigma^2(d_i)}} \quad (2.3)$$

Where d_i is the survey score for each question to be combined and σ^2 is the variance. The weighted average of the survey scores, then is given by:

$$\hat{d} = \sum_{i=1}^k w_i d_i \quad (2.4)$$

With a variance of:

$$\sigma^2(\hat{d}) = \frac{1}{\sum_{j=i}^k \frac{1}{\sigma^2(d_i)}} \quad (2.5)$$

The advantage of this approach is that it weights the scores by their uncertainty, thus leading to a smaller variance in the final combined estimate.²

Scoring Methodology for Negative Comments

Survey respondents had the opportunity to optionally provide comments at the end of the survey which resulted in 58 meaningful responses. These comments were compiled and rated on

² Hedges, Larry V., Olkin, Ingram. *Statistical Methods for Meta-Analysis*. Academic Press, Orlando, 1985.

a scale of -3 to 3 with -3 being the most negative and 3 being the most positive. The rationale for assigning scores to the various comments is presented in Table 2.

Table 2. Rationale for assigning scores to optional comments.

Score	Criterion
3	Very positive comments/good personal experiences
2	Purely positive comments
1	Mixed but generally positive comments
0	Neither positive nor negative
-1	Mixed or general/institutional negative comments
-2	Purely negative comments
-3	Very negative comments/bad personal experiences

Comments of “None,” “no,” or the like were omitted. Despite the guidelines set out in Table 2 the score assignment for the comments are based on interpretation and should not be taken as hard truth; rather, the scores are intended to provide a quick summary of overall feeling presented by the comments. The distribution of the comments scores will be presented in the appropriate section.

Because of the subjectivity in the comment scores, only positivity and negativity were used in the hypothesis testing comparing comments to scores; comments with scores greater than 0 were considered positive and those with scores less than 0 were considered negative.

II. Results

The overall scores for all questions were very positive. In all cases, more than half of respondents either agreed or strongly agreed with the positive statements in the survey and in many cases, this was true for more than 70% of the respondents. The response scores are shown in Table 3 the proportion of each score for each question is shown

. The question averages were strongly significantly positive (with a score of agree or better) with negligible p values of less than 10^{-12} . In all results reported here, a p-value of 0.05 is used as the cutoff for significance.

Table 3. Average Response Results for entire sample. All values were significantly positive with negligible p-values of less than 10^{-12} (not shown).

Question	Average	SD	Count	Margin of Error
Q1	4.08	0.87	785	2.8%
Q2	4.02	0.90	784	2.8%
Q3	3.68	0.99	784	2.8%
Q4	4.27	0.71	776	2.8%
Q5	4.33	0.80	769	2.8%
Q6	4.24	0.85	765	2.8%
Q7	4.29	0.66	776	2.8%
Q8	4.07	0.93	764	2.8%
Q9	3.96	0.83	739	2.9%
Q10	3.71	0.93	731	2.9%
Q11	4.05	0.96	768	2.8%
Q12	4.07	0.90	760	2.8%
Q13	3.92	0.99	767	2.8%
Q14	3.95	0.95	753	2.9%
Q15	3.92	0.97	744	2.9%
Q16	3.90	0.99	746	2.9%
Q17	3.59	1.04	743	2.9%
Q18	4.01	0.87	745	2.9%
Q19	3.71	1.00	743	2.9%
Q20	3.98	0.88	747	2.9%
Q21	3.58	1.14	733	2.9%
Q22	3.84	1.01	737	2.9%
Q23	3.98	1.00	729	2.9%

Sample size and its implications

Of the 789 respondents, there were 633 fully-completed surveys. The average response count on a single question was 756 with a standard deviation of 17.6 and a maximum response count of

