APPENDIX D-1

ANALYSES OF THE LINKAGE BETWEEN PAY AND PERFORMANCE: METHODS FOR STATISTICAL ANALYSES

ANALYSES OF THE LINKAGE BETWEEN PAY AND PERFORMANCE: METHODS FOR STATISTICAL ANALYSES

As in previous years, the body of this report contains results from statistical analyses performed on the objective data pertaining to the Demonstration and Comparison group employees. In this technical appendix, we provide more detail on the statistical analyses from which the results were derived as well as other methodological issues of relevance to the study design. The following information is provided:

- Use of sample versus census data analysis techniques
- Scatterplots displaying the pay-for-performance correlation in the Demonstration Group
- Results of the analysis of covariance (ANCOVA).

Use of Sample Versus Census Data Analysis Techniques

The database of Demonstration Group participants represents the entire universe of Commerce employees who are receiving the human resource interventions as part of this Demonstration Project. By definition this group is a population rather than a sample. The most widely used inferential statistics, and those used as part of this evaluation (Analysis of Covariance), were designed to be applied to sample data. Despite this theoretical hurdle, it has become common practice among researchers to use these inferential statistics in the absence of a better method.

To most accurately describe the population in question, Booz·Allen produced effect size estimates along with significance levels. By producing these additional data, Booz·Allen hopes to mitigate the theoretical concerns of applying data analysis techniques developed for samples on data derived from a population.

Scatterplots Displaying the Pay-For-Performance Correlation in the Demonstration Group

Figure 1 displays a scatterplot showing the relationship between performance ratings and salary increases (as a percentage of base salary) in the Demonstration Group. Correlational analyses revealed a correlation of $r = .42$. As in Year Two, this scatterplot suggests that high performance ratings, to some degree, are associated with higher increase percentages. This plot also suggests that lower performance ratings rarely resulted in higher increases.

Figure 1. Percent Increase by Performance Rating

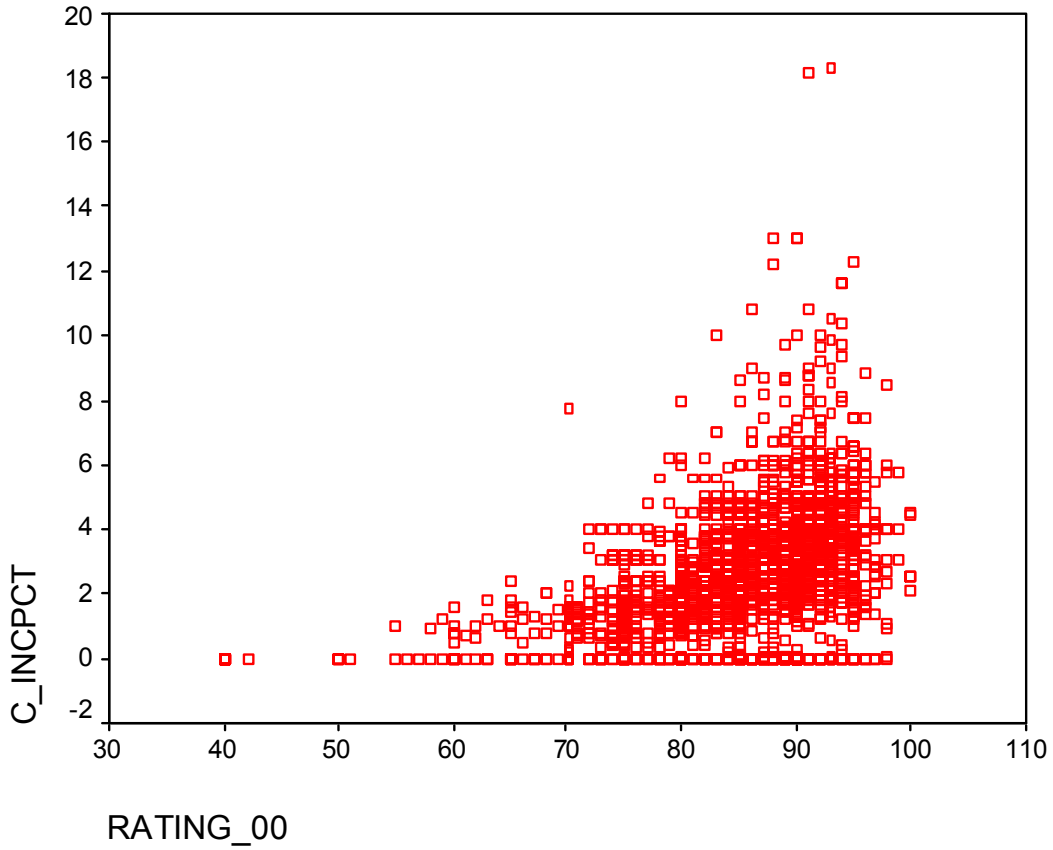
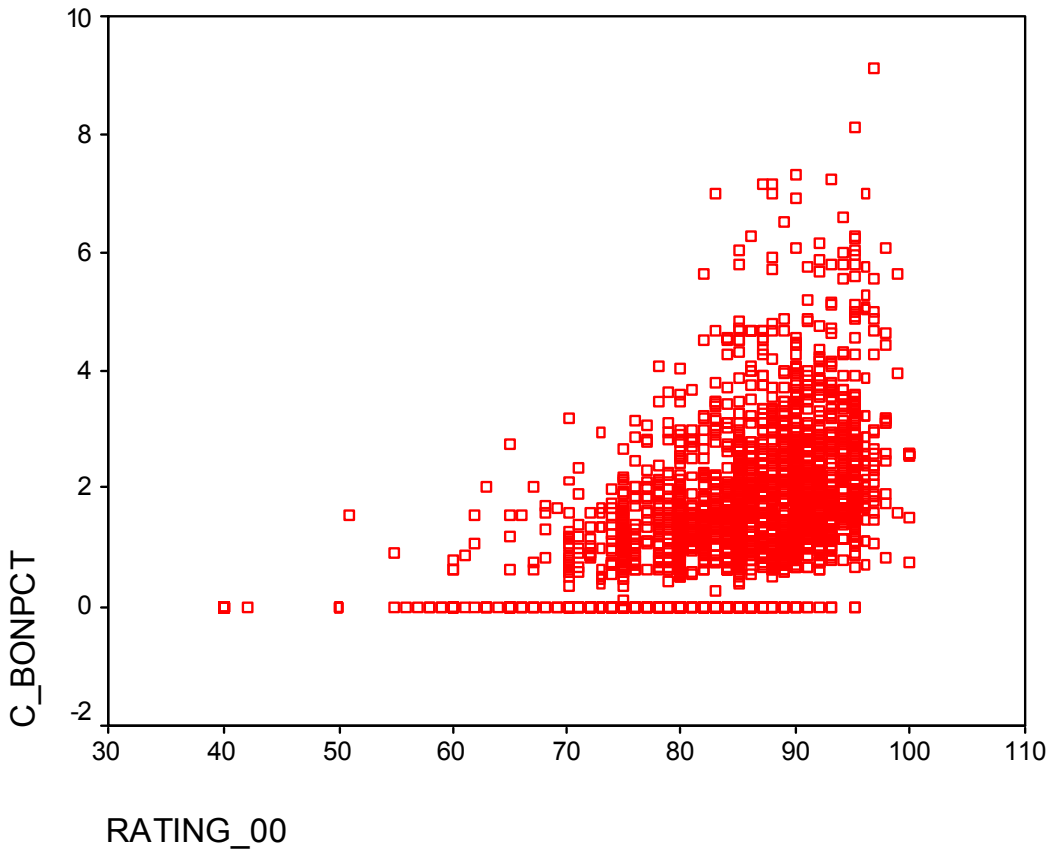


