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Establishing the Reliability and Validity of the Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire

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16. Abstract

Though the majority of Part 121 flights are operated by airlines that have FAA-approved Flight Operations Quality Assurance (FOQA) programs, only 17% of the smaller carriers have them. A recent report cited pilots' concerns about data misuse as one of the primary factors preventing participation in voluntary safety programs (GAO, 2010). Thus, increased participation in FOQA may depend on gaining insight into pilots' perceptions and developing strategies to mitigate their concerns. The present study is an evaluation of the reliability and validity of the Perceptions of Flight Operations Quality Assurance (PFOQA) questionnaire scales. The PFOQA scales were based on the assumption that negative and positive perceptions of FOQA programs represent two distinct dimensions consisting of expectations about positive safety enhancements and concerns about data misuse. Though the Positive Perceptions Scale (=.86) and the Negative Perceptions Scale (=.88) both demonstrated good internal consistency reliability, the results of Principal Components Analysis and Content Analysis suggest that the PFOQA items may not represent a sufficient sample of pilots' expectations and concerns in order to draw valid inferences about their perceptions of *existing* FOQA programs. Rather, the PFOQA questionnaire seems best suited for assessing pilots' attitudes *prior to* FOQA implementation. Providing feedback on questionnaire results and communicating how the airline plans to address pilots' concerns can set the stage for a positive program introduction. Certainly, the potential safety benefits of FOQA programs justify efforts to understand and mitigate negative perceptions that might prevent their adoption.

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Establishing the Reliability and Validity of the Perceptions of Flight Operations Quality Assurance Questionnaire

The Flight Safety Foundation (FSF) defines Flight Operations Quality Assurance (FOQA) as a program "for obtaining and analyzing data recorded in flight to improve flight crew performance, air carrier training programs and operating procedures, airport maintenance and design, and aircraft operations and design" (Enders, 1993, p.1). Under Title 14 of the Code of Federal Regulations (CFR) Part 13, §13.401, the FAA broadens the definition for regulatory purposes to include "routine collection and analysis of digital flight data gathered during aircraft operations." FOQA programs evolved from accident investigation practices using Flight Data Recorders (FDRs), which were mandated by the Civil Aeronautics Administration in 1958. Technological advances in data recording, such as Quick Access Recorders (QARs) and Digital Flight Data Recorders (DFDRs), in conjunction with improved data management capabilities, enabled the analysis of routine data in an effort to avert accidents and incidents by identifying unsafe practices or conditions falling outside optimal operating parameters.

A report published by the U.S. Government Accountability Office (GAO) in 1997 indicated that airlines' early experience with FOQA programs was positive. According to this report, FOQA programs not only enhanced safety but also provided economic benefits because they were "better able to achieve optimum fuel consumption and avoid unneeded engine maintenance. Although more difficult to quantify, enhanced safety should result in lower costs over time as a result of accidents avoided and lower insurance premiums" (GAO, 1997, p.2). Despite safety and economic benefits, as well as endorsements by the International Civil Aviation Organization (ICAO), the Federal Aviation Administration (FAA), the National Transportation Safety Board (NTSB), and Congress, voluntary FOQA participation has remained limited in the United States, particularly among small-scale operators.

Though the majority of Part 121 flights are operated by airlines that have FAA-approved FOQA programs, only 17% of the smaller carriers have them (GAO, 2010). Reservations about FOQA participation expressed by some pilots and airline officials include concerns that FOQA data might be used for enforcement, released in response to Freedom of Information Act (FOIA) requests, or civil litigation. Two regulations address these concerns: The first states that the FAA will not use data obtained from an approved FOQA program for the purpose of enforcement except in the case of criminal or deliberate acts (14 CFR §13.401). The second provides that voluntarily-submitted information will not be disclosed in response to a FOIA request (14 CFR §193). On the other hand, civil litigation disclosure remains a risk because the FAA cannot restrict the authority of courts through regulation, and legal precedents are mixed (for a thorough discussion of discovery-related court actions, see GAO, 1997, Appendix V).

A recent report cited pilots' concerns about data misuse as one of the primary factors preventing participation in voluntary safety programs (GAO, 2010). These concerns may extend to the organizations for which they work, even though the threat of enforcement action or FOIA disclosure has been removed. Pilot participation directly affects voluntary reporting programs, such as the Aviation Safety Action Program (ASAP). The impact on FOQA programs is more subtle and indirect. Resentment and concerns about data misuse may make pilots resistant to training and procedural initiatives based on FOQA data. Considered in conjunction with pressure from pilot unions, airlines might find it difficult to justify the initial investment of implementing and maintaining a FOQA program if they are dubious about its benefits. Thus, increased participation in FOQA programs may depend on gaining insight into pilots' perceptions and developing strategies to mitigate their concerns.

The Perceptions of Flight Operations Quality Assurance (PFOQA) questionnaire[1] was designed to elicit pilots' level of agreement with a series of statements about FOQA programs using a format widely recognized as one of the best for collecting information about attitudes (Nunnally, 1978). Questionnaire items were based on data concerns and recommendations proposed by the Flight Safety Foundation FOQA Task Force and reported in the 1997 GAO report. They were organized into two scale dimensions: Positive Perceptions and Negative Perceptions. As shown in Table 1, the Positive Perceptions Scale comprises expectations and beliefs about positive safety enhancements of FOQA programs. Items in the Negative Perceptions Scale address data misuse and organizational trust issues. The present study is an evaluation

[1]FOQA was developed by Thomas R. Chidester, Manager of the FAA Aerospace Human Factors Research Division, and Thomas C. Accardi, Director of FAA Aviation System Standards.