Figure 1. Distribution of Scores for Worker Involvement Survey

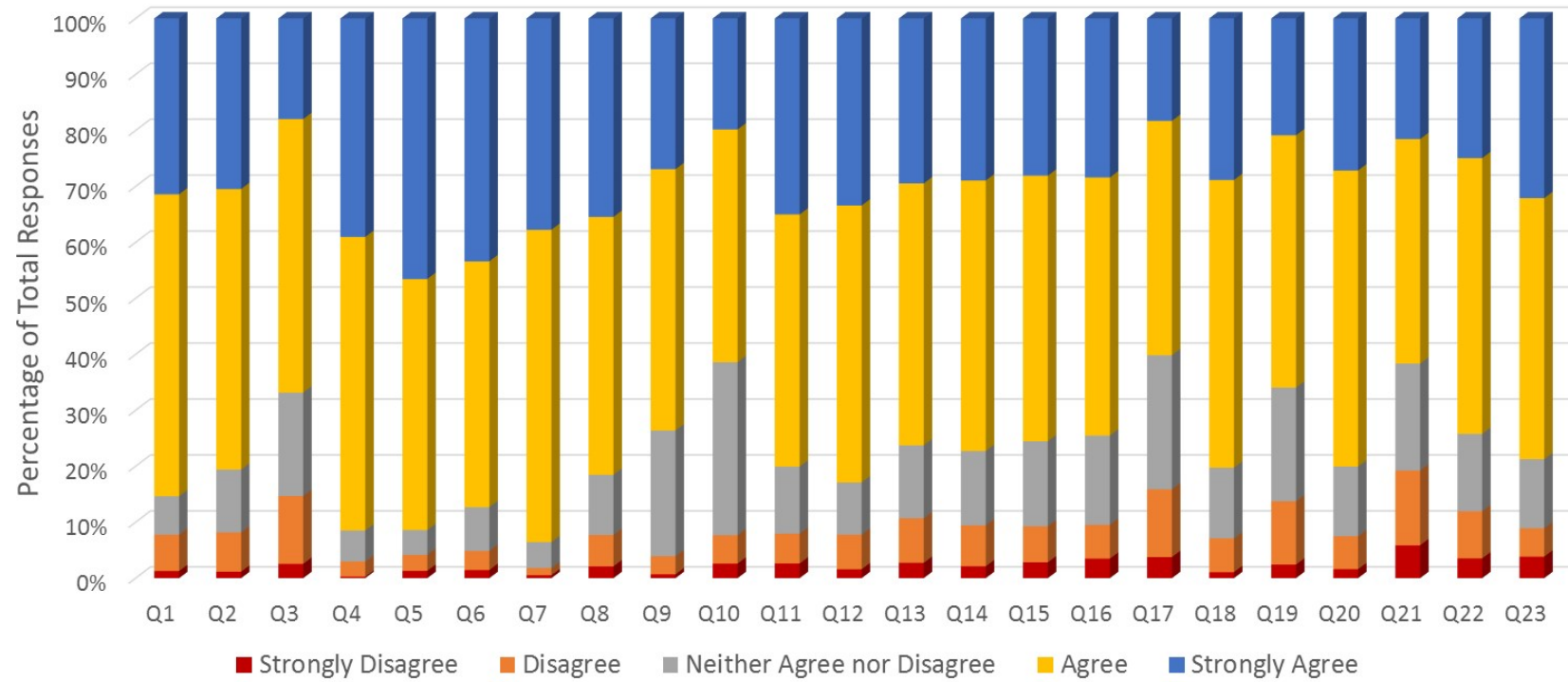


Table 4. Question number and text provided for reference

Question Number	Question Text
Q1	The work training I need is available to me.
Q2	My work makes me feel like I am part of something meaningful.
Q3	I understand how my work is measured.
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Q6	I feel comfortable raising safety and security concerns to my group leader.
Q7	I am aware of other avenues for raising safety and security concerns, such as the WSST and the Employee Concerns Program.
Q8	I feel I can raise safety and security concerns without fear of retribution.
Q9	In my workplace, pre-job briefs include all workers performing the work and participation of all workers during these briefings is actively encouraged.
Q10	I believe that the IWDs in my organization help me perform my job more safely.
Q11	My manager cares about my input and concerns.
Q12	Management encourages me to make decisions to solve problems for my customers.
Q13	My leaders create a work environment that helps me to do my job.
Q14	I believe management actively encourages sharing of good practices throughout my organization.
Q15	My management continually encourages reporting of errors/mistakes and actively promotes a team approach to avoid future mistakes/errors.
Q16	My organization operates by strong values and ethics.
Q17	My organization removes obstacles that get in the way of progress.
Q18	I know what my organization is trying to accomplish.
Q19	I know how my organization is progressing.
Q20	I understand how my work fits into the goals and objectives of the organization.
Q21	As it plans for the future, my organization asks for my ideas.
Q22	I believe workers team effectively in my organization.
Q23	My organization is a good place to work.

785. Assuming a random sample, and based on a 5-level multinomial response and a 95% confidence interval, the margin of error for each question is about 2.9%.

Did self-identified responses differ from anonymous responses?