Figure 2 displays a scatterplot showing the relationship between performance ratings and bonuses (as a percentage of base salary) in the Demonstration Group. Correlational analyses revealed a correlation of $r = .46$. The scatterplot below suggests that the employees receiving low performance ratings were unlikely to receive a large bonus. Additionally, those employees who did receive a large bonus were more likely to have received a high performance rating.

Figure 2. Bonus Percent by Performance Rating



Results of the Analysis of Covariance (ANCOVA)

Analysis of variance (ANOVA) involves determining whether the difference between two or more means is statistically significant. Analysis of covariance (ANCOVA, also referred to as ANACOVA) builds one more level of complexity. With ANCOVA, those differences between the means are examined while also *controlling* for the effects that another variable or variables may have on the relationship. That is, the question becomes "what is the effect of something when we take into account something else?" (Will G. Hopkins, A New View of Statistics).

When performing ANCOVAs, the output produces means that account for the presence of other specified variables. These means are known as "adjusted" means; they allow closer

examination of the relationship between two variables of interest while removing the impact that other variables may have on the relationship.

Using a standard statistical software, the Statistical Package for the Social Sciences (SPSS), Booz Allen ran ANCOVA analyses to assess any differences in pay outcomes for EEO groups and veterans within the Demonstration Project. In accordance with year two, separate ANCOVA analyses were run for each protected subgroup (i.e., minorities, women, and veterans) to test whether the new pay for performance system adversely affected subgroups. In essence, the ANCOVA analyses indicate whether differences for subgroups in average pay increases or bonuses/awards were significant. We examined, for example, differences in average pay increases for females and males. In this example we sought to determine whether 1) there was a statistically significant difference in average pay increases between females and males and 2) whether the size of the effect of gender on average pay increases was large enough to be meaningful.

Separate ANCOVAs were run for several independent variables whose categories were:

1. Minority/non-minority
2. Female/male
3. Veteran/non-veteran

Separate ANCOVAs for each of these subgroups were performed for each of the two dependent variables of interest:

1. Percent Increase in Salary (amount of the performance-based pay increase expressed as a percent of salary from the beginning of the performance year)

2. Percent Bonus/Award (amount of bonus/award expressed as a percent of salary from the beginning of the performance year)

As reported prior reports, ANCOVAs were calculated using three covariates: Performance Rating, Career Path, and Time in Service. The ANCOVA analyses were used to address the question of how much impact gender, for example, had on differences in Percent Increase in Salary once the effects of Performance Rating, Career Path, and Time in Service were statistically accounted for.

In these analyses, values less than .01 in the column labeled "Significance" were considered significant. Due to the large number of cases in the data set, it was not unexpected to find that many relationships were statistically significant. Because so many of these relationships were statistically significant, it is important to also consider the Eta squared value.

The column labeled "Eta Squared" is the estimate of the size of the effect that each independent variable had on the dependent variable of interest (Percent Increase in Salary or Percent Bonus/Award). For these data, values greater than .05 were considered to be of interest. However, none of the EEO group variables in any of the analyses reached this level.

For each ANCOVA analysis, raw and estimated marginal means are presented. The raw measures are labeled "Unadjusted Means." The estimated marginal means are means that have been adjusted for the covariates and are labeled "Adjusted Means."

In summary, the findings presented below indicate that while many relationships between the independent variables and the dependent variables were statistically significant (due to the large sample size), none had an effect on the distribution of pay increases or bonuses/awards large enough to be meaningful.