Table 1. ***Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire Items***

Positive Perceptions Scale (9 Items)
01 FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.
04 Flying skills have improved or will improve with a FOQA program in place.
06 I expect FOQA data to be used to take action to correct safety problems.
07 I expect FOQA data to be used to improve pilot training.
08 I expect FOQA data to be used to optimize maintenance.
10 I expect FOQA data to be used to change cockpit procedures.
11 I expect FOQA data to provide our pilot group with useful feedback on our performance.
12 I expect FOQA data to be used to change procedures outside our organization (such as in Air Traffic Control).
13 I expect the FOQA program to positively impact the safety of our operations.
Negative Perceptions Scale (7 Items)
02 (Reflected) Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedances.
03 (Reflected) I trust management will not misuse FOQA data against individual pilots.
05 I worry that FOQA data will be a source of information for enforcement action against pilots.
09 I worry that FOQA data will be used for disciplinary actions.
14 A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.
15 I worry that FOQA data could be released under the Freedom of Information Act.
16 I worry that FOQA data could be released through civil litigation.

NOTE: In the computation of the Negative Perceptions Scale, the two reflected items (02 and 03) are scored as if they were written in reverse (i.e., "Gatekeepers are [NOT] the only persons able to access identifying information…" and "I [DON'T] trust management…").

of the reliability and validity of the PFOQA scales as a measure of pilots' perceptions of FOQA programs. Several procedures will be employed in this effort: Internal Consistency Reliability Analysis, Principal Components Analysis, and Content Analysis.

Internal Consistency Reliability Analysis determines the extent to which scale items appear to measure the same attitudinal dimension. Theoretically, participants' responses will be consistent within scales when test items represent a random sample of all possible items within a particular content domain (Cronbach, 1951). Responses to poorly written items should fail to demonstrate internal consistency due to random error (e.g., misread or misinterpreted items). Thus, internal consistency reliability analysis evaluates both content homogeneity and item quality (Crocker & Algina, 1986).

Meaningful internal structure is critical to establishing construct validity, so the PFOQA test items will be submitted to Principal Components Analysis to examine the underlying dimensions in the data. The PFOQA scales were based on the assumption that negative and positive perceptions of FOQA programs represent two distinct dimensions consisting of expectations about positive safety enhancements and concerns about data misuse. Principal Components Analysis will be employed to test the validity of this hypothesis.

Content Analysis of participants' comments will be used to evaluate the content validity of the PFOQA questionnaire. Though the questionnaire comprises issues that were deemed essential by experts in the field (e.g., representatives from the FAA, the FSF, and pilot unions), source credibility does not guarantee content validity. It is important to verify that sampling adequacy of the questionnaire items is sufficient to justify using participants' scores to draw inferences about pilots' perceptions of FOQA programs. Fortunately, survey participants also constitute a set of subject matter experts. Though the volunteer participants were not asked directly whether the PFOQA items sufficiently described the underlying constructs, their responses to an open-ended question located at the end of the survey (Please tell us anything else you think we should know about your expectations or concerns about FOQA) should reveal issues that were not identified by the original FSF special working group.

METHOD

Participants

Participants were 199 flight operations employees of an anonymous commercial air carrier. On-line data collection was conducted from 2/9/2010 to 3/30/2010. Of the 195 respondents who provided crew position information, 70 were first officers, 109 were captains, and 16 were check airmen. For evaluating scale construction and reliability, the sample was split using a random selection tool available from SPSS 18.0 statistical software package. Approximately half the cases were used for the Principal Components Analysis (N=100), and the remaining cases were used for the Reliability Analysis (N=99). Of the 199 pilots who completed the PFOQA survey, 67 chose to provide additional written comments that were used for the Content Analysis.

Procedure

The invitation to participate in the PFOQA survey (Appendix A) and a link to the on-line survey (Appendix B) were embedded in the airline's Flight Operations web site for ease of access. This web site was only available to the airline's Flight Operations personnel, thereby preventing individuals outside the target population from responding. Unfortunately, easy access and participant confidentiality precluded taking measures to prevent participants from responding more than once.

RESULTS

Descriptive Statistics

Summary descriptive statistics for the PFOQA survey items are shown in Table 2. Frequencies and proportions for individual PFOQA items are provided in Appendix C. Though Likert-type scales perform reasonably well in parametric analyses when there are five or more categories (Johnson & Creech, 1983; Zumbo & Zimmerman, 1993), it is unreasonable to assume a standard normal distribution based on a 4-point scale (e.g., Berry, 1993). Not surprisingly, many of the PFOQA items deviated from normality, some by more than three standard deviations. Item 01 (FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident), Item 07 (I expect FOQA data to be used to improve pilot training), Item 13 (I expect the FOQA program to positively impact the safety of our operations) and Item 16 (I worry that FOQA data could be released through civil litigation) were particularly negatively skewed. Item14 (A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots) was positively skewed. Only Item 07 (I expect FOQA data to be used to improve pilot training), Item 10 (I expect FOQA data to be used to change cockpit procedures), and Item 13 (I expect the FOQA program to positively impact the safety of our operations) had distributions that diverged from normality by more than three standard deviations with respect to kurtosis.