One of the first questions this analysis sought to answer was whether or not respondents who identified themselves had, on average, significantly different average responses from those who chose to remain anonymous. Table 5 shows that the scores for most questions, surveys whose respondents identified themselves was significantly higher than those who chose to remain anonymous. For question 10, “I believe that the IWDs in my organization help me perform my job more safely,” there was no significant difference.

Table 5. Scores, differences and p-values for anonymous and self-identified respondents. 95% Lower and Upper refer to the 95% confidence interval about the difference of averages. For questions whose average answer scores were significantly higher among self-identified respondents at or below the 0.05 level, the p-value cell is shaded green. Unshaded p-values imply that no significant difference was found.

Question	Self-Identified	Anonymous	Difference	95% Lower	95% Upper	p-value
Q1	4.4	4.0	0.4	0.2	0.5	0.000
Q2	4.3	4.0	0.3	0.2	0.5	0.000
Q3	4.0	3.6	0.3	0.2	0.5	0.000
Q4	4.5	4.2	0.2	0.1	0.3	0.002
Q5	4.5	4.3	0.2	0.0	0.4	0.012
Q6	4.5	4.2	0.3	0.1	0.4	0.001
Q7	4.4	4.3	0.2	0.0	0.3	0.017
Q8	4.3	4.0	0.3	0.2	0.5	0.000
Q9	4.2	3.9	0.3	0.1	0.4	0.000
Q10	3.8	3.7	0.1	-0.1	0.3	0.172
Q11	4.3	4.0	0.3	0.2	0.5	0.000
Q12	4.4	4.0	0.4	0.2	0.5	0.000
Q13	4.3	3.9	0.4	0.3	0.6	0.000
Q14	4.3	3.9	0.4	0.3	0.6	0.000
Q15	4.3	3.8	0.4	0.3	0.6	0.000
Q16	4.2	3.8	0.4	0.2	0.6	0.000
Q17	3.9	3.5	0.4	0.2	0.6	0.000
Q18	4.3	4.0	0.3	0.2	0.5	0.000
Q19	4.0	3.6	0.4	0.2	0.6	0.000
Q20	4.2	3.9	0.3	0.2	0.5	0.000
Q21	4.0	3.5	0.5	0.3	0.7	0.000
Q22	4.1	3.8	0.4	0.2	0.5	0.000
Q23	4.4	3.9	0.5	0.3	0.6	0.000

Neutral scores on question 10 reflect an often-repeated sentiment in the comments; many jobs do not require IWDs, thus a score of neither agree nor disagree would be appropriate.

Comments and their Relationship to Survey Scores

Respondents were provided with the option to leave a comment at the end of the survey. As shown in **Table 6**, respondents who provided comments were found, on average, to have

Table 6. Results of Commenters vs. non-commenters. For questions whose average answer scores were significantly lower among commenters at or below the 0.05 level, the p-value cell is shaded red. Unshaded p-values imply that no significant difference was found. There were 5 positive commenters and 44 negative commenters.