DEMONSTRATION GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Minority	2.60%	1.88	438
Non-Minority	2.65%	2.06	1805
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.008	
Performance Rating	.000	.256	
Time in Service	.000	.179	
Minority/Non-Minority	.136	.001	
Group	**Adjusted Means**	**Standard Error**	
Minority	2.54%	.080	
Non-Minority	2.67%	.039	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Female	2.95%	2.19	890
Male	2.45%	1.89	1357
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.009	
Performance Rating	.000	.254	
Time in Service	.000	.164	
Female/Male	.089	.001	
Group	**Adjusted Means**	**Standard Error**	
Female	2.72%	.057	
Male	2.60%	.046	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Veteran	2.09%	1.52	326
Non-Veteran	2.73%	2.08	1917
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.007	
Performance Rating	.000	.253	
Time in Service	.000	.174	
Veteran/Non-Veteran	.013	.003	
Group	**Adjusted Means**	**Standard Error**	
Veteran	2.43%	.093	
Non-Veteran	2.68%	.038	

Dependent Variable = Percent Bonus Independent Variable Categories = Minority/Non-Minority		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Minority	1.47%	1.24	438
Non-Minority	1.73%	1.24	1805
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.010	
Performance Rating	.000	.218	
Time in Service	.008	.003	
Minority/Non-Minority	.000	.007	
Group	**Adjusted Means**	**Standard Error**	
Minority	1.50%	.053	
Non-Minority	1.73%	.026	

Dependent Variable = Percent Bonus Independent Variable Categories = Female/Male		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Female	1.85%	1.40	890
Male	1.58%	1.14	1353
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.008	
Performance Rating	.000	.215	
Time in Service	.357	.000	
Female/Male	.000	.011	
Group	**Adjusted Means**	**Standard Error**	
Female	1.83%	.037	
Male	1.59%	.030	

Dependent Variable = Percent Bonus Independent Variable Categories = Veteran/Non-Veteran		**DEMO GROUP**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Veteran	1.47%	1.00	326
Non-Veteran	1.72%	1.72	1917
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.000	.010	
Performance Rating	.000	.215	
Time in Service	.054	.002	
Veteran/Non-Veteran	.007	.003	
Group	**Adjusted Means**	**Standard Error**	
Veteran	1.53%	.061	
Non-Veteran	1.71%	.025	

COMPARISON GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority			**COMPARISON**
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Minority	.45%	1.05	196
Non-Minority	.71%	1.31	1439
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.379	.000	
Performance Rating	*	.000	
Time in Service	.000	.058	
Minority/Non-Minority	.004	.005	
Group	**Adjusted Means**	**Standard Error**	
Minority	.43%	.091	
Non-Minority	.71%	.034	

*All Comparison Group employees received a rating of "passing" in Year Three.

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male			**COMPARISON**
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Female	.74%	1.36	582
Male	.65%	1.24	1635
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.338	.001	
Performance Rating	*	.000	
Time in Service	.001	.006	
Female/Male	.509	.000	
Group	**Adjusted Means**	**Standard Error**	
Female	.71%	.054	
Male	.66%	.040	

*All Comparison Group employees received a rating of "passing" in Year Three.

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran			**COMPARISON**
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Veteran	.49%	1.17	212
Non-Veteran	.71%	1.30	1423
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.467	.000	
Performance Rating	*	.000	
Time in Service	.001	.007	
Veteran/Non-Veteran	.047	.002	
Group	**Adjusted Means**	**Standard Error**	
Veteran	.52%	.088	
Non-Veteran	.70%	.034	

*All Comparison Group employees received a rating of "passing" in Year Three.

Dependent Variable = Percent Award Independent Variable Categories = Minority/Non-Minority		**COMPARISON**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Minority	1.44%	1.89	196
Non-Minority	1.37%	1.63	1439
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.036	.003	
Performance Rating	*	.000	
Time in Service	.069	.002	
Minority/Non-Minority	.424	.000	
Group	**Adjusted Means**	**Standard Error**	
Minority	1.47%	.119	
Non-Minority	1.36%	.044	

*All Comparison Group employees received a rating of "passing" in Year Three.

Dependent Variable = Percent Award Independent Variable Categories = Female/Male		**COMPARISON**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Female	1.64%	1.86	582
Male	1.23%	1.53	1053
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.040	.003	
Performance Rating	*	.000	
Time in Service	.040	.005	
Female/Male	.000	.017	
Group	**Adjusted Means**	**Standard Error**	
Female	1.68%	.070	
Male	1.21%	.051	

*All Comparison Group employees received a rating of "passing" in Year Three.

Dependent Variable = Percent Award Independent Variable Categories = Veteran/Non-Veteran		**COMPARISON**	
Group	**Unadjusted Means**	**Standard Deviation**	**N**
Veteran	.81%	1.15	212
Non-Veteran	1.46%	1.71	1423
ANCOVA Results	**Significance**	**Eta Squared**	
Career Path	.141	.001	
Performance Rating	*	.000	
Time in Service	.029	.001	
Veteran/Non-Veteran	.000	.017	
Group	**Adjusted Means**	**Standard Error**	
Veteran	0.81%	.114	
Non-Veteran	1.50%	.044	

*All Comparison Group employees received a rating of "passing" in Year Three.

APPENDIX D-2

YEARS ONE AND TWO
OBJECTIVE DATA RESULTS

Year One and Year Two Objective Data Results

Year One Objective Data Results

Year One—Average Performance Appraisal Scores (Raw), Pay Increase Percentages (Raw and Adjusted) , and Bonus Percentages (Raw and Adjusted) for the Demonstration Group

Subgroup	Performance Appraisal Scores	Average Pay Increase Percentage		Average Bonus Percentage	
		Raw	Adjusted	Raw	Adjusted
Minority	80.34 points	2.73%	2.70%	1.46%	1.50%
Non-Minority	82.33 points	2.73%	2.74%	1.72%	1.71%
Female	82.64 points	3.10%	2.76%	1.95%	1.88%
Male	81.53 points	2.50%	2.71%	1.50%	1.54%
Veteran	79.38 points	2.26%	2.67%	1.49%	1.63%
Non-Veteran	82.22 points	2.78%	2.74%	1.69%	1.67%
Total	**81.95 points**	2.73%	--	1.67%	--

Notes:

1. *The average performance appraisal score for each Demonstration Group subgroup is the average number of points received under the 100-point system. Performance data for Demonstration Group employees are based on appraisals conducted in September 1998, and as reported in the January 1999 data file provided by DoC. Average increase and bonus percentages are based on actions effective in November 1998, as reported in the January 1999 data file provided by DoC.*
2. *The minority group includes all non-White personnel.*
3. *Adjusted averages were computed by statistically controlling for performance rating, career path, and length of service.*