The incidence of "No Opinion" responses would result in the loss of more than half of the cases using pair-wise or list-wise deletion. Spearman's correlation between the number of user-missing responses and average response items (r_s = -.64, p <.01) suggests that "No Opinion" may have been selected in some instances when the respondent intended to indicate strong disagreement with a questionnaire item. Therefore, item means were substituted for user-missing values.

Internal Consistency Reliability

The results of the Internal Consistency Reliability Analysis are shown in Table 3. By convention, a minimum Cronbach's alpha of .80 is required for a "good" scale (Nunnally, 1978). Both the Positive Perceptions Scale (α=.86) and the Negative Perceptions Scale (α=.88) demonstrated good internal consistency.

In the aggregate, indicants recommended retention for all items in both scales. Values of R^2, shown in Table 3, represent squared multiple correlations from regression

Table 2. ***Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire Items: Descriptive Statistics***

PFOQA Item	*n*	No Opinion	System Missing	Mean	*SD*	Skewness	Kurtosis
01 FOQA is a program designed to enhance safety by identifying potential hazards….	197	2	0	3.52	.58	-.88	.69
02 Gatekeepers are the only persons able to access identifying information that….	181	17	1	2.94	.92	-.66	-.30
03 I trust management will not misuse FOQA data against individual pilots.	187	12	0	1.87	.84	.41	-1.03
04 Flying skills have improved or will improve with a FOQA program in place.	184	14	1	3.14	.72	-.66	.60
05 I worry that FOQA data will be a source of information for enforcement action….	194	5	0	3.00	.85	-.36	-.77
06 I expect FOQA data to be used to take action to correct safety problems.	194	5	0	3.32	.53	-.10	.56
07 I expect FOQA data to be used to improve pilot training.	195	3	1	3.31	.69	-1.06	1.82
08 I expect FOQA data to be used to optimize maintenance.	176	19	4	3.06	.76	-.58	.22
09 I worry that FOQA data will be used for disciplinary actions.	191	7	1	3.13	.79	-.42	-.74
10 I expect FOQA data to be used to change cockpit procedures.	186	11	2	3.17	.59	-.54	1.93
11 I expect FOQA data to provide our pilot group with useful feedback on our….	191	4	4	3.36	.62	-.69	.91
12 I expect FOQA data to be used to change procedures outside our organization….	180	16	3	2.93	.76	-.41	-.04
13 I expect the FOQA program to positively impact the safety of our operations.	193	5	1	3.24	.64	-.74	1.58
14 A FOQA program has negatively impacted, or will negatively impact, the morale….	182	17	0	2.03	.80	.79	.60
15 I worry that FOQA data could be released under the Freedom of Information Act.	179	20	0	3.13	.82	-.62	-.33
16 I worry that FOQA data could be released through civil litigation.	185	14	0	3.33	.74	-.86	.18

Note: Individual items were coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

Table 3. ***Perceptions of Flight Operations Quality Assurance (PFOQA): Internal Consistency Reliability Analysis for Two Scales*** **(*N* = 99)**

Positive Perceptions Scale: α = .86 (9 items)		R^2	Item-Total *r*	α If Deleted
01	FOQA is a program designed to enhance safety by identifying potential hazards before they result in….	.45	.60	.84
04	Flying skills have improved or will improve with a FOQA program in place.	.41	.52	.85
06	I expect FOQA data to be used to take action to correct safety problems.	.44	.60	.84
07	I expect FOQA data to be used to improve pilot training.	.49	.68	.83
08	I expect FOQA data to be used to optimize maintenance.	.52	.65	.84
10	I expect FOQA data to be used to change cockpit procedures.	.10	.17	.88
11	I expect FOQA data to provide our pilot group with useful feedback on our performance.	.62	.75	.83
12	I expect FOQA data to be used to change procedures outside our organization (e.g., ATC).	.54	.62	.84
13	I expect the FOQA program to positively impact the safety of our operations.	.63	.72	.83
Negative Perceptions Scale: α = .88 (7 items)		R^2	Item-Total *r*	α If Deleted
02	(Reflected) Gatekeepers are the only persons able to access identifying information that associates….	.32	.51	.89
03	(Reflected) I trust management will not misuse FOQA data against individual pilots.	.54	.70	.86
05	I worry that FOQA data will be a source of information for enforcement action against pilots.	.80	.81	.84
09	I worry that FOQA data will be used for disciplinary actions.	.81	.81	.84
14	A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.	.27	.47	.89
15	I worry that FOQA data could be released under the Freedom of Information Act.	.64	.69	.86
16	I worry that FOQA data could be released through civil litigation.	.68	.73	.86

equations using each item as the dependent variable with all other items as predictors. As such, larger values of R^2 indicate that item responses are well predicted by responses to other items. Squared multiple correlations for Item 02 (R^2=.32) and Item 14 (R^2=.27) were slightly lower than for most other items in the Negative Perceptions Scale but not nearly as low as Item 10 (R^2=.10) in the Positive Perceptions Scale. Pearson's correlation coefficients of individual items with total scores computed from all other items (Item-Total *r*) demonstrated comparable patterns: Item 02 (*r*=.51) and Item 14 (*r*=.47) were slightly lower than for most other items in the Negative Perceptions Scale, but not as low as Item 10 (*r*=.17) in the Positive Perceptions Scale. In the Positive Perceptions Scale, Item 10 had the distinction of being the only one that would improve alpha by its absence (α If Deleted). In the Negative Perceptions Scale, Items 02 and 14 had comparatively low Item-Total correlations and R^2 values. However, removal of these items would produce a negligible increase in overall alpha.