Question	Comment	No Comment	Difference	95% Lower	95% Upper	p-value
Q1	3.9	4.1	-0.27	-0.50	0.04	0.098
Q2	3.5	4.1	-0.52	-0.83	-0.21	0.001
Q3	3.3	3.7	-0.37	-0.68	-0.06	0.020
Q4	3.9	4.3	-0.37	-0.61	-0.09	0.009
Q5	4.2	4.3	-0.09	-0.33	0.16	0.492
Q6	4.1	4.3	-0.19	-0.47	0.10	0.196
Q7	4.3	4.3	-0.03	-0.20	0.14	0.735
Q8	3.8	4.1	-0.32	-0.63	-0.02	0.037
Q9	3.6	4.0	-0.39	-0.65	-0.13	0.004
Q10	3.1	3.8	-0.65	-0.92	-0.29	0.000
Q11	3.7	4.1	-0.39	-0.73	-0.05	0.027
Q12	3.8	4.1	-0.27	-0.60	0.06	0.103
Q13	3.5	4.0	-0.49	-0.83	-0.16	0.004
Q14	3.5	4.0	-0.49	-0.83	-0.15	0.006
Q15	3.5	3.9	-0.44	-0.77	-0.11	0.010
Q16	3.5	3.9	-0.47	-0.77	-0.13	0.007
Q17	2.8	3.7	-0.81	-1.14	-0.51	0.000
Q18	3.8	4.0	-0.24	-0.53	0.05	0.100
Q19	3.3	3.7	-0.51	-0.81	-0.18	0.003
Q20	3.7	4.0	-0.30	-0.60	0.01	0.054
Q21	2.9	3.6	-0.73	-1.10	-0.35	0.000
Q22	3.5	3.9	-0.38	-0.70	-0.06	0.020
Q23	3.5	4.0	-0.5	-0.9	-0.2	0.006

significantly less positive results than those who provided no comments. It should be noted that, though the commenters were less positive than the non-commenters, for the majority of

questions, their average responses were not negative. This is demonstrated in Table 7 showing that the positive commenters had significantly positive scores, and in Table 8 showing that negative commenters had only two significantly negative scores, with the remainder being either significantly positive or neutral.

Table 7. Average scores among the 5 respondents who provided positive comments. For questions whose average answer scores were significantly positive at or below the 0.05 level, the p-value cell is shaded green. Confidence intervals that exceeded a score of 5 are shown as “>5.”

Question	Average	95% Lower	95% Upper	p-value
Q1	4.6	3.9	>5	0.003
Q2	4.4	3.7	>5	0.005
Q3	4.4	3.7	>5	0.005
Q4	4.4	3.7	>5	0.005
Q5	4.4	3.7	>5	0.005
Q6	4.4	3.7	>5	0.005
Q7	4.4	3.7	>5	0.005
Q8	4.4	3.7	>5	0.005
Q9	4.4	3.7	>5	0.005
Q10	4	3.1	4.9	0.034
Q11	4.6	3.9	>5	0.003
Q12	4.6	3.9	>5	0.003
Q13	4.6	3.9	>5	0.003
Q14	4.6	3.9	>5	0.003
Q15	4	3.1	4.9	0.034
Q16	4.6	3.9	>5	0.003
Q17	4.2	3.6	4.8	0.004
Q18	4.4	3.7	>5	0.005
Q19	4.2	3.6	4.8	0.004
Q20	4.4	3.7	>5	0.005
Q21	4.4	3.7	>5	0.005
Q22	4.5	3.6	>5	0.014
Q23	4.4	3.7	>5	0.005

Five individuals chose to leave positive feedback. These comments tended to be of a general nature providing no specifics. The comments are as follows:

- 1) “The Laboratory continues to be a great place to work and is truly concerned about our health and well being (sic). Negative press will continue but if we come together as a united workforce we can once again achieve the high standards we were once

- regarded with. I may be becoming a minority but I am proud to say I work for the Los Alamos National Laboratory.”
- 2) “Great job”
 - 3) “Great job promoting safety”
 - 4) “Thank you!”
 - 5) “I love my job”

Nine comments were neutral in tone (i.e. “Questions regarding IWDs are N/A for my work”) and the remaining 44 comments were negative in tone. The degree of negativity in the comment is addressed in the next section.