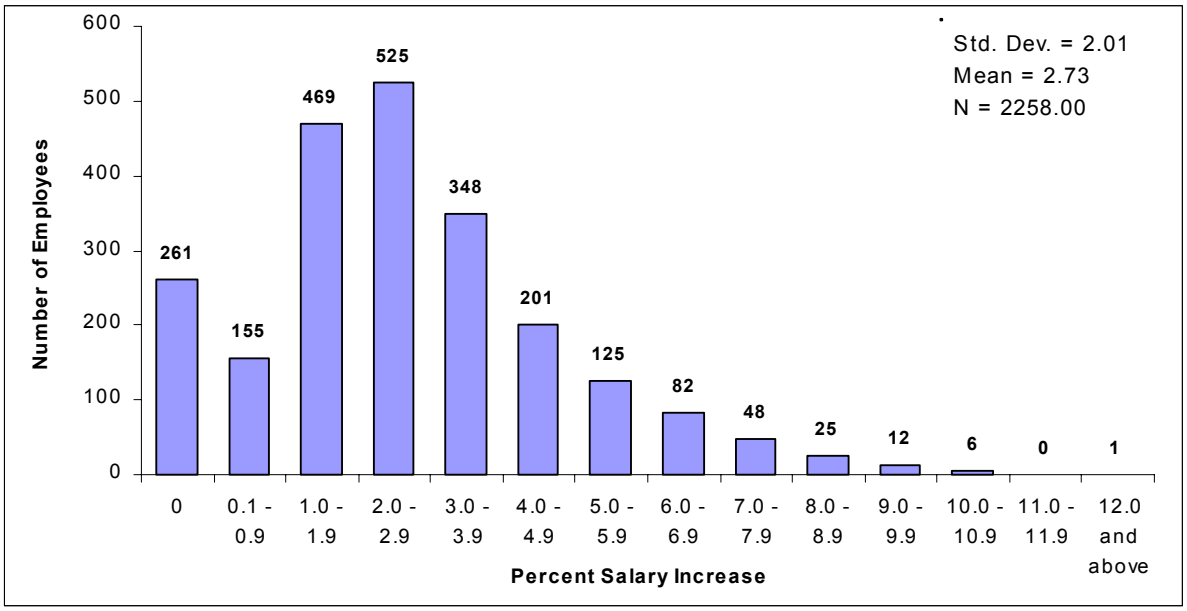
Year One—Comparison of Performance Appraisal Scores (Raw), Average Pay Increases (Adjusted), and Average Bonuses/Awards (Adjusted)

Subgroup	Performance Appraisal Scores		Average Pay Increase Percentage		Average Bonus/Award Percentage	
	Demonstration Group	Comparison Group	Demonstration Group	Comparison Group	Demonstration Group	Comparison Group
Minority	80.34 points	100% Pass; 0% Fail	2.70%	1.94%	1.50%	1.28%
Non-Minority	82.33 points	100% Pass; 0% Fail	2.74%	1.92%	1.71%	1.11%
Female	82.64 points	100% Pass; 0% Fail	2.76%	1.93%	1.88%	1.22%
Male	81.53 points	100% Pass; 0% Fail	2.71%	1.92%	1.54%	1.09%
Veteran	79.38 points	100% Pass; 0% Fail	2.67%	1.72%	1.63%	0.70%
Non-Veteran	82.22 points	100% Pass; 0% Fail	2.74%	1.94%	1.67%	1.17%

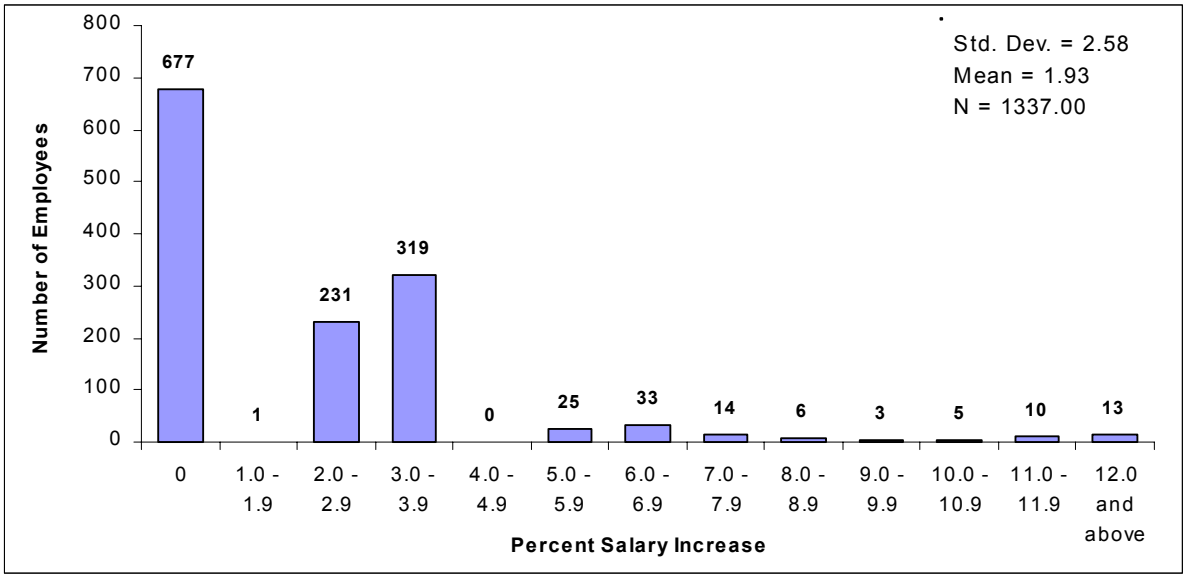
Notes:

1. *The average performance appraisal score presented for each Demonstration Group subgroup is the average number of points received under the 100-point system. The numbers presented for the Comparison Group subgroups are the percentages of employees who received "Pass" or "Fail" under the 2-level system. Performance data for Demonstration Group employees are based on appraisals conducted in September 1998, and as reported in the January 1999 data file provided by DoC. Performance data for Comparison Group employees are based on appraisals occurring between March 28, 1998 and January 31, 1999 and as reported in the January 1999 data file provided by DoC.*
2. *Average pay increase and bonus/award percentages are based on actions occurring between March 28, 1998 and January 31, 1999 as reported in the January 1999 data files provided by DoC.*

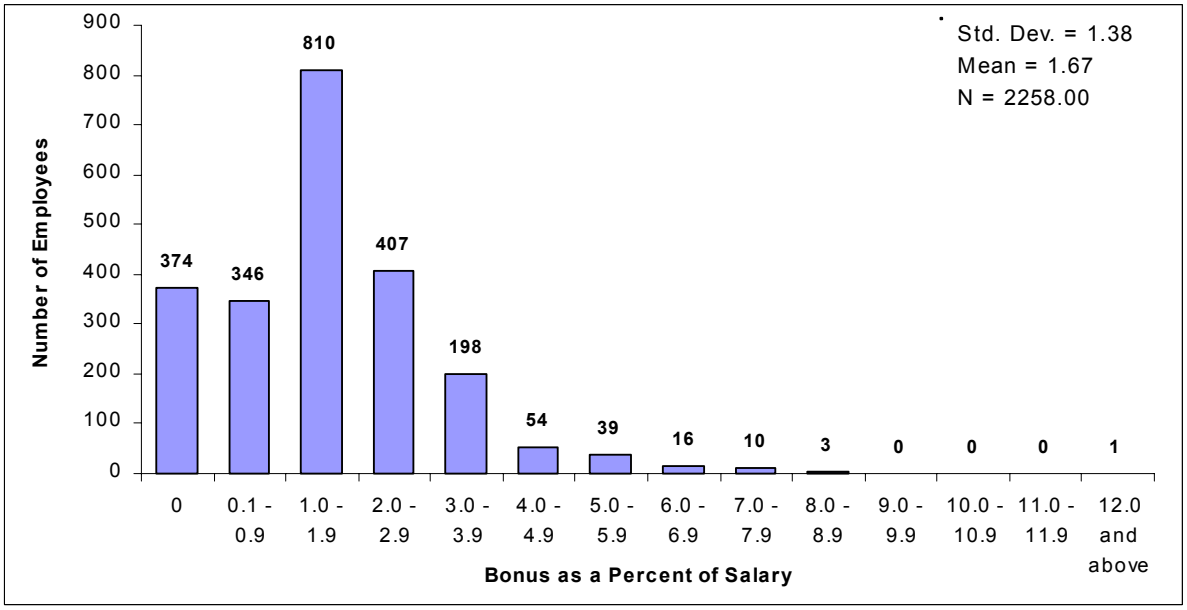
Year One—Range of Percent Salary Increases for Demonstration Group Employees



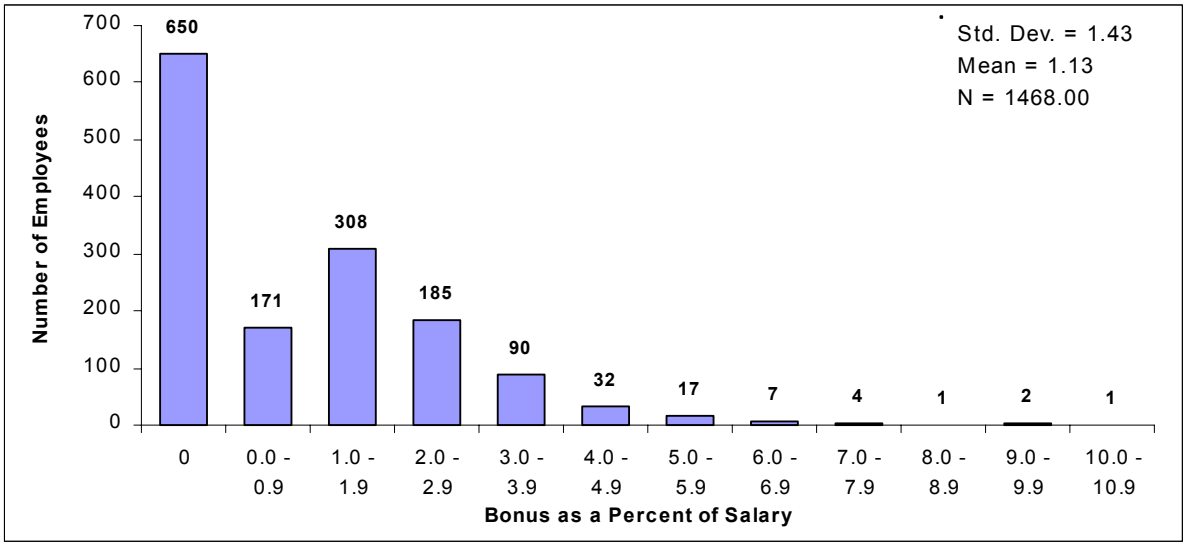
Year One—Range of Percent Salary Increases for Comparison Group Employees



Year One—Range of Bonus Percentages for Demonstration Group Employees



Year One—Range of Award Percentages for Comparison Group Employees



Year Two Objective Data Results

Year Two—Comparisons of Starting Salary Ranges Among New Hires in the Demonstration and Comparison Groups