Principal Components Analysis

Though the assumption of normality is relaxed when PCA is used descriptively, it is sensitive to the magnitudes of correlations (Tabachnik & Fidell, 2006). The number of coefficients with absolute values greater than .30 (approximately 40%) in the Pearson's correlation matrix (Table 4) is probably sufficient for a satisfactory PCA solution. In addition, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (a test of partial correlations among variables) for the PFOQA questionnaire items was .80, exceeding the criterion of .60 and above that is required for a good solution.

PCA with Varimax rotation converged in three iterations and produced three components with eigenvalues greater than 1. As shown in the rotated component matrix in Table 5, all variables had a loading of .50 or greater with at least one of the components. The three extracted components accounted for approximately 60% of the variance in the dataset. Component 1 (Negative Perceptions) had an eigenvalue of 4.84 and accounted for 24% of the variance. Items associated with Component 1 express concerns about data misuse. Component 2 (Positive Expectations) had an eigenvalue of 3.64 and accounted for 23% of the variance. Items associated with Component 2 involve positive expectations about the benefits of FOQA programs. Most items associated with Component 3 were positive declarative statements about FOQA. However, this component was not as clearly defined as the others. The proportion of variance a rotated component accounts for is an estimate of its importance (Tabachnick & Fidell, 2006). Components 1 and 2 were nearly equivalent in this regard. On the other hand, Component 3 (Positive Declarations) had an eigenvalue of 1.18 and accounted for only 13% of the variance in the dataset.

Content Analysis

Comments were coded as containing either positive, negative, or mixed (both positive and negative) content. Positive comments tended to be broad and often echoed statements included in the PFOQA questionnaire. Conversely, negative remarks tended to be more specific and several expressed concerns about issues that were unrelated to any of the existing PFOQA items. For example:

- Concern that FOQA data would not be integrated with other sources to address more global problems
- Concern that exceedance parameter definitions are too narrow
- Concern that causes may be missed in the focus on event parameters
- Concern that a zero-tolerance approach to exceedances will develop
- Concern for potential for micro-management of flying through FOQA

A series of tests was conducted to examine the characteristics of participants who provided comments relative to the PFOQA scales.[2] In general, pilots who provided comments had higher Negative Perceptions Scale scores than those who did not, $t(197)=-3.44$, $p<.01$. Of the 67 (34%) pilots who chose to provide additional written comments, 11 (16%) made only positive remarks, 34 (51%) made exclusively negative remarks, and 21 (31%) made mixed (positive and negative) remarks.[3] Figure 1 contains Positive and Negative Perceptions Scale scores grouped by comment code. Participants who made exclusively positive comments had significantly higher Positive Perceptions Scale scores, $t(65)=-2.79$, $p<.01$, and significantly lower Negative Perceptions Scale scores, $t(65)=5.83$, $p<.01$, than participants who made negative or mixed comments. Participants making exclusively negative comments did not differ significantly from those with mixed comments on either the Positive Perceptions Scale, $t(53)=1.60$, $p=.12$, or the Negative Perceptions Scale, $t(53)=.10$, $p=.92$. This is understandable, given the basic pattern of most mixed remarks: Positive statements were often offered as recognition of the potential benefits of FOQA programs in general, followed by negative comments detailing their concerns about their own program.

[2]As no hypothesis testing was involved, alphas were not adjusted for multiple analyses. It should also be noted that Levene's tests for equality of variances were non-significant for all comparisons, despite differences in sample size. Composite scale scores were adjusted for the number of items and were normally distributed.

[3]One comment was a neutral procedural recommendation and could not be categorized.

Table 4. ***Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire: Correlations*** **(*N* = 100)**

	Questionnaire Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01	FOQA is a program designed to enhance safety by identifying potential hazards before they result ….															
02	Gatekeepers are the only persons able to access identifying information that associates a pilot ….	.38**														
03	I trust management will not misuse FOQA data against individual pilots.	.16	.32**													
04	Flying skills have improved or will improve with a FOQA program in place.	.43**	.29**	.20*												
05	I worry that FOQA data will be a source of information for enforcement action against pilots.	-.14	-.26*	-.51**	-.19											
06	I expect FOQA data to be used to take action to correct safety problems.	.26**	.16	-.04	.22*	.08										
07	I expect FOQA data to be used to improve pilot training.	.28**	.26**	.14	.43**	-.15	.52**									
08	I expect FOQA data to be used to optimize maintenance.	.16	.33**	.17	.38**	-.04	.41**	.70**								
09	I worry that FOQA data will be used for disciplinary actions.	-.17	-.25*	-.66**	-.27**	.70**	.03	-.03	-.07							
10	I expect FOQA data to be used to change cockpit procedures.	.20	.15	.02	.17	.04	.54**	.36	.33**	.06						
11	I expect FOQA data to provide our pilot group with useful feedback on our performance.	.34**	.20	.02	.31**	.02	.51**	.38	.28**	.04	.40**					
12	I expect FOQA data to be used to change procedures outside our organization (e.g., ATC).	.17	.02	-.06	.18	.06	.40*	.50**	.49**	.19	.41**	.37**				
13	I expect the FOQA program to positively impact the safety of our operations.	.31**	.17	.12	.47**	-.09	.47**	.69**	.53**	-.07	.44**	.51**	.34**			
14	A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.	-.31**	-.39**	-.42**	-.43**	.29**	-.25	-.25*	-.22*	.49**	-.08	-.28**	-.03	-.34**		
15	I worry that FOQA data could be released under the Freedom of Information Act.	.00	-.23*	-.51**	-.24*	.57**	.02	-.07	.02	.65**	.11	.05	.12	-.04	.44**	
16	I worry that FOQA data could be released through civil litigation.	-.05	-.27**	-.50**	-.24*	.58**	-.02	-.09	-.06	.65**	.05	-.02	.04	-.07	.44**	.82**