Table 8. Average scores among the 44 respondents who provided negative comments. For questions whose average answer scores were significantly positive at or below the 0.05 level, the p-value cell is shaded green. P-values for significantly negative scores are shaded red. P-values for insignificant scores are not shaded.

Question	Average	95% Lower	95% Upper	p-value
Q1	3.74	3.44	4.05	0.000
Q2	3.40	3.03	3.76	0.033
Q3	3.21	2.86	3.57	0.229
Q4	3.90	3.61	4.20	0.000
Q5	4.24	3.93	4.54	0.000
Q6	4.02	3.66	4.39	0.000
Q7	4.26	4.07	4.46	0.000
Q8	3.71	3.35	4.08	0.000
Q9	3.63	3.31	3.94	0.000
Q10	3.10	2.73	3.47	0.593
Q11	3.45	3.04	3.86	0.031
Q12	3.68	3.28	4.07	0.001
Q13	3.29	2.92	3.67	0.123
Q14	3.28	2.89	3.68	0.155
Q15	3.39	3.00	3.78	0.051
Q16	3.29	2.93	3.65	0.116
Q17	2.62	2.28	2.96	0.028
Q18	3.69	3.36	4.02	0.000
Q19	3.07	2.72	3.43	0.685
Q20	3.58	3.23	3.92	0.002
Q21	2.53	2.12	2.93	0.022
Q22	3.27	2.92	3.61	0.125
Q23	3.24	2.80	3.69	0.275

Significantly positive scores in the negative-comment cohort do not *necessarily* imply bias; the survey was designed to measure different aspects of worker engagement and most negative

comments dealt with single issues that were covered by a single question. However, the possibility of acquiescence bias should not be ignored; acquiescence bias is briefly discussed in the conclusions section.

The comments with significantly negative scores were Question 17: “My organization removes obstacles that get in the way of progress” and Question 21: “As it plans for the future, my organization asks for my ideas.”

Distribution of Comment Scores

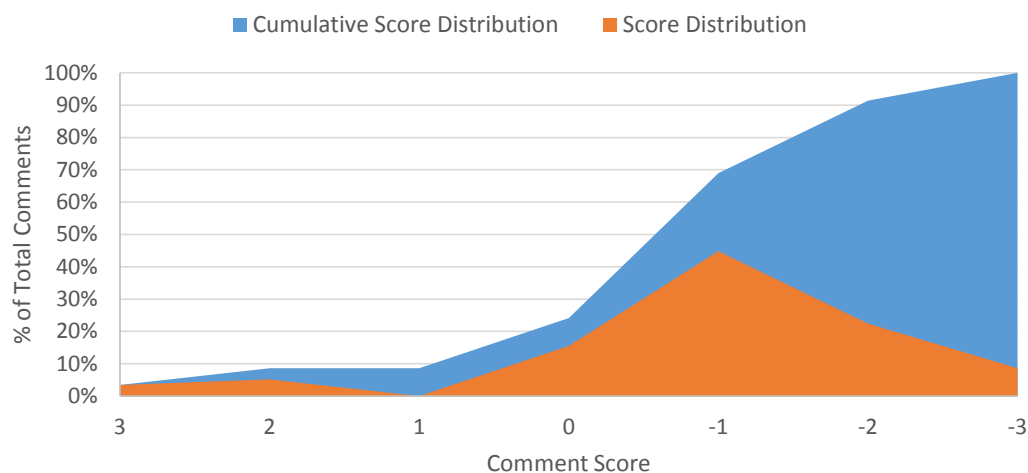
Approximately 9% of the fully completed surveys included comments. The comments varied in their degree of positivity or negativity. This variation was scored according to criteria listed in Table 9. It is reiterated that the comment scores were assigned subjectively and that different readers may assign the scores differently.