	Demonstration Group		Comparison Group	
	Number of New Hires*	Size of Range of Starting Salaries	Number of New Hires	Size of Range of Starting Salaries
ZA				
Band 1	1	$0	1	$0
Band 2	16	**$16492**	2	$1817
Band 3	8	**$23000**	2	$12894
Band 4	7	**$18171**	6	$16401
Band 5	2	$10754	0	$0
ZP				
Band 1	2	**$7372**	5	$5902
Band 2	24	**$20059**	56	$12214
Band 3	37	**$25927**	31	$22351
Band 4	31	$31657	10	**$35752**
Band 5	5	$21505	0	$0
ZS				
Band 1	10	**$6513**	3	$4008
Band 2	13	$5106	5	**$23938**
Band 3	10	$10656	11	**$11695**
Band 4	6	**$10585**	4	$2592
Band 5	3	$6278	0	$0
ZT				
Band 1	11	**$8814**	25	$6983
Band 2	2	$7526	32	**$9704**
Band 3	2	$8063	3	**$9849**
Band 4	2	$5858	0	$0
Band 5	0	$0	0	$0

** The number of cases used in this analysis is based on the number of new hires for whom starting salary, career path, and pay band data were available (i.e., 192 out of 313 new hires)*

Year Two—Turnover Rates by Group

GROUP	TURNOVER RATE
Demonstration Group	**13%**
Comparison Group	**10%**

Year Two—Demonstration Group Turnover Rates by Level of Performance

PERFORMANCE RATING	NUMBER OF EMPLOYEES*	TURNOVER RATE
All Ratings	**2275**	**10%**
90-100	748	10%
80-89	923	9%
70-79	468	11%
60-69	105	9%
50-59	34	18%
40-49	1	0%

** Participants with Valid Performance Ratings in Year 2.*

Year Two—Performance Category and Demonstration Group Participants Receiving No Performance-Based Pay Increases

PERFORMANCE CATEGORY	NUMBER OF EMPLOYEES	NUMBER OF EMPLOYEES WITH NO SALARY INCREASE	PERCENT RECEIVING NO SALARY INCREASE
90-100	748	34	5%
80-89	923	61	7%
70-79	468	51	11%
60-69	105	48	46%
50-59	34	21	62%
40-49	1	1	100%

Year Two—Performance Category and Performance-Based Pay Increases

PERFORMANCE CATEGORY	NUMBER OF EMPLOYEES	AVERAGE PAY INCREASE PERCENT
90-100	748	3.9%
80-89	923	2.9%
70-79	468	1.7%
60-69	105	0.9%
50-59	34	0.5%
40-49	1	0.0%

Year Two—Average Increases, Bonuses, and Total Awards as a Percent of Salary

Type of Award	Average Award (as a % of salary)
Pay Increase*	
Stayers	2.9%
Leavers	2.6%
Bonus	
Stayers	1.6%
Leavers	1.7%
Total Awards	
Stayers	4.5%
Leavers	4.3%

* Difference was statistically significant at the P≤.05 level.

Year Two—Average Increases and Bonuses (in Dollars)

Type of Award	Average Award
Pay Increase*	
Stayers	$1626
Leavers	$1410
Bonus	
Stayers	$934
Leavers	$946

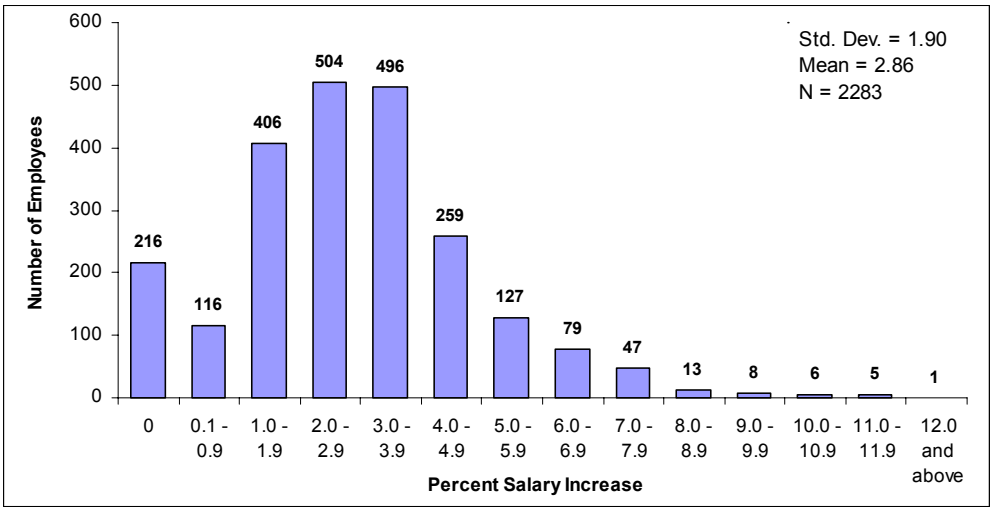
* Difference was statistically significant at the P≤.01 level.

Year Two—Turnover Among Supervisors

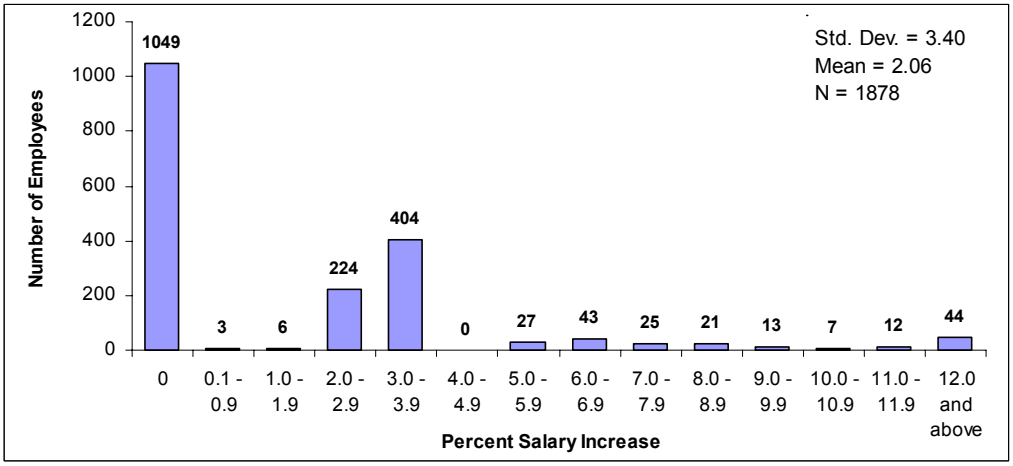
Group	Overall Number	Turnover Rate *
Demonstration Group*		
All Employees	2740	13%
All Supervisors	218	13%
Supervisors Receiving Supervisory Performance Pay	44	7%
Comparison Group *		
All Employees	1928	10%
Supervisors Only	149	7%