**$p < .01$; *$p < .05$

Table 5. ***Principal Components Analysis Rotated Component Matrix*** **(*N* = 100)**

Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire Item		Component		
		1	2	3
15	I worry that FOQA data could be released under the Freedom of Information Act.	.87		
16	I worry that FOQA data could be released through civil litigation.	.86		
09	I worry that FOQA data will be used for disciplinary actions.	.85		
05	I worry that FOQA data will be a source of information for enforcement action against pilots.	.78		
03	I trust management will not misuse FOQA data against individual pilots.	-.72		
07	I expect FOQA data to be used to improve pilot training.		.82	
08	I expect FOQA data to be used to optimize maintenance.		.76	
12	I expect FOQA data to be used to change procedures outside our organization (e.g., ATC).		.75	
13	I expect the FOQA program to positively impact the safety of our operations.		.73	
06	I expect FOQA data to be used to take action to correct safety problems.		.71	
10	I expect FOQA data to be used to change cockpit procedures.		.65	
11	I expect FOQA data to provide our pilot group with useful feedback on our performance.		.54	
01	FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.			.82
02	Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedances.			.61
04	Flying skills have improved or will improve with a FOQA program in place.			.58
14	A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.			-.55

Component loadings < .50 not shown.

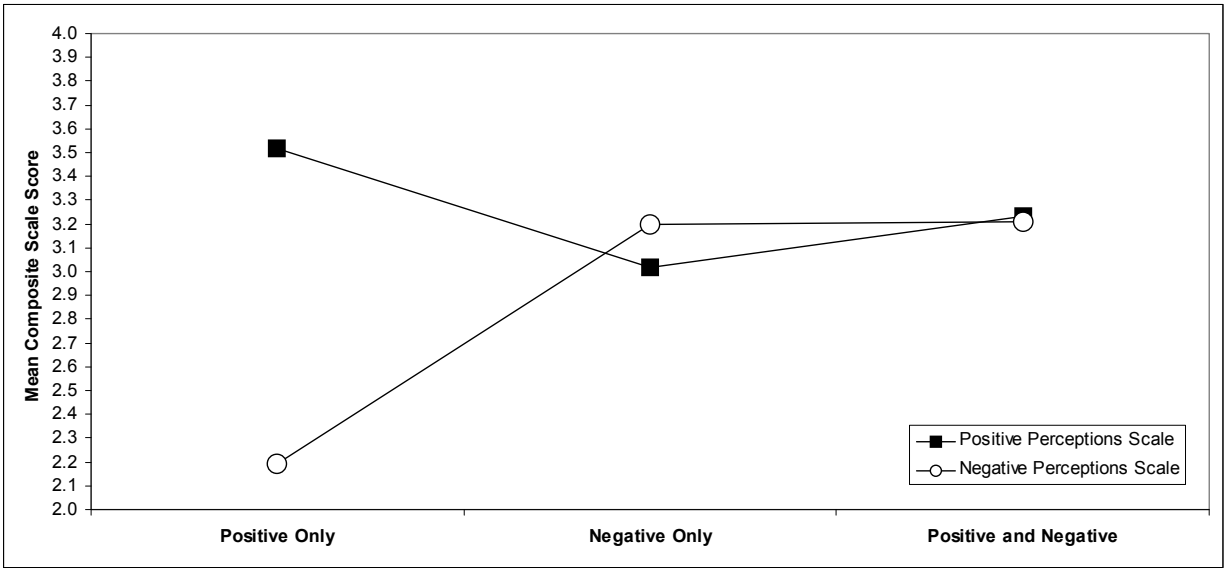

Figure 1. ***Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire Scale Scores by Comment Code***

DISCUSSION

Overall, the results suggest that the PFOQA questionnaire may be sufficient for many applications in its current form. They also highlight aspects of the questionnaire that could be improved. It is extremely important that the PFOQA items represent a sufficient sample of pilots' expectations and concerns in order to draw valid inferences about their perceptions of FOQA programs. The results of the Content Analysis of participants' comments made it clear that the PFOQA questionnaire failed to do this. The FSF Task Force (the source of the PFOQA questionnaire items) concentrated on identifying issues that might hinder or prevent the *implementation* of FOQA programs. Our participants' comments included a broader range of concerns than those covered by questionnaire items because they evolved from pilots' experiences with *existing* FOQA programs (e.g., that management will not make adequate use of the data, the potential for zero-tolerance policies). Consequently, the PFOQA questionnaire would benefit from the inclusion of additional items based on their experiences.