Table 9. Rationale for assigning scores to optional comments. (Reprint of Table 1)

Score	Criterion
3	Very positive comments/good personal experiences
2	Purely positive comments
1	Mixed or general/institutional positive comments
0	Neither positive nor negative
-1	Mixed or general/institutional negative comments
-2	Purely negative comments
-3	Very negative comments/bad personal experiences

The distribution of comment scores is shown in Figure 2.

Figure 2. Distribution of comments scored according to the criteria detailed in Table 9. A comment score of 3 indicates a very positive comment while a comment score of -3 indicates a very negative comment. Cumulative distribution of scores is shown for reference.



This figure shows that the most frequent type of comment was a mild negative comment either of a general nature or mitigated by a weaker positive comment. Roughly 9% of the comments were scored at the -3 level. These comments were extremely negative and in some cases implied first-hand experiences of retaliation. A few of the -1-rated comments had good things to say about their immediate supervisors and groups but were critical of their division or the larger lab environment. A number of the negative comments focused on communication between managers and staff members.

Approximately 76% of the comments were negative, with approximately 16% being neutral. Of the negative commenters, 7 self-identified. None of the self-identified respondents made comments that scored in the -2 or -3 range which signified the strongest critical comments. There were several commenters in this range who identified their organization; one of the more concerning comments actively refused to identify their organization by saying “If I answered this, there would be negative consequences for me.” Respondents entered their organizations in non-standard ways making it difficult to analyze effects between organizations. A cursory examination of the identified organizations showed no clear majority, though ADBI and ADESH were among the most identified organizations. The comments elicited by this survey are valuable and should be considered when discussing the survey-score results.

Comparison of results with representative SCWE data

Voluntary Protection Program (VPP) surveys were conducted in 2013 and 2014 to assess the degree to which workers at Los Alamos National Laboratory feel that their safety is valued by their management and peers. Several questions from these safety conscious work environment (SCWE) surveys overlapped concepts in the WSST-fest worker engagement study. The WSST-fest survey questions that had SCWE-survey analogs (and their scores) are listed in Table 10 along with a list of SCWE-survey question numbers. Retribution/Retaliation was explored as a part of the analysis of the 2014 SCWE data; the analogs for question 8 were identified as part of that work. The other analogs were subjectively selected by comparing question texts. The relevant SCWE question texts and scores are provided in Table 11. To compare the questions from the two surveys, as discussed above, the inverse-variance-weighted survey scores, called meta-scores were calculated. Table 12 shows the average score for the relevant WSST-fest survey question along with the meta-scores derived from the 2013 and 2014 SCWE surveys. When comparing the average scores in Table 12 several of the of the WSST-fest survey scores deviated significantly from the average SCWE meta-scores. Five of the scores were higher than both years’ results from the SCWE survey (5,6,7,8,9), four were lower (14,15,21,22) and four were statistically indistinguishable (10,11,18,19).

Table 10. Questions from WSST-fest survey with analogs in the SCWE survey. Analogs for retribution (question 8) were identified as part of the 2014 SCWE analysis.

Question Number	Avg. Score	St. Dev.	WSST-fest Survey Question	SCWE Analog Questions
5	4.3	0.80	I feel comfortable raising safety and security concerns to my immediate supervisor.	4,8,10,23
6	4.2	0.85	I feel comfortable raising safety and security concerns to my group leader.	4,8,10,23
7	4.3	0.66	I am aware of other avenues for raising safety and security concerns, such as the WSST and the Employee Concerns Program.	7,18
8	4.1	0.93	I feel I can raise safety and security concerns without fear of retribution.	7,8,9,10, 20,22,23, 32,33
9	4.0	0.83	In my workplace, pre-job briefs include all workers performing the work and participation of all workers during these briefings is actively encouraged.	16
10	3.7	0.93	I believe that the IWDs in my organization help me perform my job more safely.	13
11	4.0	0.96	My manager cares about my input and concerns.	1,4,5,8,9,10
14	3.9	0.95	I believe management actively encourages sharing of good practices throughout my organization.	1,3,28,
15	3.9	0.97	My management continually encourages reporting of errors/mistakes and actively promotes a team approach to avoid future mistakes/errors.	1,3,4,5,23,
18	4.0	0.87	I know what my organization is trying to accomplish.	16
19	3.7	1.00	I know how my organization is progressing.	16
21	3.6	1.14	As it plans for the future, my organization asks for my ideas.	8
22	3.8	1.01	I believe workers team effectively in my organization.	16,17,19