* Number of employees who left divided by the total number of employees

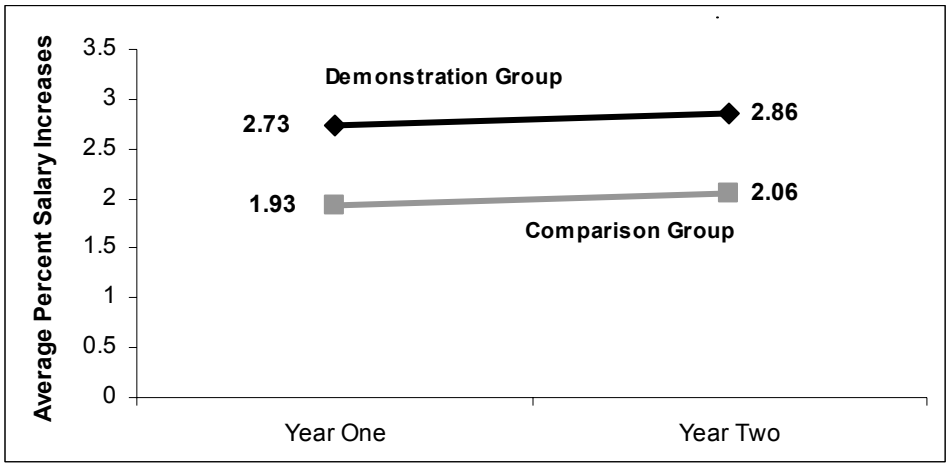
Year Two—Range of Percent Salary Increases for Demonstration Group Employees



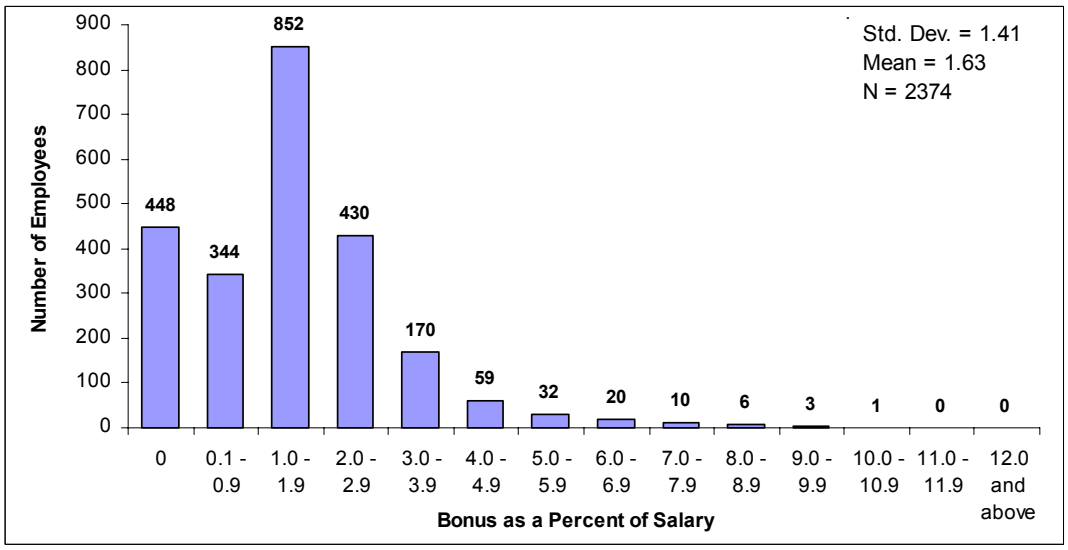
Year Two—Range of Percent Salary Increases for Comparison Group Employees



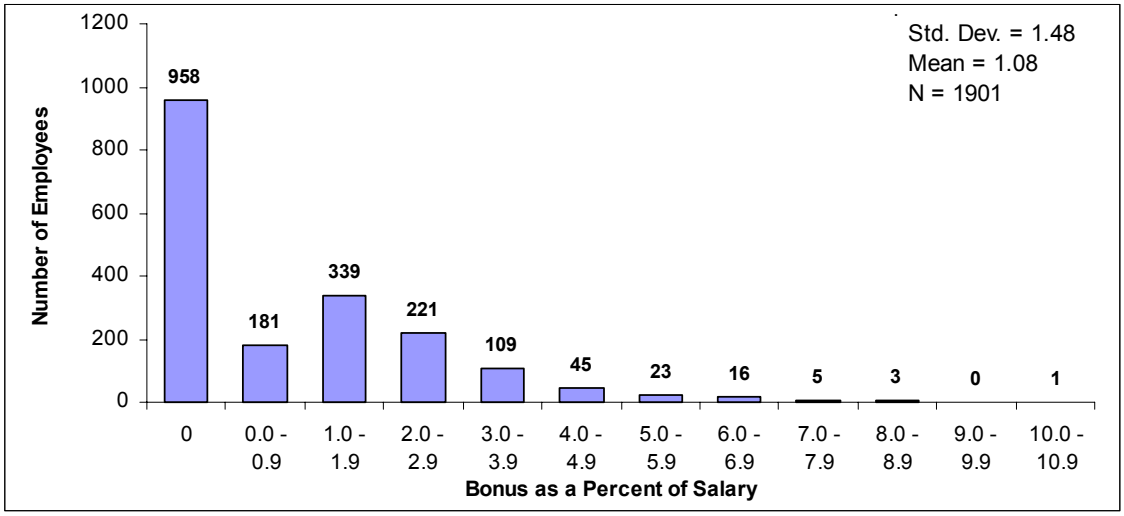
Year Two—Trend Analysis of Average Percent Salary Increases



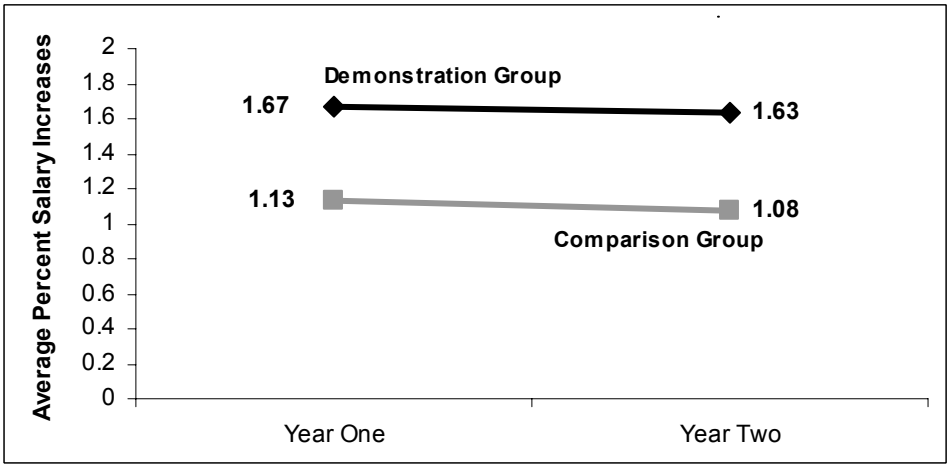
Year Two—Range of Bonus Percentages for Demonstration Group Employees



Year Two—Range of Award Percentages for Comparison Group Employees



Year Two—Trend Analysis of Average Bonus/Award Percentages



Year Two—Diversity of New Hires Compared to the Overall Demonstration Group

Category	New Hires (N=313)*		All Demonstration Group Employees (N=2,740)*	
Minority--Non-Minority	25%	75%	20%	81%
Women--Men	44%	56%	40%	60%
Veteran--Non-Veteran	12%	88%	9%	91%

* May not add to 100% due to rounding

Year Two—Average Performance Appraisal Scores (Raw), Pay Increase Percentages (Raw and Adjusted), and Bonus Percentages (Raw and Adjusted) for the Demonstration Group

	Performance Appraisal Scores	Average Pay Increase Percentage		Average Bonus Percentage	
		Raw	Adjusted	Raw	Adjusted
Minority	82.7 points	2.8%	2.7%	1.5%	1.5%
Non-Minority	83.6 points	2.9%	2.9%	1.6%	1.6%
Female	83.9 points	3.1%	2.7%	1.8%	1.8%
Male	83.1 points	2.7%	2.9%	1.5%	1.5%
Veteran	81.8 points	2.5%	2.8%	1.4%	1.5%
Non-Veteran	83.6 points	2.9%	2.9%	1.6%	1.6%
Total	**83.4 points**	**2.9%**	--	**1.6%**	--

Notes:

1. *The average performance appraisal score for each Demonstration Group subgroup is the average number of points received under the 100-point system. Performance data for Demonstration Group employees are based on appraisals conducted in September 1999, and as reported in the Year Two data file provided by DoC. Average increase and bonus percentages are based on actions effective in November 1998, as reported in the Year Two data file provided by DoC.*
2. *The minority group includes all non-White personnel, specifically Blacks, Hispanics, Asians, and American Indians.*
3. *Adjusted averages were computed by statistically controlling for performance rating, career path, and length of service.*

Year Two—Comparison of Performance Appraisal Scores (Raw), Average Pay Increases (Adjusted), and Average Bonuses/Awards (Adjusted)

	Performance Appraisal Scores		Average Pay Increase Percentage		Average Bonus/ Award Percentage	
	Demonstration Group	Comparison Group	Demonstration Group	Comparison Group	Demonstration Group	Comparison Group
Minority	82.7 points	100% Pass; 0% Fail	2.7%	2.5%	1.5%	1.2%
Non-Minority	83.6 points	100% Pass; 0% Fail	2.9%	2.5%	1.6%	1.3%
Female	83.9 points	100% Pass; 0% Fail	2.7%	2.8%	1.8%	1.5%
Male	83.1 points	100% Pass; 0% Fail	2.9%	2.3%	1.5%	1.2%
Veteran	81.8 points	100% Pass; 0% Fail	2.8%	2.3%	1.5%	0.9%
Non-Veteran	83.6 points	100% Pass; 0% Fail	2.9%	2.5%	1.6%	1.3%

Notes:

1. *The performance appraisal score presented for the Demonstration Group is the average number of points received under the 100-point system. The numbers presented for the Comparison Group are the percentages of employees who received "Pass" or "Fail" under the 2-level system. Performance data for Demonstration Group employees are based on appraisals conducted in September 1999, and as reported in the Year Two data file provided by DoC. Performance data for Comparison Group employees are based on appraisals occurring between April 1, 1999 and March 31, 2000 and as reported in the Year Two data file provided by DoC.*
2. *Average pay increase and bonus/award percentages are based on actions occurring during the 1999 performance evaluation cycle that ended 9/30/99 and as reported in the Year Two data file provided by DoC.*

Year Two—Turnover in the Demonstration Group, All Participants and High Performers

	All Participants			High Performers		
Group	**Number**	**Number Separated**	**Percent Separated**	**Number**	**Number Separated**	**Percent Separated**
Minority	520	63	12%	113	10	9%
Non-Minority	2,220	301	14%	638	62	10%
TOTAL	**2,740**	**364**	**13%**	**751**	**72**	**10%**

Year Two—Comparison of Turnover Rates in the Demonstration and Comparison Groups

	Demonstration Group			Comparison Group		
Group	**Number**	**Number Separated**	**Percent Separated**	**Number**	**Number Separated**	**Percent Separated**
Minority	520	63	12%	232	32	14%
Non-Minority	2,220	301	14%	1,696	151	9%
TOTAL	**2,740**	**364**	**13%**	**1,928**	**183**	**10%**