The results of the Principal Components Analysis also suggest the need for augmentation of the PFOQA items. Only 60% of the variance in the dataset was explained by the extracted components, leaving 40% unexplained. Most was described by the first two components: Concerns about FOQA data misuse were associated with Component 1, and expectations of potential FOQA benefits were associated with Component 2. However, Component 3 was associated with a few general statements about FOQA programs that accounted for only 13% of the variance. It is possible that this component simply represents an artifact of the semantic differences between these items and others, and this component would "disappear" with minor item revision (or analysis with a larger sample).

On the other hand, the third component may suggest a dimension that might be developed using the "theoretical versus practical" duality evidenced by participants' comments (i.e., positive statements about the ideal FOQA program, followed by negative comments about their own). Items that failed to perform as well as expected in both the Principal Components and Reliability Analysis may need to be rewritten to allow participants to express this distinction. For example, Item 02 is a general statement about the role of the Gatekeeper (Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedances). Participants might agree with the concept of the Gatekeeper's role as stated and still harbor serious concerns about threats to that role. Items that specifically address these concerns (e.g., "I worry that the Gatekeeper might succumb to pressure from management to release identifying information" or "I worry about management circumventing the Gatekeeper and re-identifying the data") should ameliorate the questionnaire's ability to fully describe pilots' perceptions of FOQA.

It is difficult to explain the poor performance of Item 10 (I expect FOQA data to be used to change cockpit procedures) in the Reliability Analysis. Kurtosis for this item diverged from normality by more than three standard deviations but cannot explain its low inter-item correlations and low squared multiple correlations. After all, Item 07 and Item 13 had similarly leptokurtotic

distributions but still managed to produce excellent inter-item correlations and squared multiple correlations. It is possible that the problems noted with Item 10 were due to word choice. Changes to cockpit procedures may be perceived as being positive or negative, and this ambiguity may have resulted in low inter-item correlations and low squared multiple correlations. Definite directionality (i.e., "I expect FOQA data to be used to *improve* cockpit procedures") might improve its performance within the Positive Perceptions Scale.

In the aggregate, the current version of the PFOQA questionnaire seems best suited for assessing pilots' attitudes prior to FOQA implementation. Completion by a representative sample would offer a clear indication of pilots' anticipated benefits as well as their concerns about the program, and the opportunity to provide unstructured comments seems to be extremely useful for identifying concerns that might be unique to the group. Providing feedback on questionnaire results and communicating how the airline plans to address pilots' concerns can set the stage for a positive program introduction. Certainly, the potential safety benefits of FOQA programs justify efforts to understand and mitigate negative perceptions that might prevent their adoption.

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APPENDIX A

Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire: Invitation to Participate

The FAA Civil Aerospace Medical Institute (CAMI) in Oklahoma City has developed an online questionnaire to assess how FOQA programs are perceived, and has agreed to collect and analyze anonymous feedback from our pilots.

[Airline] will benefit by receiving valuable input that might facilitate or improve implementation of our FOQA program. CAMI will benefit by having a relatively large group of pilots take the survey to establish its reliability and validity as a measurement for future participants.

The *Perceptions of Flight Operations Quality Assurance* online survey takes just a few minutes to complete. Participation is completely anonymous, which means that no one (not even the research team) will know the name of any pilot who responds.

CAMI's Aerospace Human Factors Research Division conducts research in support of the FAA Aviation Safety and Air Traffic organizations. Its research is compliant with 45 CFR Part 46 "Protection of Human Subjects" and FAA Order 9500.25 "Protection of Human Research Subjects," and is conducted under approval of the FAA Institutional Review Board. These regulations protect the confidentiality of participants. In this study, your feedback is both confidential and anonymous. You will not be asked for your name, and ***personal identifiers, such as IP addresses, will not be recorded.***

Although there is no direct compensation for participating in this study, understanding your expectations, experiences, and concerns is important for making FOQA programs as effective as possible. Your participation constitutes a valuable contribution to our airline, the aviation community, and the flying public.

All data that are collected will be shared with ALPA's FOQA team here at [airline].

If you consent to participate, simply login to the Flight Ops website and click on the button labeled "FOQA Survey."

This will take you directly to the *Perceptions of Flight Operations Quality Assurance* questionnaire which is restricted to [airline] pilots only.

Please remember that participation is voluntary, so you need only respond to questions you feel comfortable answering, and are free to withdraw from participation at any time.

If you have any questions about the survey, you may contact:

Tom Chidester, Manager
Aerospace Human Factors Research Division (AAM-500)
Federal Aviation Administration
Civil Aerospace Medical Institute
6500 MacArthur Blvd.
Oklahoma City, OK 73125
(405) 954-4082
Thomas.Chidester@FAA.gov

APPENDIX B

*Perceptions of Flight Operations Quality Assurance (PFOQA) On-line Survey**

Please respond to each item by indicating your level of agreement with the statement.

		Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
1.	FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.	○	○	○	○	○
2.	"Gatekeepers" are the only persons able to access identifying information that associates a pilot or pilots with exceedences.	○	○	○	○	○
3.	I trust management will not misuse FOQA data against individual pilots.	○	○	○	○	○
4.	Flying skills have improved or will improve with a FOQA program in place.	○	○	○	○	○
5.	I worry that FOQA data will be a source of information for enforcement action against pilots.	○	○	○	○	○
6.	I expect FOQA data to be used to take action to correct safety problems.	○	○	○	○	○
7.	I expect FOQA data to be used to improve pilot training.	○	○	○	○	○
8.	I expect FOQA to be used to optimize maintenance.	○	○	○	○	○
9.	I worry that FOQA data will be used for disciplinary actions.	○	○	○	○	○
10.	I expect FOQA data to be used to change cockpit procedures.	○	○	○	○	○
11.	I expect FOQA data to provide our pilot group with useful feedback on our performance.	○	○	○	○	○
12.	I expect FOQA data to be used to change procedures outside our organization (such as in Air Traffic).	○	○	○	○	○
13.	I expect the FOQA program to positively impact the safety of our operations.	○	○	○	○	○
14.	A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.	○	○	○	○	○
15.	I worry that FOQA data could be released under the Freedom of Information Act.	○	○	○	○	○
16.	I worry that FOQA data could be released through civil litigation.	○	○	○	○	○

Please answer a few questions about your background and experience.

17. **What aircraft fleet(s) are you currently flying?**
(Please check all that apply.)

18. **Have you served as a pilot on an aircraft fleet equipped with FOQA prior to joining your current airline?**
○ *Yes*
○ *No*

19. **Where are you based?**

20. **What is your crew position?**
--Click Here--

21. **What is the highest level of education you completed?**
--Click Here--

22. **Please tell us anything else you think we should know about your expectations or concerns about FOQA.**
(Your unedited comments will be compiled with others and forwarded to the airline.)

Thank you for your participation!

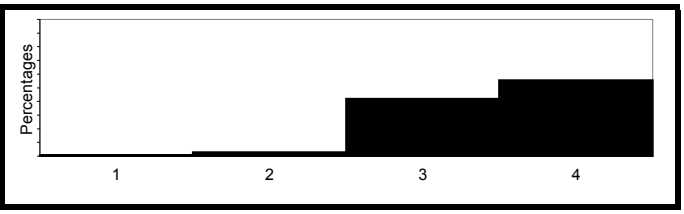
*Some demographic response items have been removed to protect the airline's anonymity.

APPENDIX C

Perceptions of Flight Operations Quality Assurance (PFOQA) Questionnaire Items: Frequencies and Percentages

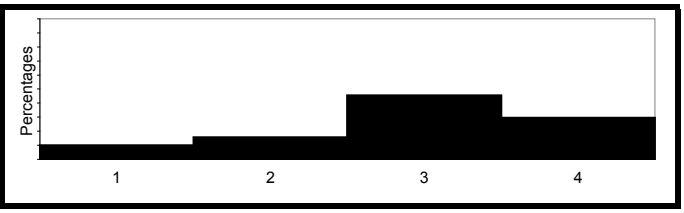
1 FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.

	Frequency	Valid Percent
1	1	0.5
2	5	2.5
3	82	41.6
4	109	55.3
Total	197	100.0



2 Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedences.

	Frequency	Valid Percent
1	18	9.9
2	28	15.5
3	82	45.3
4	53	29.3
Total	181	100.0



3 I trust management will not misuse FOQA data against individual pilots.

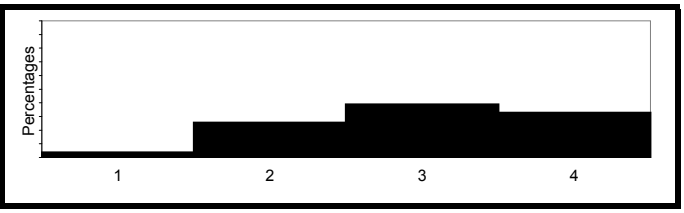
	Frequency	Valid Percent
1	76	40.6
2	62	33.2
3	46	24.6
4	3	1.6
Total	187	100.0

4 Flying skills have improved or will improve with a FOQA program in place.

	Frequency	Valid Percent
1	5	2.7
2	21	11.4
3	101	54.9
4	57	31.0
Total	184	100.0

5 I worry that FOQA data will be a source of information for enforcement action against pilots.

	Frequency	Valid Percent
1	7	3.6
2	49	25.3
3	75	38.7
4	63	32.5
Total	194	100.0



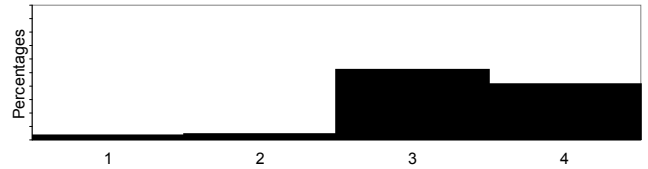
1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

6 I expect FOQA data to be used to take action to correct safety problems.

	Frequency	Valid Percent
1	1	0.5
2	3	1.5
3	122	62.9
4	68	35.1
Total	194	100.0

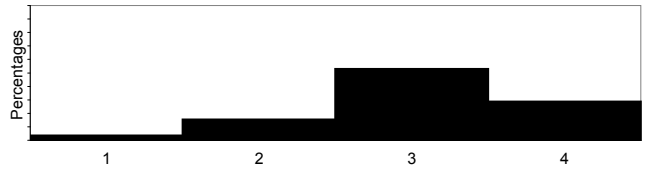
7 I expect FOQA data to be used to improve pilot training.