Table 11. Relevant questions from the SCWE study, and their scores in 2013 and 2014, provided for reference.

SCWE Question	Avg. (2013)	St. Dev (2013)	Avg. (2014)	St. Dev (2014)	SCWE Question Text
1	4.11	0.86	4.04	0.88	My manager demonstrates their commitment to safety through their actions and behaviors.
3	4.02	0.94	3.96	0.96	My manager supports programs and tools to minimize consequences of human error (examples of tools include Behavior-Based Safety, Human Performance Improvement, or layers of defenses).
4	3.41	1.14	3.61	1.06	My supervisor (e.g. team leader, foreman, group leader) spends time observing and mentoring employees in their workspaces.
5	4.18	0.93	4.21	0.88	My manager listens to me when I raise safety concerns.
7	4.06	0.86	4.01	0.90	There are a variety of methods available to me for raising safety issues and offering suggestions for improvement.
8	4.10	0.99	4.03	0.97	My manager fosters open, two-way communication with workers.
9	4.19	0.99	4.09	1.01	I can raise safety issues without fear of retaliation.
10	3.95	1.03	3.95	0.96	I am comfortable reporting significant unintended failures and errors.
13	3.74	0.99	3.74	0.95	The procedures that I use are written clearly.
14	4.13	0.93	4.09	0.92	When a procedure cannot be followed as written, I am comfortable with pausing work.
16	3.93	1.02	3.88	0.97	Teamwork and open communication are the norm.
17	4.05	0.92	3.99	0.90	My co-workers and I listen to each other and differing opinions are respected.
18	3.92	1.04	3.95	0.99	I am familiar with my Directorate or Division level Worker Safety and Security Team (WSST).
19	4.19	0.86	4.18	0.83	My co-workers and I support one another.
23	4.00	1.00	3.97	0.95	My manager encourages, values, and creates a safe atmosphere for reporting safety issues.
28	4.05	0.92	4.03	0.92	My manager maintains a strong focus on the safe conduct of work.

Table 12. Comparison of WSST-fest survey questions and SCWE analogs. Colored boxes represent results of hypothesis tests where the difference between the weighted SCWE score and the WSST-fest survey score had a p-value of <0.05. Red indicates the SCWE score was lower than the WSST-fest survey and green indicates the SCWE score was higher than the WSST-fest survey.

Q #	WSST-fest Survey (Table 10.)		Weighted Average of SCWE Questions from Table 11 (2013)		Weighted Average of SCWE Questions from Table 11(2014)	
	Avg. Score	St. Dev	Avg. Score	St. Dev	Avg. Score	St. Dev
5	4.3	0.80	4.0	0.58	4.0	0.56
6	4.2	0.85	4.0	0.58	4.0	0.56
7	4.3	0.66	4.0	0.66	4.0	0.66
8	4.1	0.93	3.9	0.33	3.9	0.33
9	4.0	0.83	3.9	1.02	3.9	0.97
10	3.7	0.93	3.7	0.99	3.7	0.95
11	4.0	0.96	4.1	0.47	4.1	0.47
14	3.9	0.95	4.1	0.52	4.0	0.53
15	3.9	0.97	4.1	0.46	4.0	0.46
18	4.0	0.87	3.9	1.02	3.9	0.97
19	3.7	1.00	3.9	1.02	3.9	0.97
21	3.6	1.14	4.1	0.99	4.0	0.97
22	3.8	1.01	4.1	0.53	4.0	0.52

IV. Conclusion

This work sought to answer a number of questions about the worker engagement survey administered at the 2015 Worker Safety and Security Team Festival (WSST-Fest). These questions, and summarizing answers are provided below:

- 1) Were survey scores negative or positive across the sample?
Respondents were overwhelmingly positive in their responses to the surveys. However, there was a small but significant cadre of respondents who were not as positive.
- 2) Were Respondents who self-identified measurably different from those who did not?
Respondents who chose to identify themselves were significantly positive for all questions except for question 10 “I believe that the IWDs in my organization help me perform my job more safely.” for which they were neutral. Many comments mentioned that their jobs did not use IWDs, thus likely explaining this neutral score.
- 3) Were commenters and non-commenters significantly different?

Scores for respondents who provided comments scored 16 of the 23 questions less positively than those who did not. The scores for the two groups on the remaining 7 questions were indistinguishable.

- 4) Were Respondents with negative comments positive or negative in their response to questions?

Respondents with negative comments were largely positive in their responses, though not as positive as respondents who made positive comments or those who made no comment. Nine questions were statistically neutral (not significantly different from “neither agree nor disagree”) and two questions, 17 (“My organization removes obstacles that get in the way of progress.”) and 21 (“As it plans for the future, my organization asks for my ideas.”) were significantly negative reflecting two common sentiments in from the negative comments.

- 5) Were Respondents with positive comments negative or positive, in their response to questions

Positive commenters were very positive in their responses, though not as positive as non-commenters. This may suggest that commenters took the survey more seriously and tried to provide useful feedback.

- 6) How do these results compare to those from the annual Safety Conscious Work Environment (SCWE) Survey?

To compare the WSST-fest survey data with the SCWE results, an attribute level approach was taken; individual WSST-fest survey questions were compared to a weighted average of relevant SCWE questions. Thirteen WSST-fest survey questions were found to have relevant analogs in the SCWE survey. Five of the WSST-fest survey question scores were higher than the SCWE survey (5,6,7,8,9), four were lower (14,15,21,22) and four were statistically indistinguishable (10,11,18,19).

It should be noted that, because the survey comprised only positively-phrased questions, the results may be subject to a phenomenon called acquiescence bias which can lead to overly optimistic results.³ There are several ways to avoid this, such as using an equal number of positively- and negatively-phrased questions⁴ or by presenting a “forced-choice” format⁵ in which the respondent chooses between two or more stated options. In example, instead of having the respondent rate their level of agreement with question 23 “My organization is a good place to work,” they could be forced to choose between five options ranging from to “My organization is a bad place to work” to “My organization is a good place to work.”

³ Podsakoff, P.M., MacKenzie, S.B., Lee, J., Podsakoff, N.P. (2003) Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903.

⁴ Erikson, Robert (2011). Eric, Stano, ed. *American Public Opinion*. Tedin, Kent L. US: Pearson Education Inc. p. 44.

⁵ Questionnaire Design. (n.d.) *Pew Research Center*. Accessed: 21 Aug. 2015 Retrieved from: <http://www.pewresearch.org/methodology/u-s-survey-research/questionnaire-design/>

Many of the comments provided specific and valuable feedback about worker engagement in their organization. There are a number of important takeaways from the comments and perhaps from the results in general:

- a) A number of workers who do not feel as though their voices are heard (see comments 4, 15, 16, 25, 30, 34, 36, 37, 38, 39, and 40 in the appendix, provided separately)
- b) Some workers feel that their jobs are being impeded by tightening safety regulations that they do not understand (see comments 10, 14, 28, 39, 22, and 42 in the appendix, provided separately) in the appendix, provided separately.)
- c) Others feel that they are pressured to perform under conditions that compromise their safety (see comments 8, 27, and 31 in the appendix, provided separately).

Due to the sensitive nature of the comments, the meta-data for this survey, including comments, and the identities of self-identified respondents will be provided in a separate appendix.