	Frequency	Valid Percent
1	6	3.1
2	8	4.1
3	101	51.8
4	80	41.0
Total	195	100.0



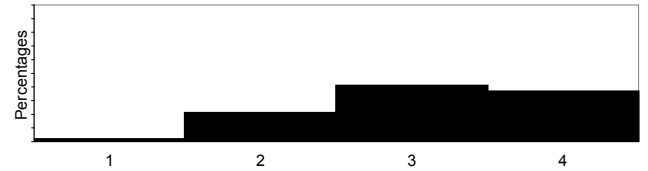
8 I expect FOQA data to be used to optimize maintenance.

	Frequency	Valid Percent
1	6	3.4
2	27	15.3
3	93	52.8
4	50	28.4
Total	176	100.0



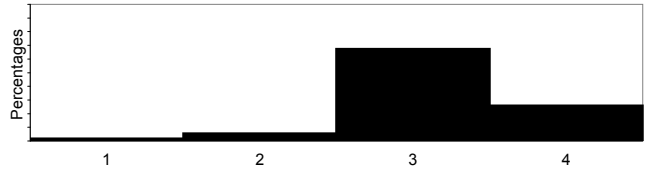
9 I worry that FOQA data will be used for disciplinary actions.

	Frequency	Valid Percent
1	3	1.6
2	40	20.9
3	78	40.8
4	70	36.6
Total	191	100.0



10 I expect FOQA data to be used to change cockpit procedures.

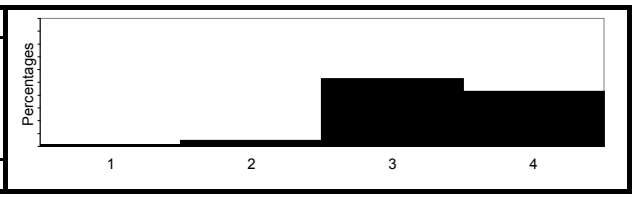
	Frequency	Valid Percent
1	3	1.6
2	10	5.4
3	125	67.2
4	48	25.8
Total	186	100.0



1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

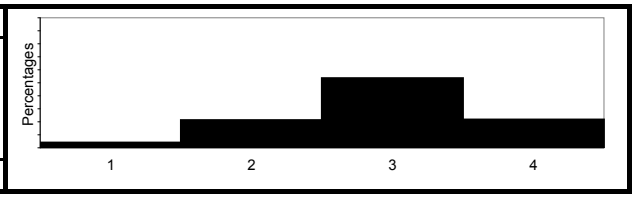
11 I expect FOQA data to provide our pilot group with useful feedback on our performance.

	Frequency	Valid Percent
1	2	1.0
2	8	4.2
3	100	52.4
4	81	42.4
Total	191	100.0



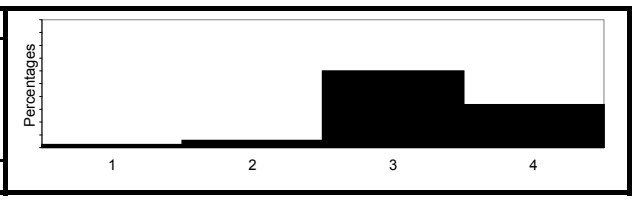
12 I expect FOQA data to be used to change procedures outside our organization (e.g., ATC).

	Frequency	Valid Percent
1	7	3.9
2	38	21.1
3	96	53.3
4	39	21.7
Total	180	100.0



13 I expect the FOQA program to positively impact the safety of our operations.

	Frequency	Valid Percent
1	4	2.1
2	10	5.2
3	115	59.6
4	64	33.2
Total	193	100.0

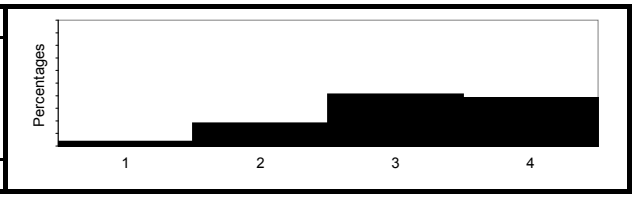


14 A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.

	Frequency	Valid Percent
1	42	23.1
2	105	57.7
3	22	12.1
4	13	7.1
Total	182	100.0

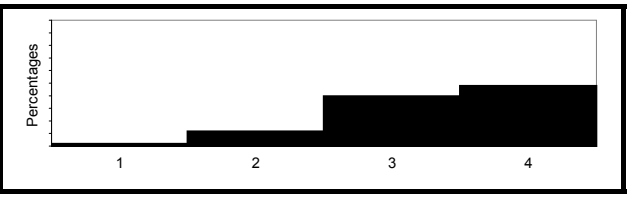
15 I worry that FOQA data could be released under the Freedom of Information Act.

	Frequency	Valid Percent
1	6	3.4
2	32	17.9
3	73	40.8
4	68	38.0
Total	179	100.0



16 I worry that FOQA data could be released through civil litigation.

	Frequency	Valid Percent
1	3	1.6
2	21	11.4
3	73	39.5
4	88	47.6
Total	185	100.0



1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree