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Public Perceptions of the Midwest's Pavements - Iowa - Phase III

David Kuemmel
Marquette University, david.kuemmel@marquette.edu

Richard Robinson
Marquette University, richard.robinson@marquette.edu

Robert J. Griffin
Marquette University, robert.griffin@marquette.edu

Ronald C. Sonntag
Marquette University

James K. Giese
Marquette University

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FINAL PHASE III REPORT

Targeted Surveys

IOWA

Final Report of the Relationship of Pavement Quality with Driver Satisfaction

PUBLIC PERCEPTIONS OF THE MIDWEST'S PAVEMENTS

Submitted to the IOWA DOT

Prepared by the Marquette University Research Team

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BACKGROUND, PHASE II RESULTS

There are several conclusions from Phase II results in Iowa and in all three states that should be repeated here. Team judgements have been added in *italics* where a different approach to Phase II results may be necessary now that Phase III results are available.

- Because highways were self-selected, there was over-sampling of better highways.

- The research team theorized that the perceptions were generalized over an entire stretch of highway which participants drove, and since it was a route regularly traveled, this, too, may have affected perceptions.

- Levels of satisfaction were very high. The percent satisfied was taken as a cumulative percent, i.e., approximately 74 percent of respondents were satisfied with the highway identified, and the upper limit of the pavement condition index (PCI) was approximately 89. *It was stated that it took a PCI of near 90 to satisfy 74 percent of the public. That may have been an incorrect statement because of the way the sample was skewed.*

- The PCI level at which 40 percent of the participants believed the pavement should be replaced was at approximately 49. *It was stated that it took a low PCI before only 40 percent of the participants believed a pavement should be replaced.*

- The research team speculated that the answers to the policy questions (public wanted longer lasting pavements, were not tolerant of travel delays) may have influenced the above results.

- There was low direct correlation between highway physical attributes and public satisfaction. It is expected this will be higher in Phase III, but will not entirely account for satisfaction.

- The Fishbein/Ajzen model performed well in explaining public satisfaction, accounting for about 65 percent of the variance in satisfaction. This was considered "respectable" for the social sciences, when trying to predict something as complex as a person's satisfaction.

PHASE III CHANGES

Phase III sampling and survey techniques were changed to address issues identified above.

- Sampling was stratified. However, there was still over-sampling of better roads in the segments provided by the Iowa DOT. It was difficult to find "poor" highways in the state particularly in urban areas, especially after removing those scheduled for reconstruction.

- The larger stratified sample, which was based on pavement conditions, produced good results.

- Participants were first recruited, then surveyed after driving the pre-selected segment. This segment may or may not have been a route driven regularly.
- Estimated times for the recruitment and post-drive interviews were 5 minutes and 8 minutes, respectively, in the project work plan. Actual interview times were approximately 6.7 minutes for the recruitment interview and 12.1 minutes for the post drive interview. Faced with the choice of requesting more funds or shortening the survey questionnaire, the research team chose to push ahead, assuming the incentive payment would reduce recruitment time, which was built into the estimate but does not show in the time stamps. The response rate was 45 percent The greater length of the post-drive interview was addressed by allowing sampling to be reduced to a minimum of 100 interviews per cell. This reduced the amount of usable completed responses to 676 in Iowa, instead of 760 in the work plan. The final decision on sample size was addressed with an analysis aimed at evaluating sample homogeneity. This proved to be a reliable tactic and is addressed in the Phase III results.

- No policy questions were included in Phase III in Iowa.

- The team expected higher correlation between highway physical attributes and public satisfaction because of sampling procedures. The team expected, however, that a psychological model would be necessary to explain satisfaction. So all questions that significantly measured satisfaction in Phase II were included in Phase III.

INTRODUCTION TO PHASE III

There are several objectives to this report. **The first objective** is to describe the sample with regard to the physical pavement data and three measures of driver satisfaction. In this section, the proportion of respondents who are satisfied with pavements on two-lane, rural, state highways will be examined and the distribution of pavement condition and roughness indices will be presented.

The second objective will be a short description of the highway segments and any differences in satisfaction found between regions and pavement types. This was done in Phase II in each state and a letter sent showing the results in all three states. That letter sets forth the revised work plan and budget for Phase III of the project.

The third objective is to describe the relationship between physical pavement characteristics and driver satisfaction. This will include a description of both the magnitude of relationship as well as identifying critical International Road Index (IRI) and Pavement Condition Index (PCI) cutoffs where a majority of the sample were satisfied. This will be done for comparative purposes with the **Phase II approach**, using the total sample to compute cumulative percentages responding to each of the three series of satisfaction questions.

It was decided by the team to present results of **Objectives 1, 2, and 3** in a manner identical to Phase II. This will allow direct comparison of the results in both phases.

A fourth objective uses the relationships between pavement characteristics and driver satisfaction to develop thresholds for pavement improvement by the Iowa DOT.

A fifth objective is to use a psychological model (Expectancy-Value theory; Fishbein & Ajzen, 1975) to explain the nature of the relationship between satisfaction and physical pavement characteristics.
Finally, **a sixth objective** includes special analyses of the survey data which may be of interest to the Iowa DOT. The team included some of the policy issues and questions that could arise in reading this report. Many others are possible, but only a few are included to show the kinds of analyses that are possible with the survey results.

Sample Description

This section provides an overview of the sample of 676 Iowa respondents in terms of demographics and driving/vehicle characteristics. Demographics included gender, age, and education. The Driving/Vehicle characteristics included driving frequency, vehicle type, quality of ride, commercial driver and motorcycle licenses.

With regard to gender, the final sample was divided between 53.3% males and 46.7% females. This compares with a 56.8% vs. 43.2% male/female split in the Phase II sample of 384 Iowa respondents. One-third of the drivers were in the 36-49 year old age category, while 25.7% were 18-35 and 40.8% were aged 50 and older. Over one-fourth of the 676 respondents were college graduates. Somewhat

fewer respondents (22.7%) in Phase II had college degrees.

In terms of driving frequency, almost one-fourth (24.4%) drove the designated highway stretch more than once a week. Over one-third (35.4%) drove it once a month, while 15.8% drove the stretch once a year. Because Phase II highway sections were selected by the people surveyed, no comparisons are possible for this section with Phase II results. As to vehicle type, over half (52.2%) drove cars, with the next two largest segments being pickup trucks (23.8%) and minivans/vans (11.5%). These compare with 53.6% cars, 26.6% pickups, and 10.7% minivans/vans in the Phase II sample.

Quality of ride reported for respondents' vehicles comprised 73.1% "good or very good," with only 4.4% "poor or very poor." Phase II had comparable frequencies with 72.9% and 3.9% respectively. Finally, with regard to other licenses, 15.8% held commercial driver licenses whereas 15.4% had motorcycle licenses. Phase II percentages were slightly higher with 19% CDL and 16.9% motorcycle licenses.

Several questions with open-ended responses were categorized for analysis purposes. Question 100 (age) was open-end as to year of birth. For the cross-tab analysis, the open-end responses needed to be consolidated into groups. The resulting groups reflected a reasonable division of the response data. Likewise, the response categories for education, Q108, were condensed to three for more effective analysis.

OBJECTIVE 1:
DESCRIBING DRIVER SATISFACTION AND PHYSICAL PAVEMENT CHARACTERISTICS

As with Phase II of the study, respondents were asked how much they agree or disagree with three statements about the quality of a selected section of state highway pavement which they were assigned to drive. The distribution of responses can be seen in **Table 1.1**. The analysis consists of 676 respondents.

Table 1.1: Frequency and percent of respondents who agreed or disagreed with three satisfaction assessment (threshold) statements.
(Analysis includes only respondents who drove on segments that met inclusion criteria)

Value Label	Value	Frequency	Percent
Q57. I AM SATISFIED WITH THE PAVEMENT ON THIS SECTION OF HIGHWAY			
STRONGLY DISAGREE	1	76	11.2
SOMEWHAT DISAGREE	2	98	14.5
FEEL NEUTRAL	3	40	6.0
SOMEWHAT AGREE	4	188	27.8
STRONGLY AGREE	5	274	40.5
	Total	676	100.0
Q58. THE PAVEMENT ON THIS SECTION IS BETTER THAN MOST SECTIONS OF STATE HIGHWAYS I'VE DRIVEN RECENTLY.			
STRONGLY DISAGREE	1	104	15.4
SOMEWHAT DISAGREE	2	115	17.0
FEEL NEUTRAL	3	120	17.8
SOMEWHAT AGREE	4	199	29.4
STRONGLY AGREE	5	138	20.4
	Total	676	100.0
Q59. THE PAVEMENT ON THIS SECTION SHOULD BE IMPROVED			
STRONGLY DISAGREE	1	142	21.0
SOMEWHAT DISAGREE	2	128	18.9
FEEL NEUTRAL	3	78	11.5
SOMEWHAT AGREE	4	181	26.8
STRONGLY AGREE	5	147	21.7

In summary, 68% percent (462) of respondents strongly agreed or somewhat agreed that they were satisfied with the pavement. Fifty percent (50% or 337) of respondents strongly agreed or somewhat agreed that the pavement was better than most stretches of state highway. Approximately half (49% or 328) of the sample said that the pavement on their identified stretch of highway should be improved.

Two physical pavement measures were analyzed for Phase III. International Roughness Index (IRI) values typically range from 0 to 5 with higher values indicating a rougher pavement surface. Thirteen highway segments provided by the Iowa DOT had missing values on IRI. This reduced the sample size by 62 (from 676 to 614) for all analyses including IRI as a variable . As expected, the distribution was positively skewed, with relatively more roads in the Very Good and Good range and relatively fewer roads in the Poor and Very Poor range. The minimum and maximum IRI values for the highways furnished by the Iowa DOT in the sample were 0.71 and 5.18, respectively. Table 1.2 presents a scale to facilitate interpretation. The mean IRI value of the sample was approximately 2.1, with a standard deviation of .94. The median IRI value was approximately 2.2.

Table 1.2: IRI Interpretive Categories
(as provided by Iowa DOT)

Range	***Interpretive Category***
0.00 - 1.4	Very Good
1.41 - 2.2	Good
2.21 - 3.0	Fair
3.01 - 3.80	Poor
>3.81	Very Poor

Scores on the Pavement Condition Index (PCI) values range from 0 to 100 with higher values indicating better pavement quality. The minimum and maximum PCI values for highways in the sample furnished by Iowa were 0 and 89, respectively. **Table 1.3** presents a scale to facilitate interpretation. The mean PCI value of the sample was 59 with a standard deviation of 20.9. The median PCI value was 61. As expected, the distribution was negatively skewed because of the sampling procedures employed. Relatively more roads of Excellent and Good quality were sampled.

Table 1.3: PCI Interpretive Categories
(as provided by Iowa DOT)

Range	***Interpretive Category***
100 to 80	Excellent
79 to 60	Good
59 to 40	Fair
39 to 0	Poor

OBJECTIVE 2:
DESCRIBING THE HIGHWAY SEGMENTS SAMPLED AND TESTING FOR DIFFERENCES.

Iowa DOT requested sampling across two regions (urban, rural) and three pavement types, Portland Cement Concrete (PCC), Asphaltic Concrete (AC), and a composite pavement (generally an AC overlay on prior PCC pavement). These are referred to in this report respectively as PC, AC and COMP Within each of these cells, pavements of excellent, good, fair and poor quality were sampled. **Table 2.1** presents targeted numbers and actual completed interviews by pavement type, pavement quality and region. The differences were primarily due to a change in the segments furnished, as well as a reduction to a minimum of 100 responses per cell (per region or pavement type).

Table 2.1: Targeted and Completed Interviews by Region, Pavement Type and Pavement Quality.

	Urban			Rural		
	PCI	Target	Actual	PCI	Target	Actual
PC	Poor	**40**	**(10)**	Poor	**40**	**(25)**
	Fair	**45**	**(56)**	Fair	**45**	**(31)**
	Good	**30**	**(46)**	Good	**30**	**(33)**
	Excellent	**20**	**(17)**	Excellent	**20**	**(27)**
AC	Poor	**40**	**(8)**	Poor	**40**	**(27)**
	Fair	**45**	**(20)**	Fair	**45**	**(28)**
	Good	**30**	**(47)**	Good	**30**	**(31)**
	Excellent	**20**	**(24)**	Excellent	**20**	**(23)**
COMP	Poor	**40**	**(26)**	Poor	**40**	**(25)**
	Fair	**45**	**(31)**	Fair	**45**	**(24)**
	Good	**30**	**(36)**	Good	**30**	**(30)**
	Excellent	**20**	**(27)**	Excellent	**20**	**(24)**

In total, 676 interviews were completed. This was 84 interviews shy of the targeted 760. Only 152 highway segments (instead of 156) were submitted by Iowa, with the planned five surveys per highway. This change in the work plan was approved by mutual agreement between Marquette University and the Iowa DOT staff. An analysis was conducted to determine if more interviews would be needed for the purposes of statistical power. That is, if there were basic differences in the relationships between pavement characteristics and satisfaction as a function of region or pavement type, then subsequent analyses would have to be run using only a fraction of the data set. This would reduce the sample size used in the analysis and statistical power would be compromised.

Therefore, analyses were conducted to search for differences in satisfaction as a function of region or pavement type. For these analyses, only those subjects who agreed or strongly agreed with Q57 were included (i.e., "I am satisfied with this section of highway"). These respondents were selected to identify the possible presence of mean differences in PCI and IRI cutoffs for those who are satisfied. Specifically, a series of ANOVAs with F tests (for three variables) and T-tests (for pairs) were conducted, using IRI or PCI as the dependent variable and region or pavement type as the independent variable. If significant differences were detected, a different psychological dynamic may be needed to explain the inconsistencies and subsequent analyses may have to focus on a particular pavement or regional subgroup.

There are statistically significant differences in IRI between urban and rural pavements (see **Table 2.2**). These statistical differences were not large enough to warrant separate analysis, based on team judgement, especially in light of lack of statistical differences in PCI discussed below on this page. This analysis was replicated for each pavement type. The justification for this assumption will be shown for IRI differences between urban and rural pavements later in Objective 4.

There are significant differences in mean IRI as a function of pavement type (for both urban and rural regions) among those satisfied. Higher mean IRI values were found on PC pavements. That is, the average IRI value (among those respondents that were satisfied) was significantly higher (higher indicating poorer pavement quality) for PC pavements than AC or COMP. This difference was much larger than that for regions, and is deemed sufficient to warrant separate analysis for PC pavements. AC and COMP pavements were significantly different from each other, but the differences are not large enough to warrant separate analysis in the team's opinion. In light of a lack of differences for PCI, AC and COMP pavements will be analyzed as a group. Psychologically, respondents would appear to be more tolerant of a poorer ride on PC pavements than they are on AC or COMP pavements.

Parallel analyses were conducted using PCI. No significant differences in PCI were found between urban/rural classification or among the three pavement types. The results of these analyses are presented in **Table 2.3**.

Both sets of analyses (IRI and PCI) were replicated including those who also felt neutral about the statement "I am satisfied with this section of highway". The results of these analyses paralleled the results found in Tables 2.2 and 2.3, with one exception. Urban PC pavements were found to have a statistically significantly lower PCI (59.16) than AC pavements (64.85) ($F = 3.04$, $p < .049$). Practically, this difference is small. This confirmed for the team that the sample size was sufficient.

Table 2.2: Mean IRI Scores by Region and Pavement Types for Respondent who were Satisfied with the Pavement.

PAVEMENT TYPE	MEAN IRI URBAN	MEAN IRI RURAL	t-value	P	Sig. diff.?
PC	2.60	2.48	2.91	.004	YES
AC	1.47	1.74	1.90	.06	NO
COMP	1.88	1.47	2.61	.01	YES

REGIONAL CLASSIF.	MEAN IRI PC	MEAN IRI AC	MEAN IRI COMP	F-value	P	Sig. diff.?
URBAN	2.60	1.46	1.88	28.41	<.001	YES
RURAL	2.48	1.74	1.47	22.31	<.001	YES

Note: For the analysis immediately above, post-hoc analyses indicate that all possible combinations were sig. different. That is, PC > AC, PC > COMP and COMP > AC..

Table 2.3: Mean PCI Scores by Region and Pavement Types for Respondents who were Satisfied with the Pavement.

PAVEMENT TYPE	Mean PCI URBAN	Mean PCI RURAL	t-value	P	Sig. diff.?
PC	59.7	62.3	.90	.369	NO
AC	65.8	62.4	1.00	.317	NO
COMP	64.0	63.1	.21	.84	NO

REGIONAL CLASSIF.	Mean PCI PC	Mean PCI AC	Mean PCI COMP	F-value	P	Sig. diff.?
URBAN	59.7	65.84	64.04	2.20	.113	NO
RURAL	62.4	62.40	63.28	.045	.956	NO

Because of significance of differences or lack thereof displayed in Table 2.2, it was concluded that more samples would not likely change the conclusions on statistical difference.

A special effort was made by the Wisconsin Survey Research Lab (WSRL) to over-sample highway segments where the stratified sample requested in the work plan was not able to be achieved by the Iowa DOT. This approach, as illustrated in Table 2.1, proved satisfactory and no further survey work was necessary in Iowa.

OBJECTIVE 3:
DESCRIBING THE RELATIONSHIP BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION USING PHASE II METHODOLOGY

The third objective of this study is to describe the relationship between pavement characteristics and driver satisfaction. The fundamental question of when drivers are satisfied with the condition of the pavement surface has important policy implications — namely, what distress and roughness levels are tolerated by the public? This question was investigated using the same strategy employed in Phase II. IRI and PCI values were identified for the cumulative percent of respondents who agreed with each the three satisfaction questions (Q57, Q58, and Q59). Using this technique, the researchers were able to answer questions such as "at what IRI value might we expect 70% of all participating drivers to be satisfied with a given section of highway?" For this analysis, the three measures of satisfaction were recoded into an agree-disagree format, such that responses of "strongly agree" and "agree" coded as "1" and responses of "feel neutral," "disagree" and "strongly disagree" were coded as "0." **Table 3.1** presents IRI cutoff values as related to the statement "I am satisfied with the pavement on this section of highway." For this analysis, IRI values were ranked from high (poor) to low (good) for IRI for respondents who agreed with the three satisfaction questions. Using this distribution of decreasing IRI scores, the team pinpointed key pavement index values as a function of the cumulative percent of the sample that agrees with each of the satisfaction questions. Similar data is presented for Q 58 and Q 59 in **Tables 3.2** and **3.3**. The ranges presented in Tables 3.1 - 3.3 represent 95% confidence intervals based on the standard error of the IRI used in the sample.

Looking at data for the entire sample, the first thing that stands out is the similarity of Phase II and III results for Q 57. The range for Phase II IRI, satisfying 74 percent of the respondents, was approximately 0.7 to 2.4. In Phase III, a range of approximately 0.9 to 2.9 included the 68 percent who strongly agreed or agreed with the statement in question 57 (satisfied with pavement). The percent is a function of the sample range of pavements. Phase III had a broader range of report pavements from "poor" to "excellent." The parallels for Q 58 and 59 are different partly because of sampling differences (larger stratified sample in Phase III)

A similar procedure was employed for PCI scores. The data for PCI is shown in **Tables 3.4, 3.5** and **3.6**. For both pavement indices, cutoffs were identified for each of the three (3) satisfaction measures as well as within and across region (i.e., urban vs. rural) and pavement types (i.e., AC, PC, COMP). The ranges presented in Tables 3.4 - 3.6 represent 95% confidence intervals based on the standard error of PCI used in the sample. **Figures 3.1 and 3.2** are prepared from **Tables 3.1 - 3.6** and show the cumulative percent of respondents who agreed with all three questions, plotted against the respective IRI and PCI values, for all pavements.

Again, looking at PCI data for the entire sample, Phase III results follow Phase II for Q 57. The range for Phase II, satisfying 74 percent of the respondents, was approximately 59 to 89. In Phase III, a range of approximately 31 to 91 included the 68 percent who strongly agreed or agreed with the statement in question 57 (satisfied with pavement). The percent is a function of the sample range of pavements. Phase III had a broader range of pavements from "poor" to "excellent."

Table 3.1: IRI Cutoffs for Question 57
At what IRI values did X percent of the respondents agree or strongly agree with the following statement:

"I am satisfied with the pavement on this section of highway."

		Cumulative Percent							
	Sample Size	10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	614	2.9	2.5	2.0	1.7	1.2	1.0	-	423/614 or 69%
Urban Rural combined									
PC	240	3.2	2.8	2.5	2.3	1.9	1.8	1.1	169/240 or 70%
AC	171	2.5	1.9	1.7	1.2	1.0	.8	.7	120/171 or 70%
COMP	203	2.7	1.9	1.4	1.2	1.1	.9	-	134/203 or 66%
Pavement type combined									
Urban	312	3.1	2.6	2.0	1.8	1.2	1.0	0.8	218/312 or 70%
Rural	302	2.6	2.3	1.9	1.7	1.2	1.0	-	205/302 or 68%
Individual cells									
Urban PC	124	3.2	3.0	2.6	2.3	1.9	1.8	-	82/124 66%
Rural PC	116	3.2	2.6	2.4	2.0	1.8	1.7	1.2	87/116 75%
Urban AC	85	2.5	1.9	1.3	1.1	1.0	.9	.7	66/85 78%
Rural AC	86	2.5	2.0	1.9	1.3	1.0	.7	-	54/86 63%
Urban Comp	103	3.0	2.4	1.8	1.2	1.1	.9	-	70/103 68%
Rural Comp	100	2.5	1.8	1.3	1.1	1.0	.8	-	62/100 62%

The thresholds presented in this table were based on a cumulative distribution of IRI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus .1 (e.g., the CI for 2.9 would be 2.8 to 3.0).

Table 3.2: IRI Cutoffs for Question 58

At what IRI values did X percent of the respondents agree or strongly agree with the following statement:

"The pavement on this section of highway is better than most sections of state highways

		Cumulative Percent							
	Sample Size	10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	614	2.6	1.9	1.3	1.0	-	-	-	303/614 or 49%
Urban Rural combined									
PC	240	3.0	2.6	2.0	1.8	1.1	-	-	120/240 or 50%
AC	171	2.0	1.4	1.1	.9	.7	-	-	107/208 or 51%
COMP	203	2.0	1.2	1.1	.9		-	-	95/203 or 47%
Pavement type combined									
Urban	312	2.8	2.0	1.3	1.0	-	-	-	150/312 or 48%
Rural	302	2.4	1.9	1.4	1.1	.7	-	-	153/302 or 51%
Individual cells									
Urban PC	124	3.1	2.8	2.4	1.4	-	-	-	55/124 or 44%
Rural PC	116	3.0	2.3	1.9	1.8	1.2	-	-	65/116 or 56%
Urban AC	85	2.0	1.9	1.1	.9	.8	-	-	49/85 or 58%
Rural AC	86	2.0	1.4	1.0	.8	-	-	-	39/86 or 45%
Urban Comp	103	2.7	1.3	1.1	.9	-	-	-	46/103 or 45%
Rural Comp	100	1.9	1.2	1.1	.9	-	-	-	49/100 or 49%

The thresholds presented in this table were based on a cumulative distribution of IRI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus .1 (e.g., the CI for 2.6 would be 2.5 to 2.7).

Table 3.3: IRI Cutoffs for Question 59

At what IRI values did X percent of the respondents agree or strongly agree with the following statement:

"The pavement on this section should be improved"

	Sample Size	Cumulative Percent 10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	614	1.7	2.2	2.6	3.2	-	-	-	299/614 or 49%
Urban Rural combined									
PC	240	1.9	2.6	2.8	3.1	3.8	-	-	122/240 or 51%
AC	171	1.7	2.0	2.6	4.0	-	-	-	75/171 or 44%
COMP	203	1.3	1.9	2.4	2.8	4.5	-	-	102/203 or 50%
Pavement type combined									
Urban	312	1.8	2.3	2.8	3.2	-	-	-	149/312 or 48%
Rural	302	1.7	2.2	2.6	3.0	4.1	-	-	150/302 or 50%
Individual cells									
Urban PC	124	1.9	2.5	2.8	3.2	5.1	-	-	66/124 or 53%
Rural PC	116	2.0	2.6	2.8	3.0	-	-	-	56/116 or 48%
Urban AC	85	1.7	2.0	3.7	-	-	-	-	30/85 or 35%
Rural AC	86	1.9	2.0	2.5	2.8	4.0	-	-	45/86 or 52%
Urban Comp	103	1.2	1.8	2.3	2.8	-	-	-	50/103 or 49%
Rural Comp	100	1.1	1.8	2.2	2.6	4.1	-	-	50/100 or 50%

The thresholds presented in this table were based on a cumulative distribution of IRI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus .1 (e.g., the CI for 1.7 would be 1.6 to 1.8).

Table 3.4: PCI Cutoffs for Question 57

At **what PCI values did X percent of the respondents agree or strongly agree with the following statement:**

"I am satisfied with the pavement on this section of highway"

		Cumulative Percent							
	Sample Size	10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	462	41	53	62	72	79	84	-	462/676 or 68%
Urban Rural combined									
PC	174	43	50	57	65	74	81	89	174/245 or 71%
AC	142	41	58	67	77	80	82	-	142/208 or 68%
COMP	146	35	58	68	78	81	85	-	146/223 or 66%
Pavement type combined									
Urban	244	41	53	61	71	78	81	89	244/348 or 70%
Rural	218	37	54	64	74	81	85	-	218/328 or 67%
Individual cells									
Urban PC	87	43	49	57	61	71	82	-	87/129 67%
Rural PC	87	37	53	60	68	74	81	87	87/116 75%
Urban AC	75	41	61	67	75	78	81	81	75/99 76%
Rural AC	67	35	54	64	79	82	88	-	67/109 62%
Urban Comp	82	33	56	66	78	80	85	-	82/120 68%
Rural Comp	64	40	59	68	79	82	89	-	64/103 62%

The thresholds presented in this table were based on a cummulative distribution of PCI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 41 would be 39 - 43).

Table 3.5: PCI Cutoffs for Question 58

At what PCI values did X percent of the respondents agree or strongly agree with the following statement:

"The pavement on this section of highway is better than most sections of state highways

		Cumulative Percent							
	Sample Size	10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	337	48	64	76	82	89	-	-	337/676 or 50%
Urban Rural combined									
PC	125	48	57	71	81	89	-	-	125/245 or 51%
AC	107	49	67	77	81	85	-	-	107/208 or 51%
COMP	105	51	70	80	85	-	-	-	105/223 or 47%
Pavement type combined									
Urban	224	45	61	72	81	89	-	-	224/348 or 50%
Rural	163	50	65	78	83	89	-	-	163/328 or 50%
Individual cells									
Urban PC	60	45	53	69	80	-	-	-	60/129 or 47%
Urban AC	58	42	66	72	78	81	-	-	58/99 or 59%
Urban Comp	56	40	70	79	85	-	-	-	56/120 or 47%
Rural PC	65	48	62	71	81	85	-	-	65/116 or 56%
Rural AC	49	50	72	80	85	-	-	-	49/109 or 45%
Rural Comp	49	59	68	80	83	-	-	-	49/103 or 48%

The thresholds presented in this table were based on a cummulative distribution of PCI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 48 would be 46 - 50).

Table 3.6: PCI Cutoffs for Question 59

At what PCI values did X percent of the respondents agree or strongly agree with the following statement:

"The pavement on this stretch of highway should be improved"

	Sample Size	Cumulative Percent 10%	20%	30%	40%	50%	60%	70%	% agreed total
Entire Sample									
Total	328	71	59	48	36	-	-	-	328/676 or 48%
Urban Rural combined									
PC	124	69	59	48	40	11	-	-	124/245 or 51%
AC	93	70	56	46	17	-	-	-	93/208 or 45%
COMP	111	72	59	47	33	10	-	-	111/223 or 50%
Pavement type combined									
Urban	163	71	60	49	40	-	-	-	163/348 or 47%
Rural	165	70	54	44	32	2	-	-	165/328 or 50%
Individual cells									
Urban PC	68	71	61	52	46	37	-	-	68/129 or 53%
Urban AC	36	66	51	42	-	-	-	-	36/99 or 36%
Urban Comp	59	75	60	51	36	-	-	-	59/120 or 49%
Rural PC	56	62	53	40	22	-	-	-	56/116 or 48%
Rural AC	57	72	56	50	35	2	-	-	57/109 or 52%
Rural Comp	52	71	57	45	32	14	-	-	52/103 or 50%

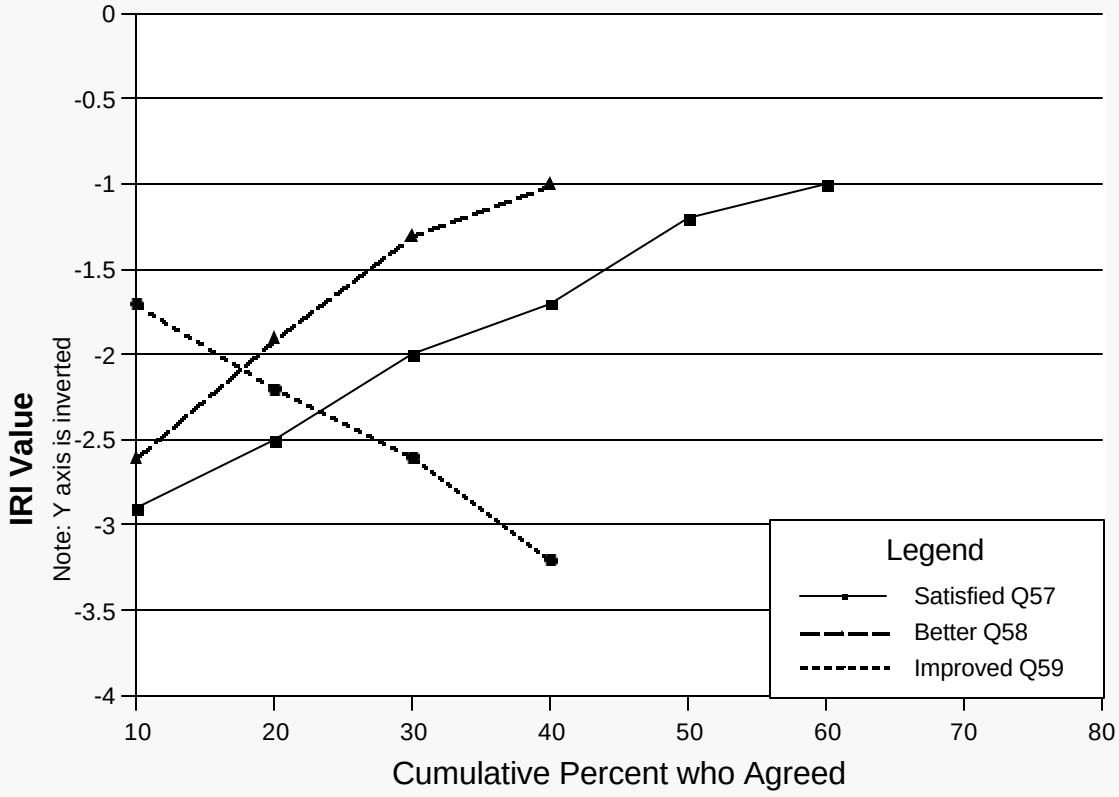
The thresholds presented in this table were based on a cumulative distribution of PCI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 71 would be 69 - 73).

Figure 3.1:
At what IRI values did X% of respondents agree with the following three statements:

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



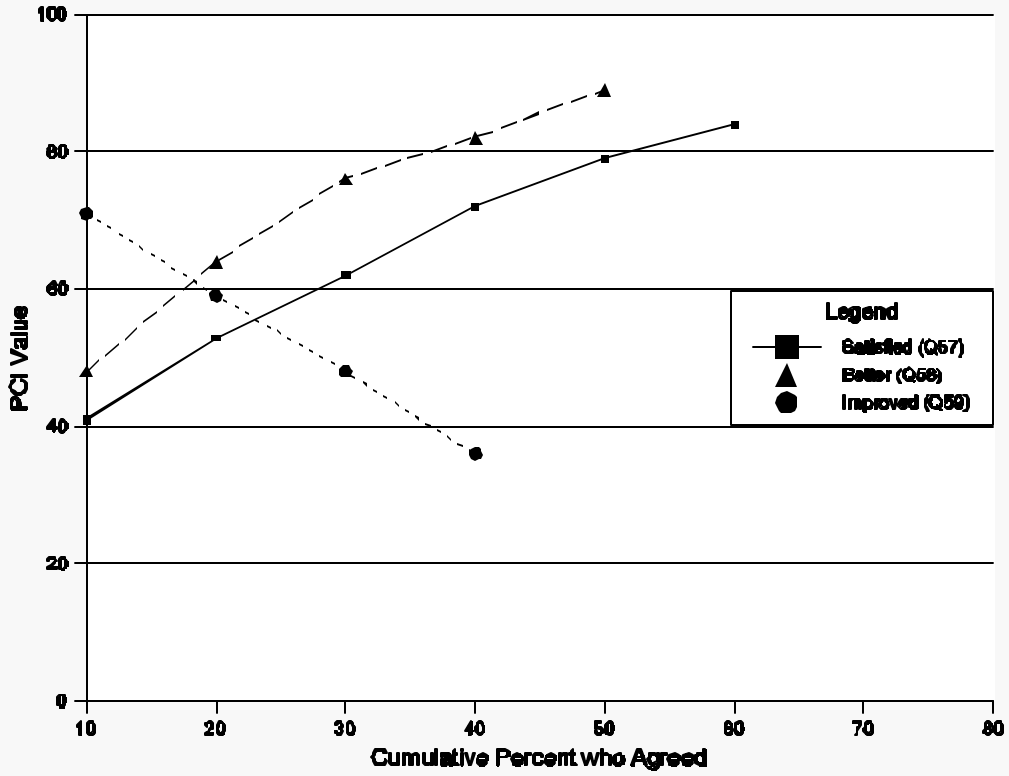
Data are graphed for the total sample (N = 676) and corresponds to data presented in Tables 3.4, 3.5 and 3.6.

Figure 3.2:
At what PCI values did X% of respondents agree with the following three statements:

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



Data are graphed for the total sample (N = 676) and corresponds to data presented in Tables 3.4, 3.5 and 3.6.

The intersection of the cumulative percent responses on Q57 and Q59 displayed in **Figures 3.1** and **3.2** are worth discussing. They are an IRI of approximately 2.3 and a PCI of approximately 55. Both Phase III intersections occur at approximately 25 percent level of the total sample. These compare closely to the Phase II analysis (Figures 2.1 and 2.2), with an IRI of 2.2 and a PCI of approximately 64. Both Phase II intersections occurred at 23 to 25 percent of the total sample. Phase III results resemble those of Phase II.

This changed the opinion of the team about the results of Phase II. It was thought that the self selection of highway segments by respondents and the respondents description of segment limits may have introduced error in selection of the appropriate physical data by the Iowa DOT. Likewise it was thought by the team that the policy questions affected both satisfaction and a decision to improve and thus may have been a factor in the results. The changes in methodology were made yet the results were very similar so the team believes this verified the methodology used in both phases.

DIRECT CORRELATIONS - PHYSICAL INDICES AND MEASURES OF SATISFACTION

Finally, another way of examining the relationship between driver satisfaction and physical indices of pavement condition and roughness is to look at the zero-order (i.e., uncontrolled) correlations between these two variables. Table 3.7 presents the relationships between these variables, including an overall index of "satisfaction" — the summation of the three "threshold" measures of satisfaction with pavement conditions:

- "I am satisfied with the pavement on this section of highway" (Q57);
- "The pavement on this stretch of highway is better than most of the stretches of state highways I've driven in Iowa"(Q58);
- "The pavement on this section of highway should be improved" (Q59, reverse coded);

Respondents indicated their agreement or disagreement with each item on a five-point, Likert-type scale. Reliability (Cronbach's alpha or α[1]) for the unidimensional satisfaction index is a satisfactory 0.86. This is a measure of how consistently each of the three questions were answered. Higher scores represent greater satisfaction. The satisfaction index should have a negative zero-order (i.e., uncontrolled) relationship with IRI because higher scores on IRI represent rougher pavement. In contrast, the satisfaction index should have a *positive* zero-order (i.e., uncontrolled), direct relationship with PCI because higher scores represent better pavement conditions.

Note:

1. Cronbach's alpha (α) is a standard measure of the internal consistency of an index or reliability of a summated scale i.e. reflecting "internal consistency," or the extent to which the items which comprise the scale co-vary and form a scale with a single underlying dimension (unidimensional, i.e. the component items all seem to be measuring the same underlying construct). Alpha can range from - 1 through + 1. Unacceptable alphas are any negative alpha or positive alphas less than 0.5. Marginal alphas range from 0.5 to about 0.75. Good alphas are 0.75 or above (some say 0.8 or above). The stronger the positive correlation among the items that comprise the scale, the higher the internal consistency of the scale, the higher the Cronbach's alpha value, and the lower the measurement error in the index.

As can be seen in Table 3.7, correlation of responses on satisfaction are similar for PCI and IRI. This implies that satisfaction as measured by questions in the survey can be measured using eithr IRI or PCI. All relationships were significant in the predicted direction. The magnitude of the relationship between satisfaction and pavement indices can be characterized as moderate. The size of the coefficients is respectable considering we are trying to predict "satisfaction," a construct of considerable psychological complexity. It compares well to Phase II and to the comparisons in the other states. Roughly 13 percent of the variance in satisfaction was predicted by physical pavement characteristics in Phase III. This is about 50% higher than in Phase II, and reaffirms why a psychological model is necessary to explain satisfaction.. This will be explained further in Objective 5.

Table 3.7: Pearson r (zero-order) correlations between satisfaction measures and indices of physical roughness and pavement condition.

	Physical Pavement Measure	
	IRI	**PCI**
(Q57) I AM SATISFIED WITH THE PAVEMENT ON THIS SECTION OF HIGHWAY.	**-.29*** **	**.31*** **
(Q58) THE PAVEMENT ON THIS STRETCH OF HIGHWAY IS BETTER THAN MOST OF THE STRETCHES OF STATE HIGHWAY I'VE DRIVEN ON RECENTLY IN IOWA .	**-.32*** **	**.31*** **
(Q59) THE PAVEMENT ON THIS STRETCH OF HIGHWAY SHOULD BE IMPROVED.	**.35*** **	**-.35*** **
SATISFACTION INDEX (THREE QUESTIONS COMBINED, WITH Q59 REVERSE-CODED)	**-.36*** **	**.36*** **

Significance key: ** p # .01 ***p# .001

OBJECTIVE 4:
DESCRIBING THE RELATIONSHIP BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION -

THRESHOLDS FOR PAVEMENT IMPROVEMENT FOR THE IOWA DOT

Introduction

Phase III results paralleled those of Phase II, with greater accuracy because of sampling and interview procedures. However, the team believes other approaches to interpreting the data should also be utilized. Satisfaction for IRI ranged from those satisfied with an IRI as poor as approximately 3.3 to an IRI as good as 0.7 (estimated values), while satisfaction for PCI ranged from pavements as poor as a PCI of approximately 30 to a PCI as good as 89. Similar variations existed in the range of respondents who agreed pavements should be improved. In Phase III, however, sample size was much larger, making possible a separate analysis of each question by pavement type using just the portion of the sample that strongly agreed or agreed with the three satisfaction questions.

In **Tables 4.1 and 4.2**, percent of sample is taken as only those who strongly agreed or agreed with the three satisfaction questions (Questions 57, 58 and 59). Hence those who disagreed are not included. The sample size is shown in the right column. Because this is a large sample (423 for IRI and 462 for PCI - Q 57), and because the range of pavements that resulted in satisfaction is very broad, the team believes that the results of the questions can be separated and compared. If a pavement of given quality results in satisfaction for a particular respondent, it is presumed pavements of higher quality would also be satisfactory. That may not be true, because satisfaction is such a multi-dependent variable. But for purposes of this analysis, this will be assumed. Subsequent analysis of the model explaining satisfaction may modify that assumption, other variables besides pavement indices can affect satisfaction.

Likewise, if a pavement of a given quality is deemed to need improvement for a particular respondent, then it is assumed pavements of lower quality would also be deemed to need improvement. Again, there are potential fallacies in this assumption, but it will be presumed for purposes of drawing useful inferences out of a large sample size (299 for IRI and 328 for PCI). Again, model analysis can modify that assumption.

In Phase III, some were satisfied with a "fair" pavement, others required an "excellent" pavement. There were 462 (**Table 1.1**) satisfied with pavements, yet 328 thought the pavements should be improved. A separate analysis of those who Strongly Agree (SA) or Agree (A) with both Q57 (satisfied) and Q 59 (should be improved) and this is contained in **Objective 6**.

The following analyses of data included in **Tables 4.1 and 4.2** are provided to illustrate how the data could be interpreted and used for policy analyses as a guide in setting of IRI or PCI thresholds to evaluate motorist's satisfaction with pavements and to determine the need for pavement replacement using only physical indices. PCI appears more useful as there were no significant differences between pavement types or regions. However, separate analyses will be performed within pavement groups.

Table 4.1: At what IRI values did X% of respondents agree with the following three statements[a]:

***Q57:** "I am satisfied with the pavement on this section of highway"*
***Q58:** "The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"*
***Q59:** "The pavement on this section of highway should be improved"*

Cumulative Percent

Question	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	N
All Pavement Types											
Q57	3.2	2.7	2.5	2.0	1.9	1.6	1.2	1.1	.9	.7	423
Q58	3.2	2.6	2.3	1.9	1.8	1.3	1.2	1.1	.9	.7	303
Q59	1.2	1.7	1.9	2.2	2.5	2.6	2.8	3.0	3.5	5.2	299
PC Pavements Only											
Q57	3.5	3.0	2.8	2.6	2.3	2.0	1.9	1.8	1.4	1.1	169
Q58	3.3	3.1	2.8	2.6	2.3	2.0	1.9	1.8	1.4	1.1	120
Q59	1.8	1.9	2.3	2.6	2.6	2.8	3.0	3.2	3.5	5.2	122
AC Pavements Only											
Q57	2.5	2.2	1.9	1.4	1.3	1.1	1.0	.9	.8	.7	120
Q58	2.5	2.0	1.9	1.4	1.3	1.1	1.0	.9	.8	.7	88
Q59	1.1	1.4	1.9	2.0	2.2	2.5	2.8	3.4	4.0	4.1	75
Composite Pavements Only											
Q57	3.0	2.5	1.9	1.5	1.3	1.2	1.1	1.1	.9	.8	134
Q58	2.8	2.2	1.8	1.3	1.2	1.1	1.1	1.0	.9	.8	95
Q59	1.1	1.3	1.8	1.9	2.1	2.4	2.5	2.8	3.2	4.5	102
AC and Composite Pavements Combined											
Q57	2.8	2.4	1.9	1.7	1.3	1.1	1.0	.9	.8	.7	254
Q58	2.6	2.0	1.9	1.3	1.2	1.1	1.0	.9	.8	.7	183
Q59	1.1	1.3	1.8	1.9	2.2	2.4	2.6	3.0	3.7	4.5	177

The thresholds presented in this table were based on a cumulative distribution of IRI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus .1 (e.g., the CI for 3.2 would be 3.1 to 3.3).

Table 4.2: At what PCI values did X% of respondents agree with the following three statements[a]:

Q57: *"I am satisfied with the pavement on this section of highway"*

Q58: *"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"*

Q59: *"The pavement on this section of highway should be improved"*

Cumulative Percent

Question	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	sample size
All Pavement Types											
Q57	32	48	54	60	68	74	78	81	85	89	462
Q58	35	48	57	64	70	76	80	81	85	89	337
Q59	78	71	64	59	52	48	42	37	22	0	328
PC Pavements Only											
Q57	37	48	51	57	61	69	74	80	85	89	174
Q58	37	48	51	59	62	71	78	81	87	89	125
Q59	75	69	61	59	52	48	44	40	30	11	124
AC and Composite Pavements Only											
Q57	31	46	58	65	71	78	80	81	84	89	288
Q58	35	49	60	68	72	78	80	82	85	89	212
Q59	79	72	65	59	52	49	41	35	21	0	204

The thresholds presented in this table were based on a cumulative distribution of PCI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 20 (e.g., the CI for 32 would be 30 - 34).

In **Table 4.1** AC and COMP pavements are shown both separately and combined. This is to illustrate why the differences between the two pavement types in IRI, although statistically significant, do not result in practical differences in values. Likewise, statistical differences between urban and rural which are of a lesser magnitude will be disregarded in this part of the analysis.

Analysis of "Satisfied" Data - IRI - (Q57)

Iowa does not use a threshold of IRI for improvement alone, relying more heavily on PCI. The current boundary condition for the "fair" IRI range used by Iowa is approximately 2.2 to 3.0 (**Table 1.2**).

All Pavements

Using the assumption that an individual respondent would be satisfied with a pavement quality at or above that indicated from their survey, analysis of all pavements together (**first line**, **Table 4.1** or **Figure 4.1**) could be used for public perception input in the following manner. If the best boundary for "fair" IRI, (i.e. 3.0 or just above "poor") is used as a threshold for replacement by the Iowa DOT, it would only include approximately 15 percent of those responding who agreed they were satisfied with pavements (herein after referred to as "indicated satisfied"). If the threshold were set at an IRI of 2.2 (at the poor end of the "good" range, and just above "fair"), it would satisfy approximately 35 percent of those who indicated satisfied. If the threshold were set at the best limit of the good range (IRI = 1.4), it would include about 65 percent of those who indicated satisfied. An IRI of 1.2 would be needed to account for 70% of those who indicated satisfied. This threshold is in the "very good" category. Pavement types were combined to calculate these estimates. Separate analyses for each pavement type are presented below. These analyses are based solely on physical data. That alone is insufficient, as will be shown later in Objective 5. But it does give a different approach to the **Table 3.1** results when the data is arrayed as in **Table 4.1**.

PC Pavements Only

Because PC pavements were significantly different when mean IRI results of those satisfied were compared to both AC and COMP pavements, a similar approach was used for **Table 3.1** data, and this is shown in the **fourth line** of **Table 4.1** or **Figure 4.2** . If the same boundaries of the pavement quality categories are applied to PC pavements only, an IRI of 3.0 (poorest of the "fair"category) would satisfy 20 percent of those who indicated satisfied. An IRI of 2.2 (best of the "fair") would include approximately 53 percent of those who indicated satisfied. An IRI of 1.9 would be needed to account for 70 percent of those indicated satisfied. This is very near the middle of the "good" category.

AC and COMP Pavements Only

The data in **Table 4.1** for AC and COMP are both separate and combined since differences between the two were not deemed substantial, but they are significantly different than PC pavements. Referring to the **thirteenth line** in **Table 4.1** or **Figure 4.3**, a similar analysis was made. If the same boundaries of the pavement quality categories are applied to AC and COMP pavements combined, an IRI of 3.0 (poorest of the "fair"category) would not satisfy any (0%)of those who indicated satisfied. An IRI of 2.2 (best of the "fair") would include approximately 25 percent of those who indicated satisfied. A threshold IRI at the best of the "good" range

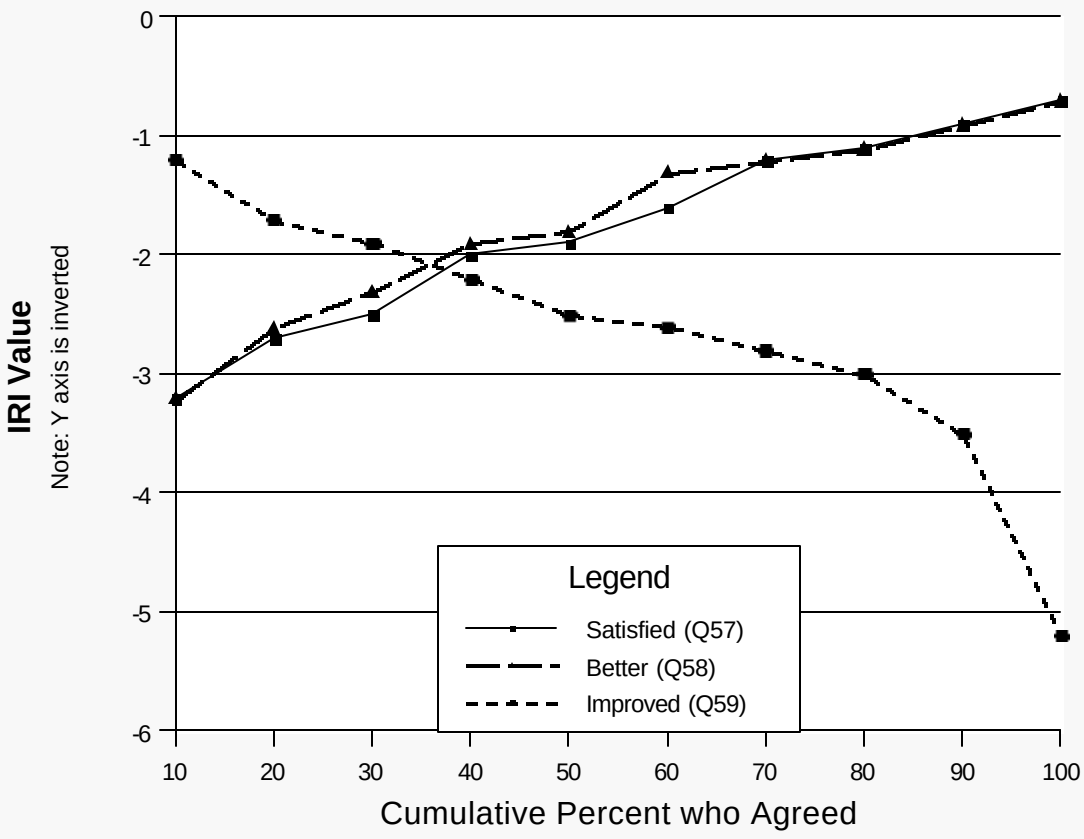
Figure 4.1:
At what IRI values did X% of respondents agree with the following three statements[a]:

(All Pavement Types Included)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

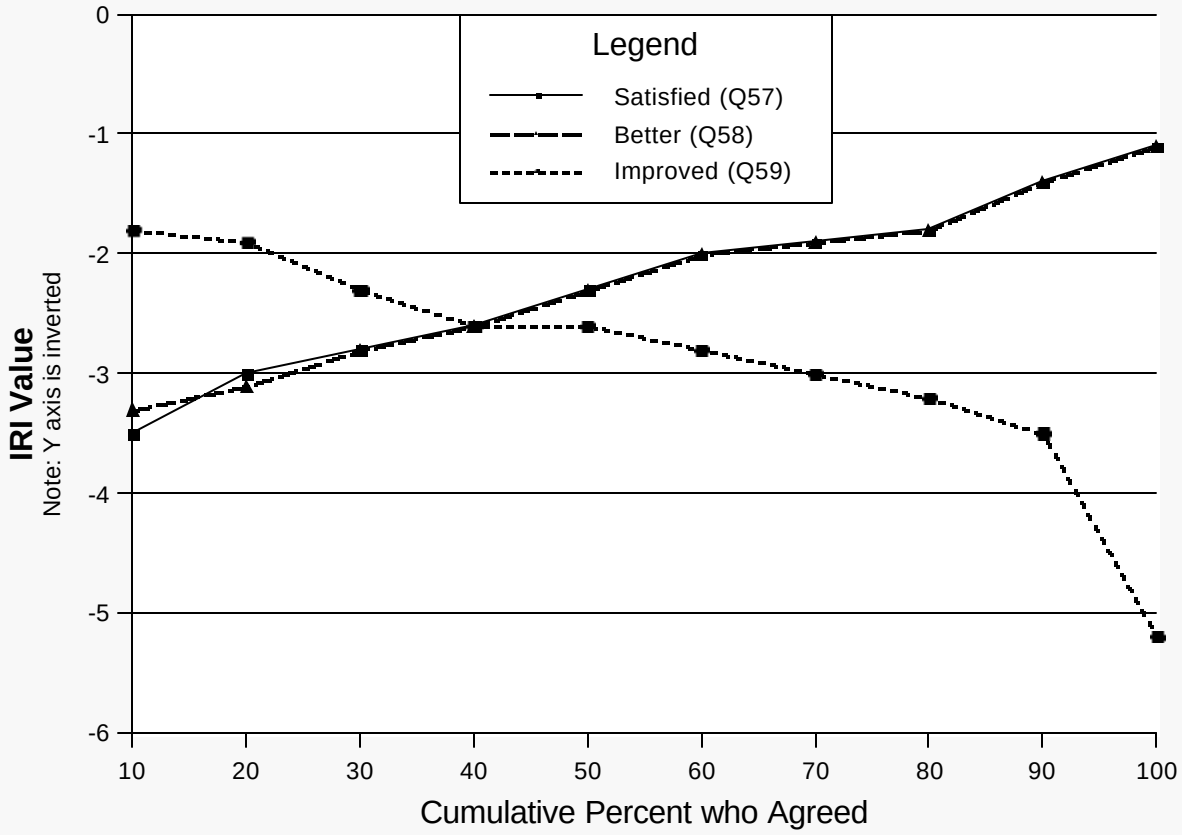
Figure 4.2:
At what IRI values did X% of respondents agree with the following three statements[a]:

(PC Pavements Only)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

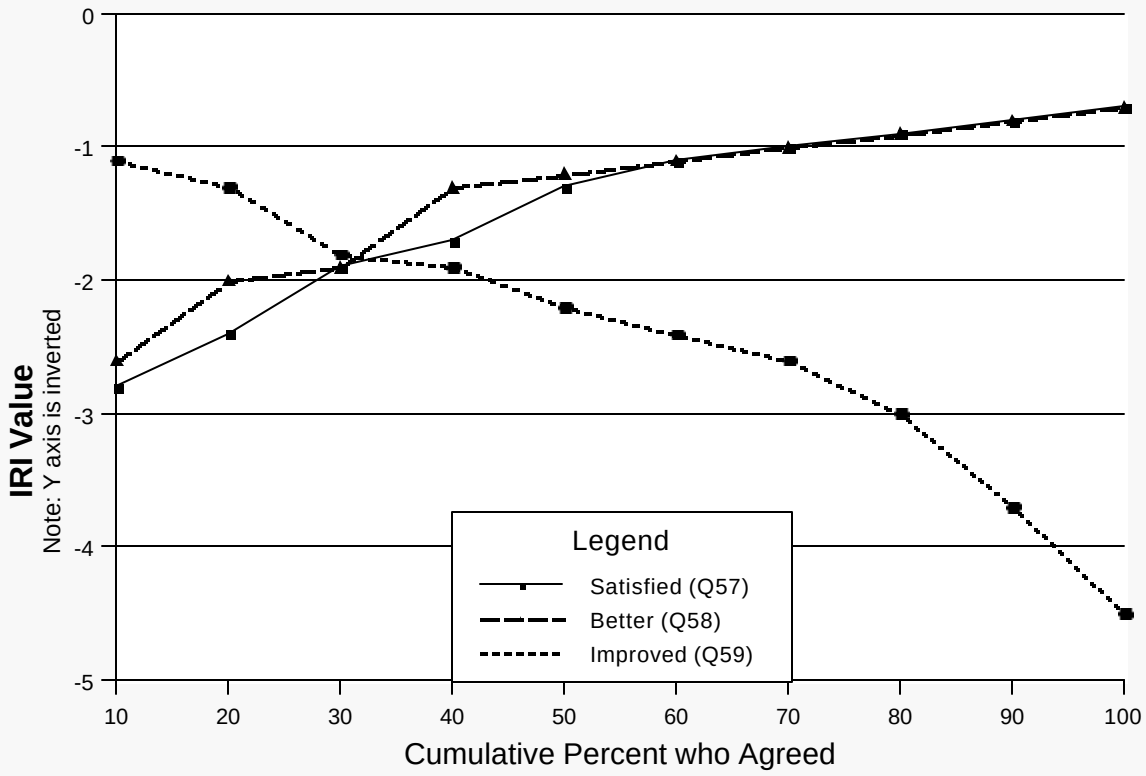
Figure 4.3:
At what IRI values did X% of respondents agree with the following three statements[a]:

(AC and Composite Pavements Combined)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

(1.4) would account for only 48 percent of those satisfied. An IRI of 1.0 would be needed to account for 70 percent of those indicating satisfied. This is close to the middle of the "very good" category.

Analysis of "Should Be Improved" Data - IRI - (Q59)

A similar assumption was made for Q 59 data as was made for Q 57 responses, i.e. a respondent who indicated a pavement should be improved at a given quality level would also agree that a pavement at a lower quality level should also be improved. Again, that may or may not be appropriate, as satisfaction is dependent on many variables. This will be explored in Objective 5 with the model testing.

All Pavements

Analysis of all pavements together (**third line**, **Table 4.1** or **Figure 4.1**) could be used for public perception input in this fashion. If the worst boundary for "fair" IRI, (i.e. 3.0 or just better than "poor") is used as a threshold for replacement by the Iowa DOT, it would include 80 percent of those agreeing that the pavements needed improvement (hereinafter referred to as "improve"). If the threshold were set at an IRI of 2.2 (at the poorest of the "good" range, and just above "fair"), it would include about 40 percent of those who agreed with improve. An IRI of 2.8 would account for 70% of those who agreed with improve. This threshold is near the poorest end of the "fair" category. Pavement type was combined to calculate these estimates. Separate analyses (within pavement type) are presented below. It should be cautioned that these analyses are based solely on physical data. That alone is insufficient, as will be shown later. But it does give a different approach to the **Table 3.1** results when the data is arrayed as in **Table 4.1**.

PC Pavements Only

Since satisfaction differed between PC pavements and others, separate analysis like that above was conducted, using the **sixth line**, **Table 4.1** or **Figure 4.2**. If a threshold of 2.2 were set (poorest of the "good" category) approximately 26 percent of those respondents who agreed with improve would be included. If the poorest of the "fair" category were selected (IRI of 3.0), 70 percent would be included.

AC and COMP Pavements Only

Since satisfaction differed between PC pavements and both AC and COMP pavements, and the latter two were combined because practically the differences were small, a separate analysis like that above was conducted for the two pavements combined. If the **ninth and twelfth lines** of **Table 4.1** are compared to the **fifteenth line**, few differences are noted. Using the **fifteenth line** of **Table 4.1** or **Figure 4.3**, if a threshold of 2.2 were set (best of "fair") approximately 50 percent of those respondents who agreed with improve would be included. If the poorest of the "fair" category were selected (IRI of 3.0), 80 percent would be included. An IRI of 2.6 would be needed to account for 70 percent of those who agreed with improve. This is close to the middle of the "fair" category.

Analysis of "Better Than Most" - IRI - (Q 58)

All Pavements

This question is not helpful in setting a threshold by itself, but when analyzed with responses to Q 57 and Q 59, it might prove helpful. Using the **second line**, **Table 4.1** or **Figure 4.1**, if the same 70 percent level is applied to those who agreed with this question, an IRI of 1.2 would result This is well into the "very good." category.

PC Pavements

If the same 70 percent level is applied to those who agreed with this question for PC Pavements only, using the **fifth line** of **Table 4.1** or **Figure 4.2**, an IRI of approximately 1.9 would result. This is somewhat better than the poorest limit for the "good." category.

AC and COMP Pavements

If the same 70 percent level is applied to those who agreed with this question for AC and COMP pavements combined, using **line eight** in **Table 4.1** or **Figure 4.3**, an IRI of approximately 1.0 would result. This is well into the "very good" category.

Satisfaction Data - PCI - (Q 57)

Similar assumptions are made regarding satisfaction as with IRI analysis in this report. Because the sample was selected based on Pavement Condition Index (PCI) a comparison of the survey response and segment condition was reviewed from **Table 2.1**. The Iowa DOT selected samples more heavily from the "good" and "fair" pavement conditions. As noted this was because it was difficult in urban areas and because of poor pavements scheduled for construction and not available. The WSRL in some cases tried to over-sample to get a good distribution across all quality categories in each cell (pavement type or region), which was the goal of Phase III and this was accomplished in many cases as shown in **Table 2.1**.

Looking at **Table 2.1**, roughly 54 percent (365 of 676) of the surveys were conducted on highways in the "good" or "excellent" condition based on PCI. From **Table 1.1**, 68 percent (462 of 676) agreed they were satisfied with pavements. Likewise, 47.6 percent (322 of 676) of the surveys were conducted on highways with "fair" or "poor" pavements and 48 percent agreed the highway should be improved. There is that overlap that needs to be explained as noted previously. Also, as noted previously, there were no significant differences in mean PCI in any region or among the pavement types (**Table 2.3**). However, separate analysis were conducted for the same groups of pavements (All pavements, PC only and AC-COMP combined, so that thresholds for both IRI and PCI could be compared. These are shown in **Table 4.2** Again, this is the same data from **Tables 3.4 -3.6**, displayed in a different fashion. The same analysis as that used for IRI could be used for public perception input for the Iowa DOT, with a separate analysis for all pavements as well as for PC and grouped AC and COMP pavements.

All Pavements

The boundaries of the "fair" pavement condition for Iowa DOT are 40 to 59 while the boundaries of the "good" condition are 60 to 79. Unlike IRI, a higher number means better pavements. Using data from **Line one** of **Table 4.2** or **Figure 4.4**, if the poorest boundary of the "fair" condition (PCI of 40) were used as a threshold, only less than 15 percent of those who indicated satisfied would be included. If the best boundary of the "fair" were used (PCI of 59), approximately 40 percent would be included. If the threshold were set at the best of the "good" range (PCI of 79), approximately 73 percent would be included. If the DOT wanted to satisfy 70 percent a threshold PCI of approximately 78 would be required, based solely on physical data. As noted previously, physical indices explain only a small part of satisfaction.

PC Pavements Only

Because PC pavements had significantly different means when IRI results were compared to both AC and COMP pavements, a similar approach was used for **Table 3.4** data for PCI, even though differences were not statistically significant. This is shown in the **fourth line** of **Table 4.2** or **Figure 4.5** . If the same boundaries of the pavement quality categories (boundaries of the "fair" condition) are applied to PC pavements only, an PCI of 40 (poorest of the "fair"category) would include approximately 14 percent of those who indicated satisfied. A PCI of 59 (top of the "fair") would include approximately 46 percent of those who indicated satisfied. A PCI of 74 would be needed to account for 70 percent of those satisfied. This is the midpoint of the "good" category.

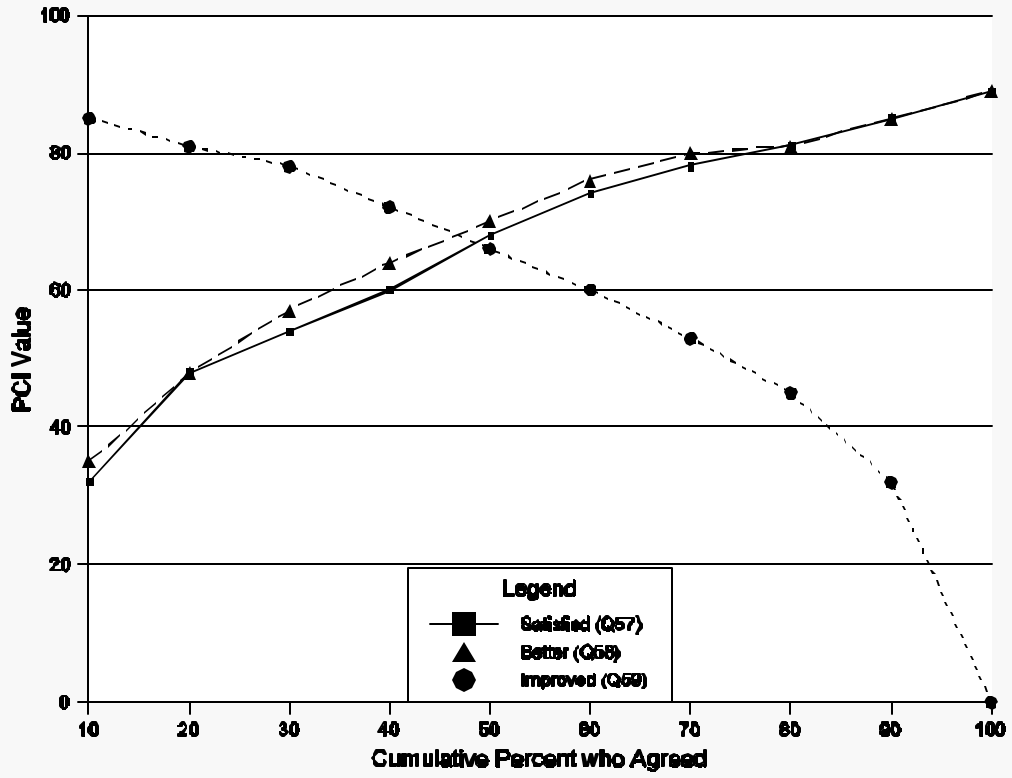
Figure 4.4:
At what PCI values did X% of respondents agree with the following three statements[a]:

(All pavement types included)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



a=Only drivers who agreed or strongly agreed with the above questions were included in the analysis. **Analysis includes all pavement types.**

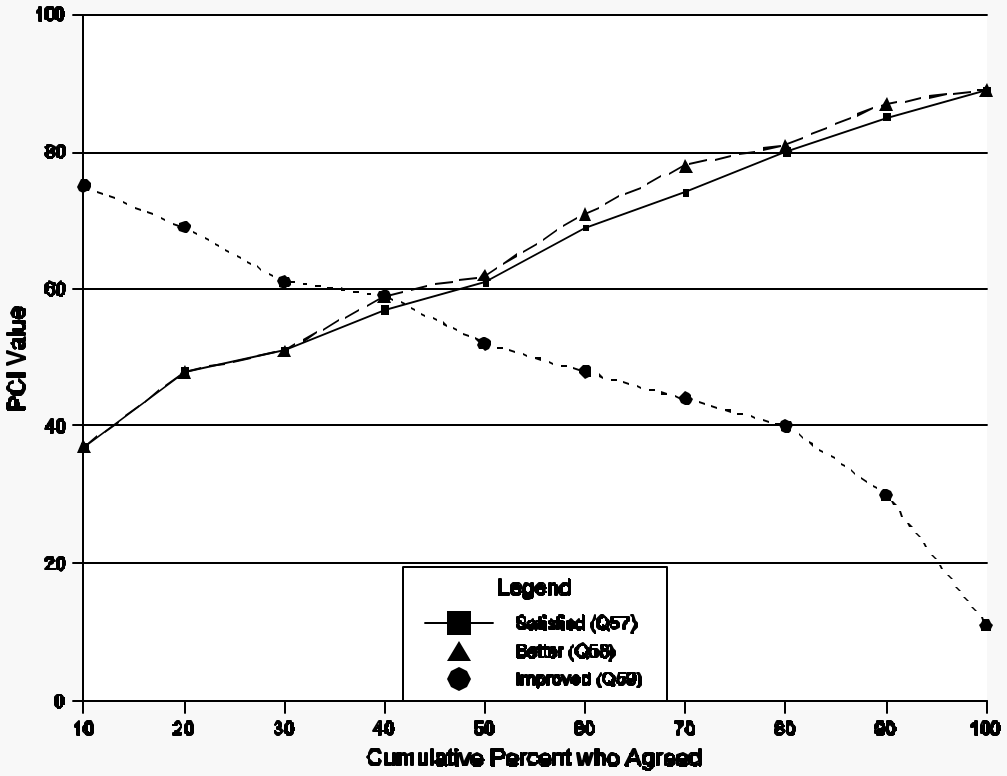
Figure 4.5:
At what PCI values did X% of respondents agree with the following three statements[a]:

(PC Pavements only)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



a=Only drivers who agreed or strongly agreed with the above questions were included in the analysis. **Analysis includes PC pavements only.**

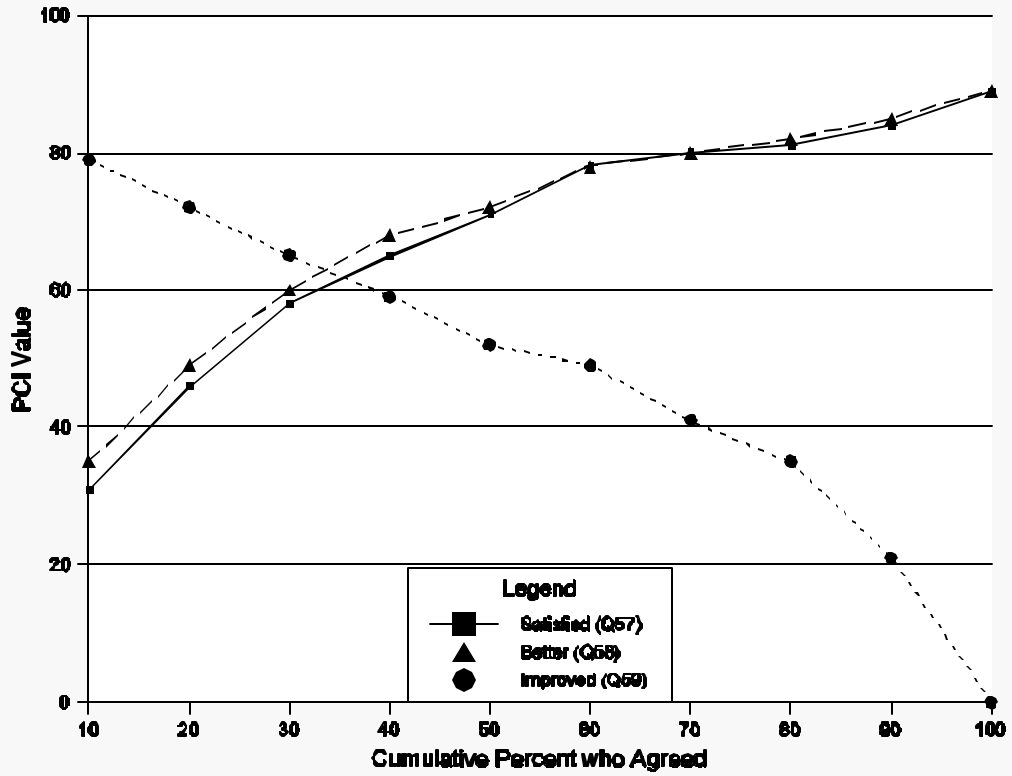
Figure 4.6:
At what PCI values did X% of respondents agree with the following three statements[a]:

(AC and Comp. pavements only)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Iowa"

"The pavement on this section of highway should be improved"



a=Only drivers who agreed or strongly agreed with the above questions were included in the analysis. **Analysis includes AC and Composite pavements only.**

AC and COMP Pavements Only

The data in **Table 3.4** for AC and COMP is combined since there were no significant differences between the two, and their mean PCIs were not significantly different than PC pavements. A separate analysis was made however like that above. Referring to the **fifteenth line** in **Table 4.2** or **Figure 4.6**, a similar analysis was made. If the same boundaries of the pavement quality categories are applied to AC and COMP pavements combined, a PCI of 40 (poorest of the "fair"category) would include approximately 15 percent of those who indicated satisfied. A PCI of 59 (best of the "fair") would include approximately 30 percent of those who indicated satisfied. A threshold PCI at the best of the "good" range (79) would account for approximately 65 percent of those satisfied. A PCI of 80 would be needed to account for 70 percent of those indicating satisfied. This is the lowest quality boundary of the "excellent" category.

Analysis Of "Should Be Improved" Data - PCI - (Q59)

All Pavements

The PCI data for those who agreed the pavement should be improved in Phase III are not as close to the Phase II results, as was the case with IRI data. Again, the same assumptions about responses were made with the analysis of PCI as were described in the IRI section. Some thought pavements near the top of the "good" range should be replaced, while the lower range for response was into the "poor" range. Using data from **line three**, **Table 4.2 or Figure 4.4**, if a threshold of 59 were set (best of the "fair" range), only 40 percent who agreed with "improve" would be included. If the poorest of the fair range (PCI of 40) were set as a threshold, approximately 75 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PCI of 42 would be required.

PC Pavements

Using data from **line six**, **Table 4.2 or Figure 4.5**, if a threshold of 59 were set (best of the "fair" range), only 40 percent who agreed with "improve" would be included. If the poorest of the fair range (PCI of 40) were set as a threshold, 80 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PCI of 44 would be required. This is not significantly different from thresholds set for all pavements (expected, since PCI is not significantly different for pavement types)

AC and COMP Pavements

Using data from **line nine**, **Table 4.2** or **Figure 4.6**, if a threshold of 59 were set (best of the "fair" range), only 40 percent who agreed with "improve" would be included. If the poorest of the fair range (PCI of 40) were set as a threshold, approximately 71 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PCI of 41 would be required. This is not significantly different from thresholds set for all pavements.

Analysis of "Better Than Most" - PCI - (Q 58)

This question is not helpful in setting a threshold by itself, but when analyzed with responses to Q 57 and Q 59, might prove helpful. **Line two** of **Table 4.2** or **Figure 4.2** can be used for PCI on all pavements. If the same 70 percent level is applied to those who agreed with this question, a PCI of 80 would result. If only PC pavements are considered, the 70 percent threshold PCI would be 78, while for AC and COMP pavements combined, it would be also be 80.

Summary - Objective 4 thresholds

Table 4.3 shows in summary form where potential thresholds would lie aside the Iowa quality scales from **Table 1.2 and 1.3**. if set at the level of 70 percent of the respondents in agreement with the three questions on satisfaction ("satisfied"marked **S**, "improve" marked **I**, and "better than most" marked **B**). These bold values of IRI and PCI come out of the analyses in Part 4. In addition, the intersection points of the cumulative response to Q 57 (satisfied) and Q 59 (improve) are marked at **X** in **Table 4.3,** near where they fall on the quality scale taken from **Tables 1.2 and 1.3**

The intersections of the cumulative percent responses on Q57 and Q59 on **Figures 4.1** and **4.4** for all pavements are slightly different than those in **Figures 3.1** and **3.2**. They are an IRI of approximately 2.2 at 38 percent and a PCI of approximately 66 at 48 percent. The difference between intersection points in the figures in Objective 3 and 4 is due to the skew of the samples. Similar intersection points are shown in **Figures 4.2, 4.3, 4.5 and 4.6** and are marked **X** in **Table 4.3**. These intersection points (**X**) are applied later in the **Summary and Conclusions**.

One additional observation that can be made from the data illustrated in the above table is that the 70% thresholds for "S" & "B" are close to each other for both IRI and PCI. This also is shown graphically in **Figures 4.1 through 4.6**.

If a threshold were to be set recommended solely on physical data, the PCI data seems to correlate better with satisfaction data (**Table 3.7**). A threshold in the middle of the "good" category, therefore, would cover both PCI and IRI for PC pavements, while AC and COMP pavements would require a higher IRI threshold if ride satisfaction controlled its selection. This may be modified based on data from the psychological model.

Table 4.3 Comparison of 70% Thresholds with Iowa DOT Quality Levels

IRI Scale Iowa DOT	IRI - All Pavts.	IRI - PC Pavts.	IRI - AC & COMP Pavts.	PCI Scale Iowa DOT	PCI - All Pavts.	PCI - PC Pavts.	PCI - AC & COMP Pavts.
V.Good 0.0				**Exc.** 100			
0.8			**1.0 B**	92			
1.0	**1.2 B**		**1.0 S**	88			
1.2	**1.2 S**			84			**80 B**
1.4				80	**80 B**		**80 S**
Good 1.41				**Good** 79	**78 S**	**78 B**	
1.6				76		**74 S**	
1.8		**1.9 B**	**1.8 X**	72			
2.0		**1.9 S**		68	**66 X**		
2.2	**2.2 X**			64			**62 X**
				60			
Fair 2.21				**Fair** 59		**58 X**	
2.4				56			
2.6		**2.6 X**		52			
2.8	**2.8 I**		**2.6 I**	48			
3.0		**3.0 I**		44	**42 I**	**44 I**	
				40			**41 I**
Poor 3.01				**Poor** <39			
3.2							
3.4							
3.6							
3.8							
V. Pr.>3.81							

S = Q 57 "Satisfied" **B = Q 58 "Better than most"** **I = Q 59 - "Improve"**

X = Intersection of Cumulative Percentage Plots, Q 57 ("Satisfied") and Q 59 ("Improve")

OBJECTIVE 5:
DEVELOPING AND TESTING OF "THE MODEL"--
EXPLORING THE PATH BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION USING THE "EXPECTANCY VALUE THEORY OF FISHBEIN AND IJZEN"

Introduction

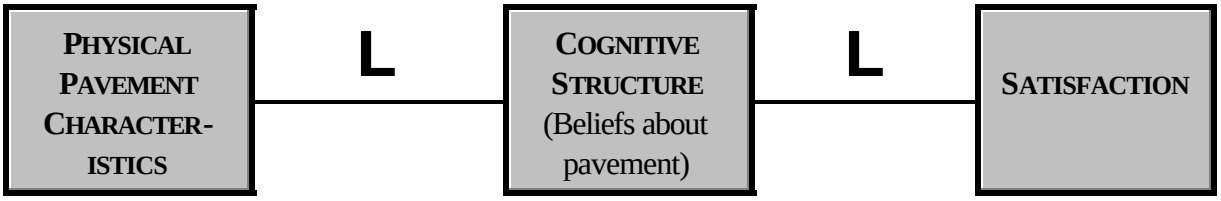
The same psychological theory developed in Phase 2 was used to explain the relationship between physical pavement characteristics and driver satisfaction. This model is based on Fishbein's and Ajzen's Theory of Planned Behavior. It proposes, for example, that a person's attitude toward driving a stretch of pavement is based on a limited set of salient beliefs (usually 5 - 9 beliefs) about that particular stretch of highway. Each belief associates the behavior (i.e., driving) with a specific attribute or outcome. In general, people develop favorable attitudes when good outcomes are perceived as likely and bad outcomes are perceived as unlikely. People tend to develop bad attitudes when bad outcomes are perceived as likely and good outcomes unlikely.

The relevant beliefs are formed by prior experience, information gained from others, and by inferences a person draws from experience and information. The theory suggests that a motorist mentally weighs the set of beliefs to develop an overall attitude toward driving on a particular stretch of highway. The beliefs used in the analysis that follows were identified via focus groups in phase one of the study. Collectively, the beliefs are called "**cognitive structure**".

Figure 5.1 illustrates the hypothesized ordering of variables leading to driver satisfaction. The variables are 1) physical pavement characteristics, 2) cognitive structure as composed of salient beliefs about the act of driving on the pavement, and 3) attitude operationalized as satisfaction with pavement characteristics. Knowing what motorists believe about the pavement will help policy makers determine what aspects of pavement quality are perceived by motorists and how those perceptions drive satisfaction with pavement quality.

Physical pavement characteristics - Physical pavement characteristics are operationalized as the IRI and PCI as described above. The measures are used separately in statistical analyses.

Figure 5.1: Cognitive structure as intervening variable between physical pavement characteristics and satisfaction with pavement characteristics



Model Development

Satisfaction- Satisfaction, as noted previously, is operationalized as the summation of the three "threshold" measures of satisfaction with pavement conditions. Question 58 was reverse coded for this index.

Pavement beliefs and cognitive structure - The same five beliefs used in Phase 2 will be included in this analysis. The beliefs were originally ascertained via a subcontractor (the Wisconsin Survey Research Laboratory) who conducted a series of focus groups around the state. Analysis of focus group transcripts revealed the following five dimensions of belief which were then turned into Likert-type items in the questionnaire:

- "Driving on the pavement on this section of highway causes extra wear on my vehicle's suspension system" (Q32);
- "Driving on the pavement on this section of highway produces a bumpy ride" (Q34);
- "Driving on the pavement on this section of highway causes me to focus my attention on the pavement surface" (Q36);
- "Driving on the pavement on this section of highway is noisy" (Q38);
- "The pavement on this section of highway looks patchy" (Q40).

As with Phase 2, the five measures were summed to produce a single, unidimensional scale of cognitive structure with a superb reliability (Cronbach's alpha of .89 - See explanation on Page 20). The Cronbach's alpha for the identical scale Phase 2 was also .89, lending additional support to the measures reliability. Higher scores represent beliefs that the pavement is of *lower* quality along the dimensions noted. Therefore, cognitive structure should be positively related to IRI and negatively related to PCI. Cognitive

structure should also be negatively related to satisfaction.

Cognitive structure as intervening variable - The path analyses illustrated in **Figure 5.2** indicate that cognitive structure does indeed mediate between pavement characteristics and satisfaction. The pattern of results are nearly identical to those found in Phase 2. As predicted, the strength of the direct (unmediated) relationship between pavement characteristics and satisfaction is stronger in Phase 3 (.36) than Phase 2 (.26).

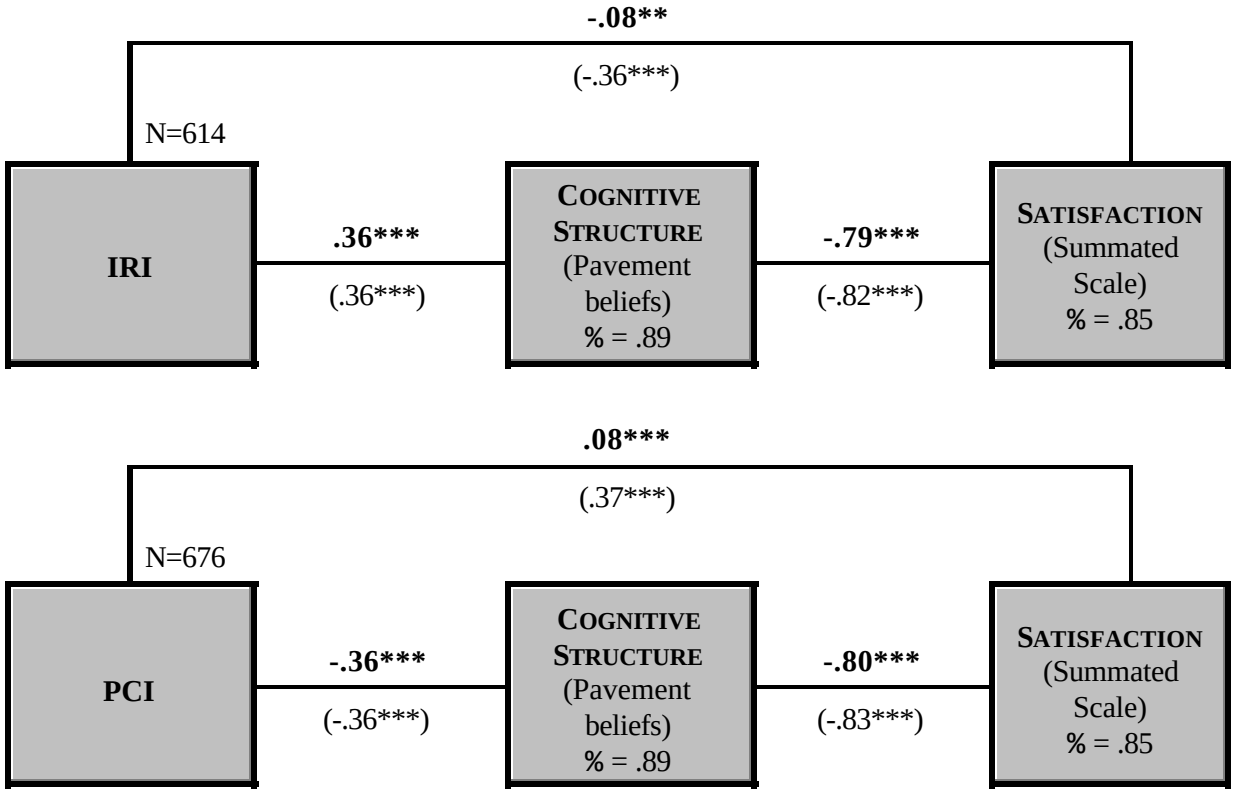
Mediation is suggested, because, for example, the statistically significant, zero-order (original) relationship between IRI and satisfaction (beta[1] = -.36, p#.001) diminishes to near zero (beta = -.08, p#.01) when cognitive structure is entered into the path analysis as an intervening variable. The relationship between IRI and cognitive structure remains significant, as does the inverse relationship between cognitive structure and satisfaction. The beliefs that comprise cognitive structure also seem to be reasonably comprehensive, at least to the extent that they intercept the beliefs that people can derive from the physical characteristics of the pavements as measured by IRI and PCI.

The strength of the relationships in **Figure 5.2** suggest that this a relatively concise model that works well. However, even though relationship between cognitive structure (CS) and satisfaction is remarkably strong, (beta= -.79, p# .001), there is still some variance in satisfaction (about 38%) not explained by cognitive structure and pavement characteristics. A more elaborate model will be used to try to account for the remaining 38% of variance in satisfaction. Of course, some unexplained variance is certainly error stemming from measurement error and sampling error, although the amount of measurement error in the cognitive structure and satisfaction indices is reasonably small, judging from their reliabilities.

In the Phase II Report, Figure 3.2, the path coefficients for IRI and CS were 0.27 and for CS and Satisfaction 0.73, explaining about 53 % of the variance. The more extensive model in Phase II increased that to approximately 61 % of the variance . As in Phase II, a more extensive model is needed to more fully explain variation in public satisfaction.

[1] Beta is a coefficient like a correlation coefficient that can range from -1 to +1 and is the product of a regression analysis in which the measures are standardized (universal scale of -1 to +1).

Figure 5.2: Path analysis —
Cognitive structure as intervening variable
between physical pavement characteristics and satisfaction
(zero-order beta) **Path Coefficient**



Other predictors - Expectancy Value Model

The full psychological model predicting satisfaction is illustrated in **Figure 5.3**. It is the same model used in Phase 2 of the project, with the following two exceptions. Income was dropped as a demographic variable and "Miles driven per year" was dropped as an experiential variable because they did not seem to have predictive utility in Phase 2. The following variables were predicted to account for variance in satisfaction above and beyond PCI and cognitive structure.

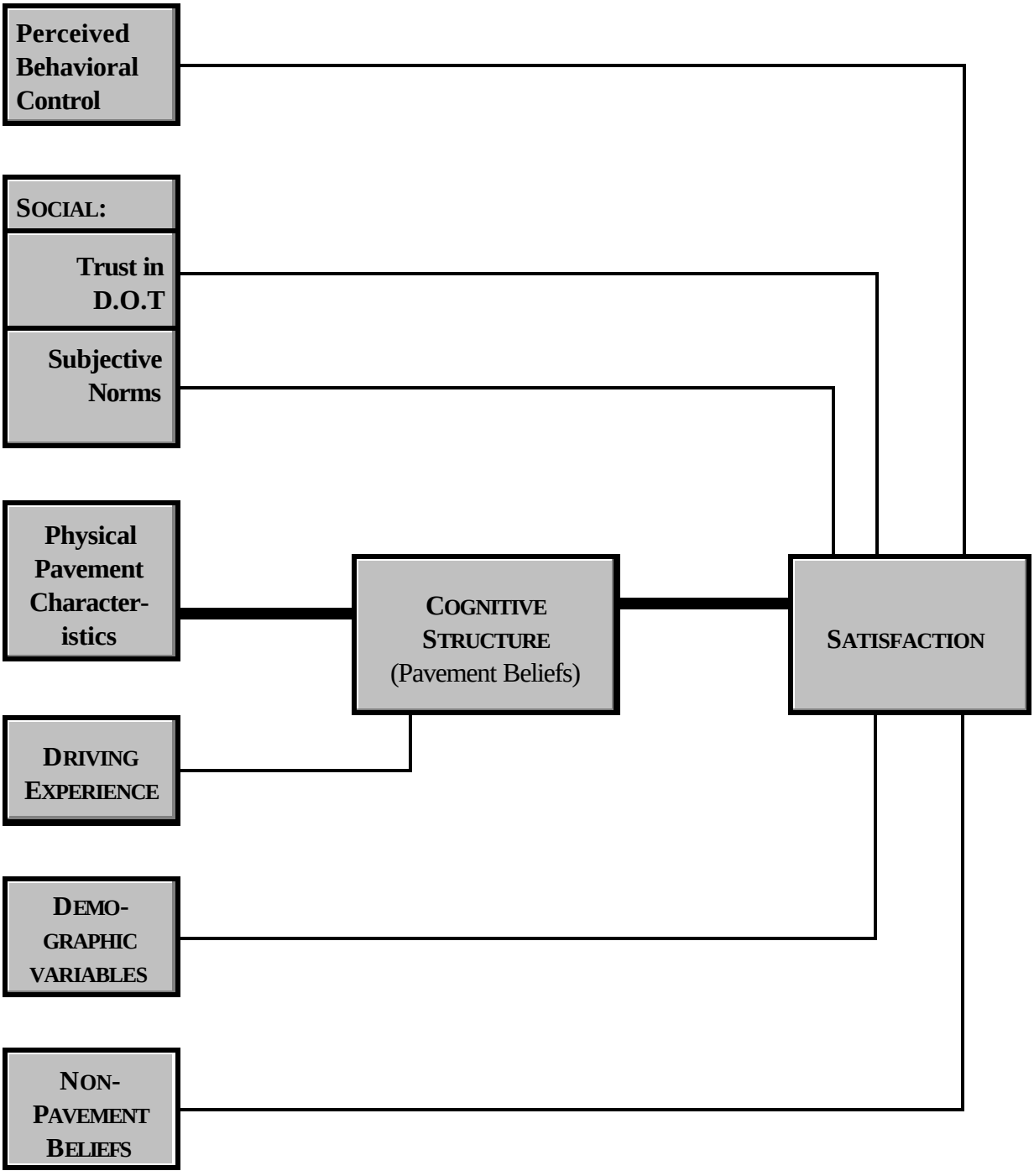
Perceived Behavioral Control (PBC). Adapted from Ajzen's model, we expected that perceived behavioral control could affect satisfaction. PBC reflects the amount of perceived control or voluntariness in a given behavior — in this case, driving along a given stretch of highway. Although PBC is usually a predictor of behavior, it was reasoned that motorists' responses to highway pavement conditions might be affected by whether or not they could choose an alternate route to travel. To measure PBC, responses were gathered on five-point, Likert-type scales to this item (Q55): "If I wanted to, I could easily find a convenient alternate route to the places I usually go instead of using this stretch of highway."[3] Higher scores represent greater perceived control.

Social variables: Subjective norms and trust. Two variables reflecting social relationships — subjective norms and trust in the state department of transportation — might also affect satisfaction. Also adapted from Ajzen's model, subjective norms (SN) reflect felt social pressures, specifically, what a person believes others think he or she should do. In adapting this measure from being a predictor of behavior to a predictor of attitude (satisfaction), the wording became: "Most people whose opinions are important to me think that it is OK for me to drive this stretch of highway" (Q59a). It was reasoned that a person's own attitude could be affected by others who matter to him or her, especially if they express concern over the person's driving on a given stretch of road. Higher scores on this Likert-scaled item represent stronger agreement with the item.

Trust in the department of transportation might also affect satisfaction, at least by mitigating any anger that might be produced by driving along stretches of road with deteriorating pavement conditions. Trust was ascertained by summing respondent answers to four Likert-scaled items (Cronbach's alpha = .70, see p. 20 for explanation):

- The state DOT is capable of doing a good job of fixing and replacing pavements on rural highways in Iowa" (Q51);
- "I trust the judgment of the state DOT when it comes to scheduling pavement improvements" (Q52);
- "State DOT officials care about the safety and convenience of drivers on this stretch of road" (Q53);
- "The DOT considers input from people like me when making decisions about repairs or improvements to this stretch of highway" (Q53a).

Figure 5.3:
Hypothesized predictors of satisfaction with pavement conditions



Driving experience. A person's driving experience can serve as a foundation for the development of his or her beliefs about pavement conditions. Three separate variables were used to reflect this experience: frequency of driving a motorcycle (derived from Q105b), the frequency of driving along the specific stretch of highway in question (Q28a), and the self-reported quality of ride of his or her vehicle (Q103). As mentioned above, the question measuring miles driven per year (Q104) was dropped from the Phase 3 survey.

Non-pavement beliefs. Results from Phase 2 confirmed the importance of considering non-pavement beliefs when attempting to understand driver satisfaction. Above and beyond pavement condition, beliefs people hold about the environment they experience when driving along a stretch of highway is significantly related to satisfaction. Responses were again gathered via Likert-type scales to indicate whether the motorists believed that the stretch of highway in question was very hilly (Q48), was very curvy (Q47), was scenic (Q46), had a high volume of traffic (Q44), had pavement marking lines that were clear and easy to see (Q45), and made one feel comfortable pulling on to the shoulder if necessary (Q43).

Analysis

Table 5.1 shows the results of the path analytic multiple regression analyses. The procedures used are similar to those followed in Phase 2. In Phase 2, three separate analyses were conducted, one with each pavement measure (i.e., IRI, PCI, Patch). Here, three parallel analyses were conducted using different combinations of pavement types. One analysis used all pavements (PC, AC and Composite), one included only respondents who drove on PC pavements and one used AC and Composite pavements. In each case, cognitive structure was first regressed on the various blocks of predictor variables. Then satisfaction was regressed on the same blocks plus cognitive structure. The results will (1) test the relationships illustrated in Figure 5.3 and (2) show how the relationships among physical characteristics of the pavement, cognitive structure, and satisfaction illustrated in **Figures 5.2 and 5.3** may be affected by the other variables. Hierarchical multiple regression was used, with blocks of variables entered in the following order: **(1)** Demographic control variables — education (Q108), sex (Q998b), and age (from Q100); **(2)** the set of experiential variables; **(3)** the set of social variables; **(4)** perceived behavioral control; **(5)** the set of non-pavement beliefs; **(6)** the physical pavement measure; and **(7)** cognitive structure (for the regression of satisfaction only).

Results confirm what was found in Phase 2. The **physical measures $ cognitive structure $ satisfaction** relationships from **Figure 5.2** remain in effect (albeit reduced in magnitude) even with controls for these sets of variables. For example, when looking at the analysis that includes all pavement types, the path from PCI to cognitive structure is -.29 (p#.001), from cognitive structure to satisfaction -.75 (p#.001), and from PCI to satisfaction .06 (p#.001). Similar patterns are found for regression analyses including only subjects who drove on PC pavements and analyses of only AC and Composite pavements. In each case, cognitive structure significantly reduces (i.e., mediates) the relationship between physical pavement characteristics and satisfaction. Thus, the basic model holds, even with rigorous controls. These results strongly replicate the findings in Phase 2. Overall, the set of predictor variables account for up to 28% of the variance (see adjusted R^2 in Table 5.1) in cognitive structure and 73% of the variance in satisfaction.

Table 5.1: Relationship of control variables and PCI to cognitive structure and satisfaction with pavement conditions (full model)

Multiple regression analyses (betas)

	All Pavements		*PC Only*		*AC and Comp.*	
DEPENDENT VARIABLE:	**Cognitive Structure ℅ = .89**	**Satis-faction ℅ = .85**	**Cognitive Structure**	**Satis-faction**	**Cognitive Structure**	**Satis-faction**
DEMOGRAPHIC:						
Education	-.02	-.02	-.03	.02	-.01	-.04
Female Sex	-.04	.07	-.05	.08	-.04	.07
Age	-.01	.01	-.02	.05	-.01	-.04
R^2 change	**.00**	.00	.00	.07	**.00**	.00
EXPERIENTIAL:						
Cycle driving frequency	.04	-.03	-.04	.02	.08	-.06
Vehicle "ride"	.06	-.06	**.19****	**-.18****	-.02	**.01***
Frequency of driving stretch	-.01	.00	.01	-.03	-.03	.03
R^2 change	**.01**	.00	**.04***	**.03***	**.00**	.00
SOCIAL:						
Trust in transportation dept. %=.70	**-.05**	**.16*****	**.02**	.07	**-.09**	**.20*****
Subjective norms	**-.36*****	**.36*****	**-.40*****	**.40*****	**-.34*****	**.32*****
R^2 change	**.14*****	**.18*****	**.15*****	**.17*****	**.14*****	**.18*****
PERCEIVED BEHAVIORAL CONTROL	.00	.05	-.09	**.16****	.06	-.01
R^2 change	.01	.00	.01	**.03****	.00	.00
NON-PAVEMENT BELIEFS						
Very hilly	**.09***	-.03	**.16****	-.11	.04	.02
Very curvy	.04	-.01	.01	-.03	.05	.00
Scenic	**-.10****	**.13*****	-.07	.11	**-.11****	**.15*****
High traffic volume	**.14*****	**-.11*****	**.06**	-.10	**.17*****	**-.11****
Comfortable shoulders	**-.09****	**.17*****	-.04	**.17****	**-.12*****	**.17*****
Clear pavement markings	**-.17*****	**.20*****	**-.15***	**.19*****	**-.16*****	**.39*****
R^2 change	**.07*****	**.11*****	**.06****	**.11*****	**.08*****	**.11*****
PAVEMENT CONDITION INDEX (PCI)	**-.29*****	**.06****	**- .26*****	**.07**	**-.29****	**.06***
R^2 change	**.07*****	**.00**	**.06*****	**.00**	**.08*****	**.00**
COGNITIVE STRUCTURE		**-.75*****		**-.72*****		**-.76*****
R^2 change		**.44*****		**.38*****		**.45*****
Multiple R	**.54*****	**.86*****	**.56*****	**.86*****	**.55*****	**.86*****
Adjusted R^2	.28	.73	.27	.72	.29	.73
N	676	676	245	245	431	431

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

To streamline the analysis, forward stepwise regression was performed to maintain R^2 while limiting the number of variables in the analysis. The results in **Table 5.2** indicate (on a preliminary level) the variables that should be retained by the Iowa DOT for the creation of a survey form to assess driver satisfaction in the future. This recommendation should be considered preliminary and may change depending on results from Minnesota and/or Wisconsin samples. In addition to measures of cognitive structure and satisfaction, they are quality of vehicle ride, trust in D.O.T., subjective norms, and all five non-pavement beliefs. When all of these variables are considered, 28% of the variance in cognitive structure and 73% of the variance in satisfaction is accounted for by the equations. (By comparison, PCI alone accounts for about 7 % of the variance in cognitive structure — see R^2 *change* for PCI). For this reason, it is important to include psychological measures, such as beliefs and trust to supplement physical pavement measures.

The paths of relationships from the analysis using all pavement types is illustrated in **Figure 5.4** and can be compared to the hypothesized relationships in Figure 5.3. As noted previously, the path from PCI to cognitive structure to satisfaction remains intact, with cognitive structure being by far the best predictor of satisfaction. Lower PCI ratings seem to produce stronger beliefs about pavement problems on the stretch of highway (beta = -.29, p #.001) and, in turn, these beliefs seem to yield less satisfaction with the pavement (beta = -.75, p# .001).

Perceived behavioral control was not related to satisfaction or cognitive structure. As hypothesized, those with higher levels of trust in D.O.T. are more satisfied with the pavement (beta = .16, p#.001), as are those who believe that relevant others feel it is okay for them to drive that stretch of road (subjective norms beta = .35, p#.001). However, subjective norms also had an unexpected, significant relationship with cognitive structure. Specifically, those who believe that relevant others think it is not okay for them to drive that stretch are more likely to believe that the pavement has problems (beta = -.36, p# .001). Thus, subjective norms seems to affect what people perceive or believe (cognition, as indicated by cognitive structure) as well as how they feel about it (affect, as indicated by satisfaction).

All of the non-pavement beliefs were related to cognitive structure and all but one belief (the belief that the stretch of highway is hilly) was related to satisfaction. In general, the variables seem to behave in a manner consistent with the model.

Notes, Table 5.1:

1. Cronbach's alpha (**%**) is a standard measure of instrument reliability. It is explained on p. 20.

2. A second PBC item, "Most of the trips I take on this stretch of highway are trips that I have to take" (Q56), was dropped from the analysis because it produced a low reliability score when combined with the other PBC item and because initial analysis showed that it correlated very little with other variables in the analysis.

Table 5.2: Relationship of control variables and PCI to cognitive structure and satisfaction with pavement conditions (focused model)

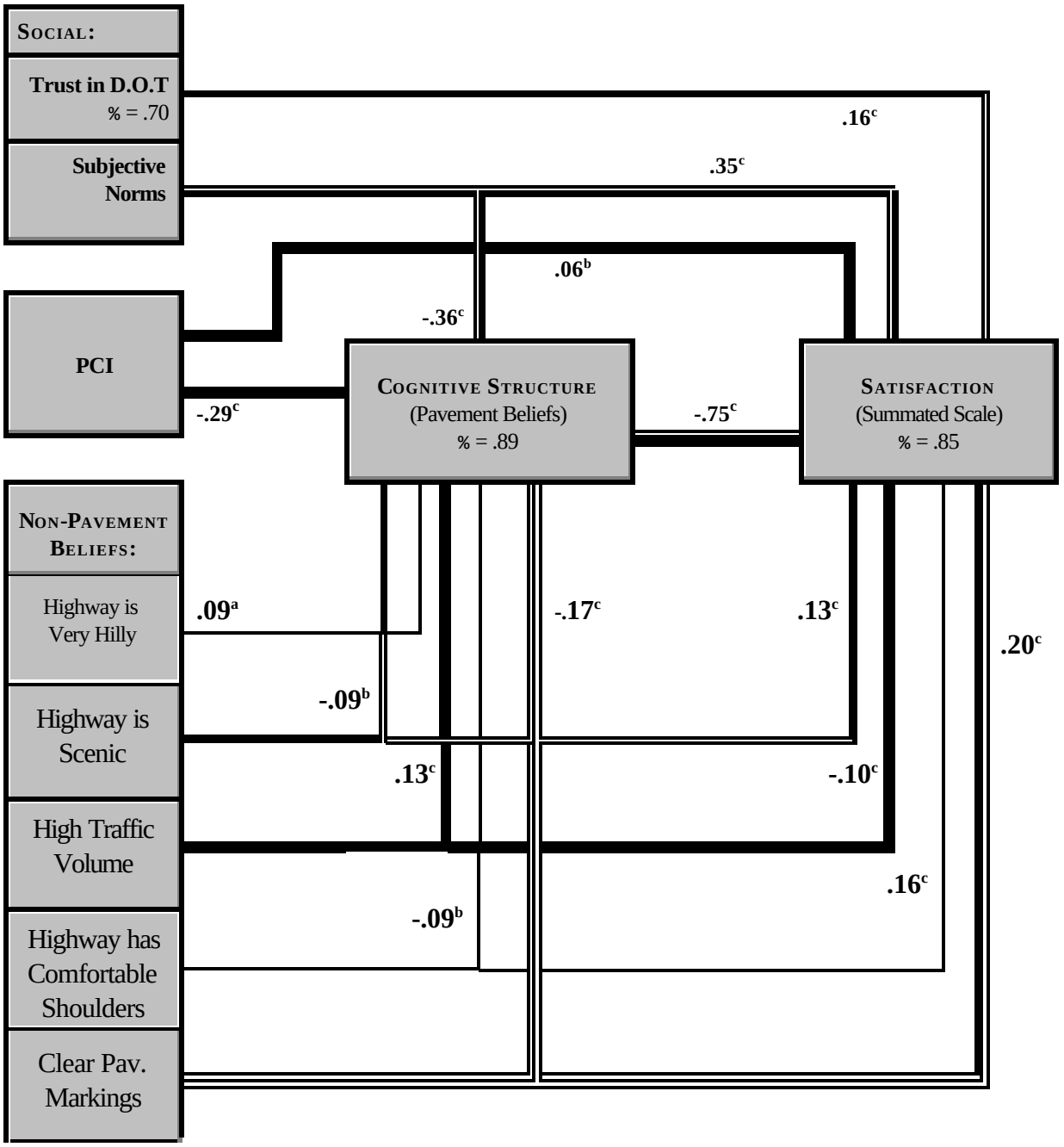
Multiple regression analyses (betas)

	All Pavements		*PC Only*		*AC and Composite*	
DEPENDENT VARIABLE:	**Cognitive Structure α = .89**	**Satis-faction α = .85**	**Cognitive Structure**	**Satis-faction**	**Cognitive Structure**	**Satis-faction**
EXPERIENTIAL:						
Vehicle "ride"	.06	-.07	**.20****	**-.20****	-.02	.01
R^2 change	.00	.00	.04	.04	.00	.00
SOCIAL:						
Trust in transportation dept. α=.70	-.05	**.16*****	.02	.07	-.09	**.20*****
Subjective norms	**-.36*****	**.35*****	**-.39*****	**.40*****	**-.34*****	**.32*****
R^2 change	**.14*****	**.18*****	**.15*****	**.17*****	**.14*****	**.18*****
PERCEIVED BEHAVIORAL CONTROL	.00	**.04**	-.09	**.16****	.06	-.02
R^2 change	.00	.00	.00	**.02****	.00	.00
NON-PAVEMENT BELIEFS						
Very Hilly	**.09****	-.03	**.16****	**-.12***	.04	.02
Scenic	**-.09****	**.13*****	-.07	.11	**-.10***	**.14*****
High traffic volume	**.13****	**-.10****	.06	**-.11***	**.16*****	**-.11***
Comfortable shoulders	**-.09***	**.16*****	-.04	**.17*****	**-.13****	**.17*****
Clear pavement markings	**-.17*****	**.20*****	**-.15****	**.19*****	**-.17*****	**.19*****
R^2 change	**.07*****	**.10*****	**.06*****	**.11*****	**.08*****	**.10*****
PAVEMENT CONDITION INDEX (PCI)	**-.29*****	**.06****	**-.26*****	**.06**	**-.30*****	**.06***
R^2 change	**.08*****	**.00**	**.06*****	**.00**	**.08*****	**.00**
COGNITIVE STRUCTURE		**-.75*****		**-.72****		**-.76*****
R^2 change		**.44*****		**.38*****		**.45*****
Multiple R	**.54*****	**.86*****	**.56*****	**.86*****	**.56*****	**.86*****
Adjusted R^2	.28	.73	.29	.72	.29	.73
N	676	676	245	245	431	431

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

Figure 5.4: Partial path analysis — Predictors of satisfaction with pavement conditions based on focused model, using PCI, all pavements

Path Coefficients



Two-tailed significance key: **a** = p # .05 **b**= p # .01 **c**= p # .001

Microscopic Analysis of Select Relationships

To diagnose the dynamics of the relationships in the **physical measures $ cognitive structure $ satisfaction** chain, we conducted analyses of the relationships among the individual items that comprise the cognitive structure and satisfaction indexes.

Partial correlation coefficients in **Table 5.3** indicate that overall (dis)satisfaction appears to be most affected by beliefs that the pavement causes extra wear on a vehicle's suspension (partial r= -.66, p#.001) and produces a bumpy ride (partial r= -.70, p#.001). Other important beliefs include that the pavement looks patchy (partial r= -.66, p#.001) and the pavement is noisy (partial r= -.60, p#.001). Consistent with Phase 2 results, beliefs about diversion of attention to the road surface play important but somewhat less, but still significant, role in overall satisfaction.

A microscopic analysis of the relationships between both physical pavement measurements and pavement beliefs (components of cognitive structure) is shown in **Table 5.4.** Each pavement indices (IRI and PCI) were significantly related to each of the five beliefs that comprise cognitive structure, even after controlling for several control variables. Cognitive structure was most highly related with PCI (partial r= -.31, p#.001) and to a lesser extent IRI (partial r= .26, p#.001). The size of this difference between these partial correlations is slight to moderate. PCI seems to be more highly related to the beliefs drivers hold about the pavement (beliefs that form the basis of driver satisfaction). It would appear to be a better measure for this type of modeling.

Table 5.3: Relationship of pavement beliefs to satisfaction

Partial correlation coefficients [1]

	Satisfaction Measure [2]:			
	Satisfied with pavement (item)	**Better than most (item)**	**Should be improved (item)**	**Satisfaction (summated)** [3] % = .80
PAVEMENT BELIEFS [2]				
Driving on the pavement on this section of highway....				
...Causes extra wear on my vehicle's suspension system.	-.60***	-.51***	.59***	-.66***
...Produces a bumpy ride.	-.63***	-.52***	.64***	-.70***
...Causes me to focus my attention on the pavement surface.	-.47***	-.40***	.51***	-.54***
...Is noisy.	-.53***	-.46***	.52***	-.60***
The pavement looks patchy.	-.57***	-.53***	.61***	-.66***
COGNITIVE STRUCTURE (summated pavement beliefs) % = .89	-.70***	-.60***	.71***	-.79***

N = 676

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

1. Fifteenth-order partials controlled by education, sex, age, cycle driving frequency, vehicle "ride," frequency of driving stretch of highway, trust in transportation department, subjective norms, perceived behavioral control, and the set of six non-pavement beliefs. *Not controlled by physical pavement characteristics.*

2. Beliefs and satisfaction items are scaled such that greater agreement produces higher numerical values.

3. Scoring of the item "the pavement...should be improved" was reversed in the calculation of the summated index.

Table 5.4: Relationship of pavement beliefs to physical pavement measures

Partial correlation coefficients [1]

	Physical Pavement Measure:	
	IRI	***PCI***
PAVEMENT BELIEFS [2]		
Driving on the pavement on this section of highway....		
...Causes extra wear on my vehicle's suspension system.	**.22*** **	**-.27*** **
...Produces a bumpy ride.	**.22*** **	**-.27** **
...Causes me to focus my attention on the pavement surface.	**.18*** **	**-.21*** **
...Is noisy.	**.18** **	**-.24*** **
The pavement looks patchy.	**.25*** **	**-.28*** **
COGNITIVE STRUCTURE (summated pavement beliefs) % = .89	**.26*** **	**-.31*** **
N=	614	676

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

1. Fifteenth-order partials controlled by education, sex, age, cycle driving frequency, vehicle "ride," frequency of driving stretch of highway, trust in transportation department, subjective norms, perceived behavioral control, and the set of six non-pavement beliefs.

2. Beliefs are scaled such that greater agreement produces higher numerical values.

Model Summary.

As predicted, the strength of the correlation between PCI and satisfaction was greater in Phase 3 (.36) than in Phase 2 (.22). In general, analysis of the Phase 3 Iowa data confirm the robustness of the model. This is especially true of the core relationships among physical data, cognitive structure, and satisfaction. It is expected that these findings will be replicated in the analyses of the Minnesota and Wisconsin data. The model continues to work well not only as an explainer of satisfaction with pavements but also as a diagnostic tool. The relationships between physical data and cognitive structure continue to be impressive and consistent with expectations. The model illustrates that variables such as:

1) trust in the DOT,

2) subjective norms,

3) beliefs about the pavement and

4) beliefs about non-pavement characteristics

are important considerations when attempting to understand driver satisfaction.

OBJECTIVE 6 - SPECIAL ANALYSIS OF SELECTED RELATIONSHIPS

To gain additional insights into the responses of this sample of Iowa drivers, relationships among responses to selected items were analyzed.

Reasons for Improvement

The first set of relationships examined involved questions 57 and 59. Question 57 made the statement "I am satisfied with the pavement on this section" and question 59 stated, "The pavement on this section should be improved." Both question could be responded to with Strongly Agree, Somewhat Agree, Feel Neutral, Somewhat Disagree, or Strongly Disagree. The data examined in the following table comes from 130 respondents who Strongly Agreed or Somewhat Agreed with both questions. Questions 59a_1 through 59a_6 asked for further insight into why they felt the pavement needed improvement. The following table contains the "yes/no" responses to these six questions.

Table 6.1
Breakdown of Those who SA or A with Both Q 57 and 59 by Response to Q 59a

	Yes	**No**
Q59a_1 The pavement causes extra wear on my vehicle's suspension.	**43%** 56	**54%** 70
Q59a_2 It produces a bumpy ride	**54%** 70	**43%** 56
Q59a_3 It causes me to focus my attention on the pavement surface.	**37%** 48	**60%** 78
Q59a_4 The Pavement is noisy	**35%** 46	**61%** 80
Q59a_5 It looks patchy.	**58%** 75	**39%** 51
Q59a_6 Because of a non-pavement reason?	**40%** 52	**57%** 74
Total agreeing with both Q57 and Q59	130	

Seventy respondents indicated that they had both pavement and non-pavement reasons to want an improvement made. A further breakdown of these 70 responses can be found in Table 6.2. Note that all 70 had both pavement and non-pavement reasons for indicating the pavement should be improved.

Table 6.2
Breakout of those who Agreed with Both Q 57 (satisfied) and Q 59 (improve) and gave both Pavement and Non-Pavement Reasons

	Yes	No	Total
Q59a_1 The pavement causes extra wear on my vehicle's suspension.	**49%** 34	**51%** 36	70
Q59a_2 It produces a bumpy ride	**60%** 42	**40%** 28	70
Q59a_3 It causes me to focus my attention on the pavement surface.	**40%** 28	**60%** 42	70
Q59a_4 The Pavement is noisy	**41%** 29	**59%** 41	70
Q59a_5 It looks patchy.	**67%** 47	**33%** 23	70
Q59a_6 Because of a non-pavement reason?	**100%** 70	**0%** 0	70

Of the remaining 60 respondents who wanted the pavement improved, 16 had only non-pavement reasons and 44 had only pavement reasons.

Since 86 respondents felt that the pavement should be improved for non-pavement reasons, there is an indication that non-pavement related issues can cause a desire for pavement section improvements.

Table 6.3 summarizes all 123 individuals who agreed with Q 59 and answered "yes" to Q 59a 6) (non-pavement reason for improvement) and their non-pavement beliefs (Q 43-48 responses). This was done to see if there was any obvious single reason for their response. Only two question responses, (Q 43 and 44), disagreeing with "the shoulder is comfortable" and agreeing with "lots of traffic" stand out. This illustrates the importance of non-pavement beliefs and their interaction with the public's desire for the road section to be improved. The 123 non-pavement beliefs represent 38 percent of 328 respondents who thought the highway should be improved.

Correlation analyses was also performed to compare the reasons for improvement listed in Q 59a 1) through 5 with the same respondents list of pavement beliefs (Q 32 through 40) which were identical with these choices. **Table 6.4** shows those correlations.

Table 6.3
Breakdown of Non-Pavement Beliefs for all those who Answered "Yes" to Q59a 6) as a Reason for Improve

	Strongly Disagree	**Somewhat Disagree**
Question 43 I would be comfortable pulling on to the shoulder on this section?	**46%** 57	**17%** 21
Question 45 The lines on this section are clear and easy to see.	**15%** 18	**18%** 22
Question 46 The scenery on this section is attractive.	**11%** 14	**11%** 14
	Strongly Agree	**Somewhat Agree**
Question 44 There is a lot of traffic on this section	**37%** 45	**28%** 34
Question 47 This section is very curvy.	**22%** 27	**11%** 13
Question 48 This section is very hilly.	**17%** 21	**30%** 37
Totals	**123**	

Table 6.4
Correlation of Pavement Beliefs and Pavement Reasons for Improvement

	Correlation
Q32 & Q59a_1	0.66
Q34 & Q59a_2	0.55
Q36 & Q59a_3	0.60
Q38 & Q59a_4	0.66
Q40 & Q59a_5	0.50

In order to validate responses, questions 32 through 40 are almost the same as questions 59a_1 through 59a_6. The questions are worded in a slightly different fashion. This allows a correlation analysis to be performed on the data. This information is found in Table 6.4. This correlation analysis provides a consistency check of the respondents answers. The correlation coefficients were all .50 or higher which confirms that responses were consistent.

Pavement Improvement by Selected Pavement Belief and Pavement Types.

This comparison involved respondents who agreed with Q59 (needs improvement), and also agreed with one or more of the pavement beliefs (Q 32 through 40). The breakdown of responses by pavement type is shown in **Table 6.5**. While the table would appear to indicate that AC pavements received fewer positive responses (pavement needs improvement), factoring in the actual number of people who were surveyed by pavement type would make the response rates virtually the same. Once the data was normalized the information in Table 6.5 did not yield any conclusions worth noting.

Table 6.5
Pavement Beliefs by Pavement Types

	PCC	AC	COMP	Total
Question 32 Driving on the PAVEMENT on this section causes extra wear on my vehicle's suspension system.	**36%** 83	**27%** 62	**37%** 85	230
Question 34 Driving on the PAVEMENT on this section produces a bumpy ride.	**38%** 118	**28%** 87	**34%** 106	311
Question 36 Driving on the PAVEMENT causes me to focus on the pavement surface.	**39%** 117	**28%** 84	**33%** 99	300
Question 38 Driving on the PAVEMENT on this section is noisy.	**40%** 91	**28%** 64	**33%** 75	230
Question 40 The pavement on this section looks 'patchy'.	**40%** 97	**28%** 68	**33%** 80	242

Pavement Improvement, Select Pavement Beliefs and Quality of Vehicle Ride

A question (103) was included at the end of the survey asking drivers to judge the quality of their ride. It was thought this might affect either their pavement beliefs or their perceptions of whether the pavement needed improvement. Correlation analysis (bi-variate) was run between all responses to the Q 32 (wear on vehicle suspension), 34 (bumpy ride) and 36 (focus attention)and the self-judgement of vehicle ride quality (hereafter called "ride quality"). Correlations are low (below - 0.2). Correlation of all responses to Q 59 (needs improvement) and ride quality (Q 103) is also low.

Table 6.6 shown below, shows all responses for Q 32, Q 34 and Q 36 for those respondents who agreed with Q 59 (pavement section should be improved).

Table 6.6
Agreement with Select Pavement Beliefs and with "Improve" By "Ride Quality"

	VG	G	F	P	VP	Total
Q 32 (SA, A) Driving on the pavement on this section causes extra wear on my vehicle's suspension system.	**33%** 76	**32%** 74	**27%** 62	**6%** 14	**2%** 4	**100%** 230
Q 34 (SA, A) Driving on the pavement on this section produces a bumpy ride.	**35%** 108	**31%** 95	**28%** 86	**6%** 17	**2%** 5	**100%** 311
Q 36 (SA, A) Driving on the pavement on this section causes me to focus my attention on the pavement surface	**11%** 77	**10%** 66	**24%** 51	**7%** 15	**1%** 3	**100%** 213
Q 59 (SA, A) The pavement on this section should be improved	**36%** 118	**32%** 104	**25%** 82	**6%** 19	**1%** 4	**100%** 328

PHASE II VS. PHASE III TRUST AND SATISFACTION RESPONSES

One of the more important actions in reviewing both Phase II and Phase III results is to compare the survey responses for the trust and satisfaction questions, which were central to much of the analysis. It should be noted, of course, that the two surveys involved completely different samples of Iowa drivers. Phase II was a random sample of drivers, and Phase III was a select sample of potential households and then drivers who lived in proximity to a specific segment to be surveyed.

For the trust items, Phase III results exhibited an increase in percentages of respondents who strongly agreed or agreed with the statements in the questions. For question 51, IaDOT's capability of doing a good job in pavement repair, agreement [Strongly agree (SA) and Agree (A)] was higher in Phase III than in Phase II, 80.5% vs. 77.6%, respectively. As to trust in IaDOT's judgement in scheduling pavement improvements, Q52, agreement (SA and A) rose from 64.1% in Phase II to 67.9% in Phase III. With regard to Q53, regarding IaDOT caring about drivers' safety and convenience, positive response increased from 77.6% in Phase II to 81.1% in Phase III. Finally, for Q53a, whether IaDOT considers input from Iowa drivers, agreement rose substantially from 37.5% in Phase II to 56.4% in Phase III. Finally, further analysis of the response data revealed no significant differences between responses of urban versus rural drivers. Overall, the findings not only verify the results of Phase II, but also indicate that there is a high degree of trust in IaDOT.

Questions 57 through 59, which deal with satisfaction, revealed a mixed pattern in terms of comparisons of the two phases. Overall satisfaction with the pavement sections throughout Iowa (Q57) dropped from 74% in Phase II to 68.3% in Phase III. In contrast, agreement that the pavement on the respondent's section was better than most other sections in Iowa (Q58) increased from 40.6% in Phase II to 49.8% in Phase III. It should be noted that a stratified sample was used in Phase III. This caused more pavements in the "poor" and "very poor" categories to be included in the sample. For question 59 agreement that the respondent's pavement section should be improved fell from 53.9% in Phase II to 48.5% in Phase III.

TRUST QUESTION CROSSTAB ANALYSIS

The trust portion of the Phase III survey (Q 51 through Q 53a) discussed above was subjected to further analysis. This analysis was done by cross-tabulating these four questions with: 1) driving frequency, question 28; 2) pavement belief questions 32-40; 3) non-pavement questions 42-48; 4) satisfaction questions 57-59; 5) vehicle type questions 101-103; 6) demographic questions: age Q100, education Q108, gender Q998b; and 7) licenses, Q105-Q105b.

It is expedient at this point to identify the specific nature of the statistical analysis conducted on the survey data. The chi-square test of independence was employed to determine whether relationships between cross tabulated variables were significant at the 95 percent confidence level. Since the data are predominately ordinal in nature, the appropriate test is the Spearman Correlation Coefficient, which has been applied throughout the analysis. This test measures the extent of the relationship between two

response sets. In that the term "crosstab" will be used repeatedly in subsequent report sections, it has been abbreviated to "Xtab."

Trust vs. Satisfaction

Intuitively, one might well expect trust in IaDOT to be related to satisfaction with the pavement on which respondents were driving. Analysis by means of cross-tabulating the four trust questions against the three satisfaction questions confirmed statistically-significant relationships across all Xtabs. The results are discussed below and summarized in Table 6.1, which follows the complete discussion.

Q51 (IaDOT is capable of fixing and replacing pavements)

Since responses to all three satisfaction questions were significantly related to those for item 51, this section simply highlights the specific nature of the relationships. Respondents who strongly agreed (SA) with Q57 (satisfied with the pavement), were much more likely to strongly agree that IaDOT is capable of doing a good job of fixing and replacing pavements than were those who strongly disagreed [SA 52.7% vs. SDA 9.1%]. For Q58, over half of the drivers who strongly agreed that their pavement section was better than most others (52.2%) also strongly agreed as to IaDOT's capability. As would be anticipated, then, for Q59, over half of the motorists who strongly disagreed that their section's pavement should be improved (52.1%) strongly agreed that IaDOT is capable of doing a good job of pavement repair.

Q52 (Trusting IaDOT's judgment in scheduling pavement improvements)

Drivers who were very satisfied with the pavement, Q57, were considerably more likely to strongly agree that they trusted the judgement of IaDOT when it comes to scheduling pavement improvements [SA 56.9% vs. SDA 7.7%]. As to perceptions about pavement, motorists who strongly agreed that their section was better than most others (Q58) were more likely to strongly agree with this trust item than were those who strongly disagreed [SA 28.7% vs. SDA 13.8%]. Finally, respondents who strongly disagreed that their pavement section should be improved, Q59, chose "strongly agree" for this trust item more frequently than did those who strongly agreed on pavement improvement.

Q53 (IaDOT cares about the safety and convenience of drivers on this stretch)

Satisfaction responses also affected perceptions as to IaDOT caring about the safety and convenience of drivers. Respondents who SA with Q57 (satisfied with their pavement), were much more likely to strongly agree that IaDOT cares than were those who SDA, [SA 57.2% vs. SDA 6.3%]. Once again, more than half (54.3%) of the motorists who strongly agreed that their pavement section was better than most others also strongly agreed that IaDOT cares about drivers' needs. At the same time, over half (57.7%) of the drivers who strongly disagreed that their pavement section should be improved, Q59, strongly agreed that IaDOT cares.

Q53a (IaDOT considers input from people like me when making decisions on improvement on this stretch)

The final trust item queried respondents as to whether IaDOT considered input from people like them when making decisions on pavement repair. As was true before, motorists who SA with Q57 (satisfied) with their pavement section were considerably more likely to strongly agree that IaDOT heeds input from drivers [SA 52.8% vs. SDA 9.2%]. While the relationship with Q58 on pavement judgement was not as compelling, it was nevertheless significant. It revealed that drivers who strongly agreed with Q58 were more likely to strongly agree that IaDOT notes input than those who strongly disagreed [SA 29.6% vs. SDA 14.4%]. Finally, respondents who strongly disagreed that their pavement section should be improved, Q59, were more likely to strongly agree that IaDOT considers input than were those who strongly agreed with improvement.

Trust vs. Pavement/ Non-Pavement Beliefs and Selected Demographic/Vehicle Variables

As was true with the Phase II survey response analysis, the satisfaction items outperformed the demographic/vehicle items in terms of statistically-significant relationships. Reported in this section, therefore, are only a few of the latter variables which had significant Xtab results. Parallel to the Phase II analysis of the trust questions, a number of the pavement and non-pavement items exhibited statistically-significant Xtab relationships. As such, they are the primary focus of this section. Consistent with the preceding section, the results are organized in relation to the four trust questions.

Q51 (IaDOT is capable etc.)

For this first trust item, the Xtab results yielded significant relationships for two pavement and two non-pavement items. Drivers who strongly disagreed that their section produced a bumpy ride (Q34) were more likely to strongly agree that IaDOT is capable of doing a good job fixing and replacing pavements than were those who strongly agreed regarding a bumpy ride [SDA 36% vs. SA 18.9%]. Strong agreement that IaDOT is capable was considerably more frequent for respondents who strongly disagreed that their pavement section was noisy (Q38) than for those who strongly agreed [SDA 39.4% vs. SA 12.1%]. For the non-pavement items, the contrast in response patterns was even more notable. Motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) more frequently chose "strongly agree" that IaDOT is capable than did those who strongly disagreed with the comfort issue [SA 39% vs. SDA 18.6%]. Finally, drivers who strongly agreed that the lines on their pavement section were clear and easy to see (Q45) were significantly more likely to strongly agree that IaDOT is capable than were those who strongly disagreed that lines were clear [SA 58.3% vs. SDA 5.7%].

Q52 (Trust IaDOT's judgment etc.)

Emerging from the Xtab analysis for this second trust item were significant associations again for two

pavement and two non-pavement questions. Significant relationships, moreover, were found for two demographic/vehicle items. First, for the pavement items, strong agreement on trust in IaDOT's judgement was substantially more frequent for respondents who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) than for those who strongly agreed [SDA 48.6% vs. SA 13.3%]. Selection of "strongly agree" on this trust item was more likely for motorists who strongly disagreed that their section produced a bumpy ride (Q34) than for those who strongly agreed [SDA 37% vs. SA 16.6%]. For the non-pavement items, questions 43 and 45 again came into play. Drivers who strongly agreed that they would feel comfortable pulling onto their section's shoulder (Q43) were significantly more likely to strongly agree with this trust item than were those who strongly disagreed [SA 39.8% vs. SDA 20.4%]. Strong agreement with this trust item, moreover, was considerably greater for motorists who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 63.5% vs. SDA 8.3%].

The two demographic/vehicle items which were related involved one license item and one demographic measure. Choice of "strongly agree" with this trust item was more frequent for respondents who did not have a commercial drivers license (CDL), Q105, than for those who had a CDL [28.7% vs. 16.8% for CDL respondents]. Likewise, strong agreement was somewhat more likely for female drivers (Q998b) than for male drivers [F 29.4% vs. M 24.4%].

Q53 (IaDOT cares about safety etc.)

Of the four trust items, question 53 had the most statistically-significant relationships with the variables highlighted in this section. These included all five pavement beliefs, two non-pavement beliefs, and one demographic item. Respondents who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were significantly more likely to strongly agree that IaDOT cares than were those who strongly agreed [SA 52.4% vs. SDA 11.2%]. Selection of "strongly agree" that IaDOT cares was more frequent for motorists who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed [SDA 39.4% vs. SA 13.8%]. Similarly, strong agreement that IaDOT cares was much more likely for drivers who strongly disagreed that their section's pavement caused them to focus their attention on the pavement surface (Q36) than for those who strongly agreed [SDA 40.9% vs. SA 12.6%].

Respondents who strongly disagreed that driving on their section's pavement was noisy (Q38) were considerably more likely to strongly agree that IaDOT cares than were those who strongly agreed [SDA 42% vs. SA 10.4%]. Likewise, motorists who strongly disagreed that the pavement on their section looked patchy (Q40) strongly agreed that IaDOT cares more frequently than did those who strongly agreed [SDA 35.3% vs. SA 22.3%]. Consistent with preceding results, questions 43 and 45 were the non-pavement items which reflected significant relationships. Selection of "strongly agree" for this trust item was considerably more frequent for drivers who strongly agreed that they would feel comfortable pulling onto their section's shoulder (Q43) than for those who strongly disagreed [SA 49.8% vs. SDA 14.9%]. At the same time, respondents who strongly agreed that the lines on their pavement section were clear (Q45) were

substantially more likely to strongly agree that IaDOT cares than were those who strongly disagreed [SA 65.4% vs. SDA 7.1%]. Finally, this was the only trust item for which the age demographic entered into the significant findings. Choice of "strongly agree" that IaDOT cares increased significantly with age (Q100) [rising from 21.3% for motorists 18-35 yrs. of age to 45.5% for those aged 50 and over].

Q53a (IaDOT considers input etc.)

Interestingly, none of the pavement questions were significantly related to this final trust item. Responses to whether IaDOT considers input from Iowa drivers, however, were associated with two non-pavement items, once again Q43 and Q45, and two demographic/vehicle questions. Respondents who strongly agreed that they were comfortable pulling onto their section's shoulder (Q43) strongly agreed that IaDOT considers drivers' input much more frequently than did those who strongly disagreed [SA 43% vs. SDA 16.9%]. Similarly, strong agreement that IaDOT notes input was significantly greater for motorists who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 65.5% vs. SDA 6.3%]. As was the case with trust question 52, a license question came into play, although this time it involved motorcycles. Choice of "strongly agree" that IaDOT heeds input was more frequent for respondents who did not have a motorcycle license (Q105a) than for those who did have a motorcycle license (ML) [22.8% vs. 11.5% for ML respondents]. Finally, drivers who had no more than a high school education (Q108) were much more likely to strongly agree that IaDOT considers input than were those who had education beyond high school [57.7% for high school level vs. approximately 21% for some college or beyond.

Table 6.7
Relationships Among Survey Variables

TRUST QUESTIONS	**Related Variables**
IaDOT is capable of doing a good job of pavement repair (Q51). [80.5% agree (SA or A)]	Strong agreement that IaDOT is capable of doing a good job fixing and replacing pavement was much more likely for respondents who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed [SDA 36% vs. SA 18.9%]. Motorists who strongly disagreed that their pavement section was noisy (Q38) were considerably more likely to strongly agree with the capability of IaDOT than were those who strongly agreed [SDA 39.4% vs. SA 12.1%]. Selection of "strongly agree" on IaDOT's capability was more frequent for drivers who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA 39% vs. SDA 18.6%]. Respondents who strongly agreed that the lines on their pavement section were clear and easy to see (Q45) were considerably more likely to strongly agree that IaDOT is capable than were those who strongly disagreed that lines were clear [SA 58.3% vs. SDA 5.7%]. Drivers who SA with Q57 (satisfied with the pavement) were significantly more likely to strongly agree that IaDOT is capable of doing a good job of fixing and replacing pavements than were those who strongly disagreed with Q57 [SA 52.7% vs. SDA 9.1%].

Strong agreement with IaDOT's capability was recorded by over half (52.2%) of the motorists who strongly agreed that their pavement section was better than most others.

Over half (52.1%) of the respondents who strongly disagreed that their pavement section should be improved (Q59) strongly agreed that IaDOT is capable of doing a good job.

Trust IaDOT's judgment in scheduling pavement improvements (Q52). [67.9% agree (SA or A)]

Selection of "strongly agree" on trust in IaDOT's judgment was much more frequent for motorists who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) than for those who strongly agreed [SDA 48.6% vs. SA 13.3%].

Strong agreement with this trust item was more likely for drivers who strongly disagreed that their section produced a bumpy ride (Q34) than for those who strongly agreed [SDA 37% vs. SA 16.6%].

Respondents who strongly agreed that they would feel comfortable pulling onto their section's shoulder (Q43) were substantially more likely to strongly agree with this trust item than were those who strongly disagreed [SA 39.8% vs. SDA 20.4%].

Choice of "strongly agree" for this trust item was significantly greater for motorists who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 63.5% vs. SDA 8.3%].

Strong agreement with this trust item was more likely for respondents who did not have a commercial drivers license (CDL), Q105, than for those who had a CDL [28.7% vs. 16.8% for CDL respondents].

Selection of "strongly agree" with this trust item was somewhat more frequent for female drivers (Q998b) than for male drivers [F 29.4% vs. M 24.4%].

Motorists who were very satisfied with the pavement (Q57) were significantly more likely to strongly agree that they trusted the judgment of IaDOT than were those who were very dissatisfied [VS 56.9% vs. VD 7.7%].

Strong agreement with this trust item was more frequent for motorists who strongly agreed that their section was better than most others (Q58) than for those who strongly disagreed [SA 28.7% vs. SDA 13.8%].

Choice of "strongly agree" on this trust item was more likely for drivers who strongly disagreed that their pavement section should be improved (Q59) than for those who strongly agreed with pavement improvement.

IaDOT cares about the safety and convenience of Iowa drivers (Q53). [81.1% agree (SA or A)]

Motorists who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were significantly more likely to strongly agree that IaDOT cares than were those who strongly agreed [SDA 52.4% vs. SA 11.2%].

Strong agreement that IaDOT cares was more frequent for drivers who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed [SDA 39.4% vs. SA 13.8%].

Respondents who strongly disagreed that their section's pavement caused them to focus their attention on the pavement surface (Q36) were considerably more likely to strongly agree that IaDOT cares than were those who strongly agreed [SDA 35.3% vs. SA 22.3%].

Choice of "strongly agree" for this trust item was much more frequent for motorists who strongly disagreed that driving on their section's pavement was noisy (Q38) than for those who strongly greed [SDA 42% vs. SA 10.4%].

Drivers who strongly disagreed that the pavement on their section looked patchy (Q40) were more likely to strongly agree that IaDOT cares than were those who strongly agreed [SDA 35.3% vs. SA 22.3%].

Strong agreement that IaDOT cares was much more frequent for respondents who strongly agreed that they would feel comfortable pulling onto their section's shoulder (Q43) than for those who strongly disagreed [SA 49.8% vs. SDA 14.9%].

Motorists who strongly agreed that the lines on their pavement section were clear (Q45) were significantly more likely to strongly agree that IaDOT cares than were those who strongly disagreed [SA 65.4% vs. SDA 7.1%].

Selection of "strongly agree" that IaDOT cares increased significantly with age (Q100) [from 21.3% for drivers 18-35 yrs. old to 45.5% for those 50 and over in age].

Respondents who were very satisfied with the pavement (Q57) were substantially more likely to strongly agree that IaDOT cares about drivers' needs than were those who were very dissatisfied [VS 57.2% vs. VD 6.3%].

More than half (54.3%) of the drivers who strongly agreed that their pavement section was better than most others (Q58) also strongly agreed that IaDOT cares.

Choice of "strongly agree" that IaDOT cares was made by over half (57.7%) of the motorists who strongly disagreed that their pavement section should be improved.

IaDOT considers input from Iowa drivers (Q53a). [56.4% agree (SA or A)]

Drivers who SA with Q57 (satisfied with the pavement) were significantly more likely to strongly agree that IaDOT heeds input than were those who SDA [SA 52.8% vs. SDA 9.2%].

Choice of "strongly agree" that IaDOT notes input was more frequent for motorists who strongly agreed that their pavement section was better than most others (Q58) than for those who strongly disagreed [SA 29.6% vs. SDA 14.4%].

Respondents who strongly disagreed with improvement of their pavement section (Q59) were more likely to strongly agree that IaDOT considers input than were those who strongly agreed.

Strong agreement that IaDOT considers drivers' input was much more likely for respondents who strongly agreed that they would feel comfortable pulling onto their section's shoulder (Q43) than for those who strongly disagreed [SA 43% vs. SDA 16.9%].

Drivers who strongly agreed that the lines on their pavement section were clear (Q45) were significantly more likely to strongly agree that IaDOT heeds input than were those who strongly disagreed [SA 65.5% vs. SDA 6.3%].

Selection of "strongly agree" that IaDOT notes input was more frequent for respondents who did not have a motorcycle license (Q105a) than for those who did have a motorcycle license (ML) [22.8% vs. 11.5% for ML respondents].

Strong agreement that IaDOT considers input was much more likely for motorists who had no more than a high school education (Q108) than for those with higher education [57.7% for high school level vs. approximately 21% for some college or beyond].

7. SUMMARY AND CONCLUSIONS

Sampling

The stratified sample furnished by the Iowa DOT and the participants recruited by the WSRL provided a sample adequate for purposes of fulfilling the objectives of Phase III. The sample as furnished by the DOT was slightly skewed towards better pavement quality because of the actual PCIs of all highways that were available for the sample. That is also a reality of the highway system. The sample size was adequate to show differences in means of those indicating the were satisfied. These differences showed up for both urban and rural regions, and between pavement types in IRI, but not in PCI.

Because the differences in IRI were substantial between PC and AC and COMP pavements, analyses were performed by pavement type for both IRI and PCI, with AC and COMP pavements combined because of the closeness of actual differences in the mean (in spite of statistically significant differences). Regional differences were statistically significant for IRI, but deemed too small for separate analysis. This was illustrated when the analyses in Part 4 were undertaken.

Results - Satisfaction Thresholds

Phase III results paralleled those of Phase II. In Phase III, 68 percent indicated satisfaction with the segments they were assigned to drive, and 50 percent indicated the pavements should be improved. Approximately 17 percent agreed they were satisfied (Q 57) and the pavement needed improvement (Q 59) and this will be analyzed along with other relationships for a better understanding of results.

The mean IRI of those satisfied with PC pavements was substantially poorer than that of those satisfied who drove on AC and COMP pavements (approximately 2.5 vs. 1.7). There were no significant differences between mean PCI by region or pavement type.

When results were analyzed as in Phase II, there were substantial similarities in thresholds and the curves plotted in **Figures 3.1 and 3.2**. Differences were due to use of a more stratified sample in Phase III. For this reason a different approach to analyses was used to interpret threshold data.

Direct correlations between physical indices (IRI and PCI) and satisfaction increased approximately 50 percent (0.22 to 0.36) as predicted due to better control of segment physical data. But these direct correlations still explain only approximately 13 percent of the variation in satisfaction. Therefore as in Phase II, a psychological model is employed to explain as much of the variance as possible from the survey data.

A different approach, using assumptions about respondents answers was used to develop a tool to allow the DOT to answer questions about specific thresholds of physical indices, how many would be satisfied and how many would agree with improvement. The assumptions are that

1) if a pavement of a given quality results in satisfaction for a particular respondent, then it is presumed pavements of higher quality would also result in satisfaction;

2) if a pavement of a given quality is deemed to need improvement for a particular respondent, then it is presumed pavements of lower quality would also be deemed to need improvement.

Since satisfaction is a multi-dependent variable, that may not always be true, and this needs to be recognized, or else physical indices alone would account for most variance in satisfaction.

In Part 4, thresholds are developed for both IRI and PCI, by pavement type, for use of the Iowa DOT. IRI is shown in **Table 4.1**, and is also shown if **Figures 4.1 through 4.3**. For example, if Iowa, based on this survey data, wanted to set a threshold around 2.2 for PC pavement improvement, about 55 percent would be satisfied, but only about 28 percent would think it needed improvement (interpreting from **Figure 4.2**). If the intersection of the cumulative responses to Q57 (satisfied) and Q 59 (needs improvement) were selected, an IRI for PC pavements of 2.6 (middle of the "fair" quality category) would be an "optimum" IRI, i.e. any better quality pavement (lower IRI number) would satisfy more of the public, but result in less agreeing it should be improved. Any lower quality level IRI (higher IRI number) would find more agreeing pavements needed improvement, but less being satisfied. These applications are qualified, however, with the reminder that physical indices alone do not determine satisfaction, or need for improvement.

Similar analyses for AC and COMP pavements combined indicate much higher (poorer quality) IRI values are required than with PC pavements. The Q 57 - Q59 crossover for AC-COMP pavements (**Figure 4.3**) is an IRI of 1.8, near the middle of the "good" quality category. As stated, residents are apparently more tolerant of poorer ride on PC pavements than on AC-COMP pavements (This will be explored further at a later date).

When this type of analysis was applied to PCI, there were slight but insignificant differences between pavement types. A PCI of 60 (lower boundary of the "good" condition) for all pavements (**Figure 4.4**) would include about 40 percent of those satisfied, but include 60 percent of those agreeing it needed improvement. The intersection of the two questions (Q57 and 59) is a PCI of 66 for all pavements. If separate figures (**Figures 4.5 and 4.6**) were used for each pavement type, the intersections for PC and AC-COMP combined would be 58 and 62 respectively, each very close to 60 (the boundary between "good" and "fair" pavement qualities).

Results - Psychological Model

Since physical indices alone do not explain satisfaction, the **"Expectancy Value Theory of Fishbein and Ajzen"** was used. Beliefs about pavements (Cognitive Structure) again intervene, as in Phase II, with improved path coefficients. The strength of the relationships in **Figure 5.2** are strong, but only explain approximately 64 percent of the variance. Application of the Expectancy Value Theory again showed

improved understanding of other variables affecting satisfaction. In general, analysis of the Phase 3 Iowa data confirm the robustness of the model. This is especially true of the core relationships among physical data, cognitive structure, and satisfaction. It is expected that these findings will be replicated in the analyses of the Minnesota and Wisconsin data. The model continues to work well not only as an explainer of satisfaction with pavements but also as a diagnostic tool. The relationships between physical data and cognitive structure continue to be impressive and consistent with expectations. The model illustrates that variables such as 1) trust in the DOT, 2) subjective norms, 3) beliefs about the pavement and 4) beliefs about non-pavement characteristics are important considerations when attempting to understand driver satisfaction.

Results - Special Analyses

The 130 respondents who SA or A with both Q 57 (satisfied with pavement) and Q 59 (needs improvement) were analyzed to find out why they agreed with both. Seventy (70) of the respondents had both pavement and non-pavement reasons why they believed the pavement should be improved, while a total of 86 had non pavement reasons. Further analysis of all 328 drivers who SA or A the pavement should be improved showed 123 listed non-pavement reasons as one of the reasons for improvement. Disagreement that there was a safe shoulder to pull onto and agreement there was a lot of traffic were the two highest non-pavement beliefs given by those 123 drivers, although there was a scattering among all the non-pavement beliefs.

It should be noted that the total number who SDA or DA that they felt comfortable pulling onto the shoulder was 278 or 41 percent. Half or more of that number however did not agree the pavement should be improved.

There was response continuity between pavement beliefs and reasons listed for agreeing the pavement should be improved. The reason listed for improvement were analyzed by pavement type and response was distributed fairly equally among the three pavement types in proportion to their representation in the sample.

The need for improvement and pavement beliefs were also compared to the drivers self evaluation of their vehicle's ride and their responses showed low correlation. In fact, almost 2/3 of those who agreed with improve and agreed with pavement beliefs affecting ride rated their ride very good or good, so the team believes the vehicle ride did not impact drivers decision to agree with improve.

Results - Trust and Select Variables

The trust in the Iowa DOT responses were slightly to significantly higher in Phase III than in Phase II in all four questions, indicating again high levels of trust. Levels of satisfaction differed in the two phases as well, but that is believed to be a part of the sample differences.

When Xtab analyses were performed between satisfaction and all four trust questions, those who trusted in the DOT were more likely to be satisfied, believed the pavements driven were better than most and disagreed the pavements needed improvement to a greater degree than those who did not trust. Another way of saying it is that better pavements lead to higher trust.

Agreement with trust items correlated highly with disagreement with some negative pavement beliefs (example pavement was bumpy) and correlated highly with two positive non-pavement beliefs (comfortable shoulders and clear pavement markings) and several demographic items (primarily non-CDL license holders, females and older persons).

Overall, the goals of Phase III were met and numerous relationships explored to help the Iowa DOT answer questions about satisfaction with given pavement thresholds and policies. Trust in the DOT and many other variables also again as in Phase II, help explain just how complicated satisfaction. with pavements can be.

APPENDIX - CODE BOOK, IOWA PHASE III SURVEY

****
project 3366 n of cases 676.0
.....

deck01
****

question 0c column(s) 6-6

Can you tell me how many adults 18 or older are LICENSED drivers and
CURRENTLY DRIVE and live in your household ?

n	%	
169	25.00	1. ONE
428	63.31	2. TWO
67	9.91	3. THREE
11	1.63	4. FOUR
1	0.15	5. FIVE
0	0.00	6. SIX
0	0.00	7. SEVEN
0	0.00	8. EIGHT OR MORE
0	0.00	9. DON'T KNOW / REFUSED

****

question 0e column(s) 7-7

How many MEN living there are 18 or older and licensed drivers ?

n	%	
94	13.91	0. NONE
523	77.37	1. ONE
52	7.69	2. TWO
7	1.04	3. THREE OR MORE
0	0.00	9. REFUSED / DK

****
question 0f column(s) 8-8

And how many WOMEN living there are 18 or older and licensed drivers ?

n	%	
101	14.94	0. NONE
527	77.96	1. ONE
44	6.51	2. TWO
4	0.59	3. THREE OR MORE
0	0.00	9. REFUSED / DK

****

question 1d column(s) 9-10

CURRENT MONTH FROM COMPUTER'S CLOCK

n	%	
0	0.00	01. JANUARY
0	0.00	02. FEBRUARY
0	0.00	03. MARCH
0	0.00	04. APRIL
0	0.00	05. MAY
0	0.00	06. JUNE
29	4.29	07. JULY
492	72.78	08. AUGUST
155	22.93	09. SEPTEMBER
0	0.00	10. OCTOBER
0	0.00	11. NOVEMBER
0	0.00	12. DECEMBER
0	0.00	98. DON'T KNOW
0	0.00	99. REFUSED

****

question 1f column(s) 11-12

CURRENT DAY FROM COMPUTER'S CLOCK

n	%	
7	1.04	01. 1ST
25	3.70	2.
29	4.29	3.
36	5.33	4.
40	5.92	5.
32	4.73	6.
26	3.85	7.
16	2.37	8.
53	7.84	9.
37	5.47	10.
34	5.03	11.
35	5.18	12.
34	5.03	13.
21	3.11	14.
24	3.55	15.
43	6.36	16.
31	4.59	17.
21	3.11	18.
17	2.51	19.
23	3.40	20.
11	1.63	21.
8	1.18	22.

10	1.48	23.
10	1.48	24.
5	0.74	25.
6	0.89	26.
6	0.89	27.
8	1.18	28.
8	1.18	29.
14	2.07	30.
6	0.89	31. 31ST
0	0.00	98. DON'T KNOW
0	0.00	99. REFUSED

****

question 2 column(s) 13-14

(The section is Iowa state highway {STATE HIGHWAY NAME} from {TOWN FROM} to {TOWN TO} starting at {STARTING POINT} and ending at {ENDING POINT}.)

What date did you drive this section ?

n	%	
0	0.00	01. JANUARY
0	0.00	02. FEBRUARY
0	0.00	03. MARCH
0	0.00	04. APRIL
0	0.00	05. MAY
0	0.00	06. JUNE
55	8.14	07. JULY
467	69.08	08. AUGUST
154	22.78	09. SEPTEMBER
0	0.00	10. OCTOBER
0	0.00	11. NOVEMBER
0	0.00	12. DECEMBER
0	0.00	98. DON'T KNOW/NOT SURE (skip to q 28)
0	0.00	99. REFUSED (skip to q 28)

****

question 2a column(s) 15-16

DAY OF THE MONTH

n	%	
24	3.55	01. 1ST
31	4.59	2.
34	5.03	3.
53	7.84	4.

34	5.03	5.
34	5.03	6.
22	3.25	7.
35	5.18	8.
35	5.18	9.
30	4.44	10.
31	4.59	11.
38	5.62	12.
25	3.70	13.
31	4.59	14.
30	4.44	15.
29	4.29	16.
17	2.51	17.
18	2.66	18.
15	2.22	19.
13	1.92	20.
11	1.63	21.
7	1.04	22.
7	1.04	23.
7	1.04	24.
4	0.59	25.
4	0.59	26.
7	1.04	27.
4	0.59	28.
14	2.07	29.
15	2.22	30.
17	2.51	31. 31ST
0	0.00	98. DON'T KNOW
0	0.00	99. REFUSED
0	0.00	^. INAP

****

question 28 column(s) 17

(The section is Iowa state highway {STATE HIGHWAY NAME} from {TOWN FROM} to {TOWN TO} starting at {STARTING POINT} and ending at {ENDING POINT}.)

How often do you NORMALLY drive that section ? Would you say more than once a week, once a week, once a month, once a year or never ?

n	%	
165	24.41	1. MORE THAN ONCE A WEEK
132	19.53	2. ONCE A WEEK
239	35.36	3. ONCE A MONTH
107	15.83	4. ONCE A YEAR
33	4.88	5. NEVER
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 32 column(s) 18

Now, I'm going to read some statements that people might make about the pavement on rural highways. Thinking about driving that section, please tell me if you strongly agree, somewhat agree, feel neutral, somewhat disagree, or strongly disagree with each one. Remember, we are only talking about the PAVEMENT right now. First...

Driving on the PAVEMENT on this section causes extra wear on my vehicle's suspension system.

n	%	
98	14.50	1. STRONGLY AGREE
132	19.53	2. SOMEWHAT AGREE
43	6.36	3. FEEL NEUTRAL
134	19.82	4. SOMEWHAT DISAGREE
266	39.35	5. STRONGLY DISAGREE
3	0.44	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 34 column(s) 19

Driving on the PAVEMENT on this section produces a bumpy ride.

n	%	
130	19.23	1. STRONGLY AGREE
181	26.78	2. SOMEWHAT AGREE
38	5.62	3. FEEL NEUTRAL
125	18.49	4. SOMEWHAT DISAGREE
201	29.73	5. STRONGLY DISAGREE
1	0.15	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 36 column(s) 20

Driving on the PAVEMENT on this section causes me to focus my attention on the pavement surface.

(INTERVIEWER: THIS MIGHT INCLUDE THINGS LIKE TURNING DOWN THE RADIO OR STOPPING CONVERSATIONS)

n	%	
83	12.28	1. STRONGLY AGREE
130	19.23	2. SOMEWHAT AGREE
81	11.98	3. FEEL NEUTRAL
155	22.93	4. SOMEWHAT DISAGREE
225	33.28	5. STRONGLY DISAGREE
2	0.30	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 38 column(s) 21

Driving on the PAVEMENT on this section is noisy.
(NOTE: This would INCLUDE noise caused by grooves running across the pavement to improve traction, which can make a high-pitched whining sound. We are NOT talking about rumble strips or bars.)

n	%	
86	12.72	1. STRONGLY AGREE
144	21.30	2. SOMEWHAT AGREE
58	8.58	3. FEEL NEUTRAL
164	24.26	4. SOMEWHAT DISAGREE
222	32.84	5. STRONGLY DISAGREE
2	0.30	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 40 column(s) 22

The pavement on this section looks "patchy".

n	%	
182	26.92	1. STRONGLY AGREE
160	23.67	2. SOMEWHAT AGREE
42	6.21	3. FEEL NEUTRAL
119	17.60	4. SOMEWHAT DISAGREE
170	25.15	5. STRONGLY DISAGREE
2	0.30	8. DON'T KNOW/NOT SURE
1	0.15	9. REFUSED

****

question 43 column(s) 23

Now I would like to read some statements about other, NON-PAVEMENT, characteristics of this section using the same scale.

I would feel comfortable pulling on to the shoulder on this section if I had to. (This is not refering to the PAVEMENT on the shoulder.)

n	%	
218	32.25	1. STRONGLY AGREE
153	22.63	2. SOMEWHAT AGREE
23	3.40	3. FEEL NEUTRAL
119	17.60	4. SOMEWHAT DISAGREE
159	23.52	5. STRONGLY DISAGREE
4	0.59	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 44 column(s) 24

There is a lot of traffic on this section.

n	%	
249	36.83	1. STRONGLY AGREE
167	24.70	2. SOMEWHAT AGREE
71	10.50	3. FEEL NEUTRAL
99	14.64	4. SOMEWHAT DISAGREE
85	12.57	5. STRONGLY DISAGREE
5	0.74	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 45 column(s) 25

The lines on this section are clear and easy to see.

n	%	
332	49.11	1. STRONGLY AGREE
166	24.56	2. SOMEWHAT AGREE
38	5.62	3. FEEL NEUTRAL
83	12.28	4. SOMEWHAT DISAGREE
47	6.95	5. STRONGLY DISAGREE
10	1.48	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 46 column(s) 26

The scenery on this section is attractive.

n	%	
256	37.87	1. STRONGLY AGREE
207	30.62	2. SOMEWHAT AGREE
121	17.90	3. FEEL NEUTRAL
55	8.14	4. SOMEWHAT DISAGREE
35	5.18	5. STRONGLY DISAGREE
2	0.30	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 47 column(s) 27

This section is very curvy.

n	%	
84	12.43	1. STRONGLY AGREE
111	16.42	2. SOMEWHAT AGREE
41	6.07	3. FEEL NEUTRAL
99	14.64	4. SOMEWHAT DISAGREE
341	50.44	5. STRONGLY DISAGREE
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 48 column(s) 28

This section is very hilly.

n	%	
75	11.09	1. STRONGLY AGREE
163	24.11	2. SOMEWHAT AGREE
47	6.95	3. FEEL NEUTRAL
117	17.31	4. SOMEWHAT DISAGREE
273	40.38	5. STRONGLY DISAGREE
1	0.15	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 51 column(s) 29

Now, I would like to read you some general statements about the DOT, driving, and that section still using the same scale.

The state DOT is CAPABLE of doing a good job of fixing and replacing pavements on rural highways in Iowa.

n	%	
264	39.05	1. STRONGLY AGREE
280	41.42	2. SOMEWHAT AGREE
61	9.02	3. FEEL NEUTRAL
38	5.62	4. SOMEWHAT DISAGREE
27	3.99	5. STRONGLY DISAGREE
6	0.89	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 52 column(s) 30

I trust the JUDGEMENT of the state DOT when it comes to scheduling pavement improvements.

n	%	
181	26.78	1. STRONGLY AGREE
278	41.12	2. SOMEWHAT AGREE
112	16.57	3. FEEL NEUTRAL
78	11.54	4. SOMEWHAT DISAGREE
23	3.40	5. STRONGLY DISAGREE
4	0.59	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 53 column(s) 31

State DOT officials care about the safety and convenience of drivers on this section of road.

n	%	
269	39.79	1. STRONGLY AGREE
279	41.27	2. SOMEWHAT AGREE
84	12.43	3. FEEL NEUTRAL
23	3.40	4. SOMEWHAT DISAGREE
13	1.92	5. STRONGLY DISAGREE
8	1.18	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 53a column(s) 32

The DOT considers input from people like me when making decisions about repairs or improvements to this section.

n	%	
142	21.01	1. STRONGLY AGREE
239	35.36	2. SOMEWHAT AGREE
166	24.56	3. FEEL NEUTRAL
65	9.62	4. SOMEWHAT DISAGREE
29	4.29	5. STRONGLY DISAGREE
34	5.03	8. DON'T KNOW/NOT SURE
1	0.15	9. REFUSED

****

question 55 column(s) 33

If I wanted to, I could easily find a convenient alternate route to the places
I usually go instead of using this section.

n	%	
220	32.54	1. STRONGLY AGREE
156	23.08	2. SOMEWHAT AGREE
36	5.33	3. FEEL NEUTRAL
90	13.31	4. SOMEWHAT DISAGREE
171	25.30	5. STRONGLY DISAGREE
3	0.44	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 56 column(s) 34

Most of the trips I take on this section are trips that I have to take.

n	%	
321	47.49	1. STRONGLY AGREE
121	17.90	2. SOMEWHAT AGREE
59	8.73	3. FEEL NEUTRAL
82	12.13	4. SOMEWHAT DISAGREE
90	13.31	5. STRONGLY DISAGREE
3	0.44	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 57 column(s) 35

I am satisfied with the pavement on this section.

n	%	
274	40.53	1. STRONGLY AGREE
188	27.81	2. SOMEWHAT AGREE
39	5.77	3. FEEL NEUTRAL
98	14.50	4. SOMEWHAT DISAGREE
76	11.24	5. STRONGLY DISAGREE
1	0.15	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 58 column(s) 36

The pavement on this section is better than most of the sections of state highways I've driven recently in Iowa.

n	%	
138	20.41	1. STRONGLY AGREE
199	29.44	2. SOMEWHAT AGREE
117	17.31	3. FEEL NEUTRAL
115	17.01	4. SOMEWHAT DISAGREE
104	15.38	5. STRONGLY DISAGREE
3	0.44	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 59 column(s) 37

The pavement on this section should be improved.

n	%	
147	21.75	1. STRONGLY AGREE
181	26.78	2. SOMEWHAT AGREE
75	11.09	3. FEEL NEUTRAL
128	18.93	4. SOMEWHAT DISAGREE
142	21.01	5. STRONGLY DISAGREE
3	0.44	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 59a column(s) 38-38

Now, I am going to read a list of reasons why you might agree the road should be improved. Please tell me all that apply.

1) The pavement causes extra wear on my vehicle's suspension system.

n	%	
203	30.03	1. YES
120	17.75	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****
question 59a column(s) 39-39
2) It produces a bumpy ride.

n	%	
242	35.80	1. YES
81	11.98	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****
question 59a column(s) 40-40

3) It causes me to focus my attention on the pavement surface

n	%	
165	24.41	1. YES
158	23.37	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****
question 59a column(s) 41-41

4) The pavement is noisy

n	%	
171	25.30	1. YES
152	22.49	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****
question 59a column(s) 42-42

5) It looks patchy

n	%	
245	36.24	1. YES
78	11.54	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****

question 59a column(s) 43-43

6) Because of a non-pavement reason ?

n	%	
123	18.20	1. YES
200	29.59	2. NO
3	0.44	8. DON'T KNOW/NOT SURE
2	0.30	9. REFUSED
348	51.48	^. INAP

****

question 60 column(s) 44

Most people whose opinions are important to me think that it is OK for me to drive this section.

n	%	
366	54.14	1. STRONGLY AGREE
210	31.07	2. SOMEWHAT AGREE
67	9.91	3. FEEL NEUTRAL
14	2.07	4. SOMEWHAT DISAGREE
13	1.92	5. STRONGLY DISAGREE
6	0.89	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 100 column(s) 45-46

The next few questions ask for a little more information about yourself.

First, in what year were you born ?

n	%	
1	0.15	09. 1909
1	0.15	10.
1	0.15	11.
2	0.30	12.
1	0.15	13.
1	0.15	14.
1	0.15	15.
3	0.44	16.
1	0.15	17.
4	0.59	18.
1	0.15	19.
5	0.74	20.

4	0.59	21.
5	0.74	22.
5	0.74	23.
7	1.04	24.
6	0.89	25.
5	0.74	26.
6	0.89	27.
6	0.89	28.
5	0.74	29.
8	1.18	30.
6	0.89	31.
10	1.48	32.
11	1.63	33.
12	1.78	34.
12	1.78	35.
12	1.78	36.
8	1.18	37.
10	1.48	38.
8	1.18	39.
12	1.78	40.
6	0.89	41.
4	0.59	42.
14	2.07	43.
9	1.33	44.
9	1.33	45.
13	1.92	46.
12	1.78	47.
12	1.78	48.
17	2.51	49.
9	1.33	50.
17	2.51	51.
14	2.07	52.
13	1.92	53.
18	2.66	54.
21	3.11	55.
8	1.18	56.
18	2.66	57.
13	1.92	58.
20	2.96	59.
19	2.81	60.
12	1.78	61.
22	3.25	62.
20	2.96	63.
16	2.37	64.
17	2.51	65.
9	1.33	66.
10	1.48	67.
11	1.63	68.
15	2.22	69.
7	1.04	70.
15	2.22	71.
16	2.37	72.
10	1.48	73.

5	0.74	74.
4	0.59	75.
7	1.04	76.
8	1.18	77.
4	0.59	78.
8	1.18	79.
8	1.18	80.
4	0.59	81. 1981
0	0.00	98. DON'T KNOW/NOT SURE
2	0.30	99. REFUSED

****

question 101 column(s) 47-47

What kind of vehicle did you USE to drive this section ? Did you drive a car, van, pickup truck, sports utility vehicle, or some other vehicle ?

n	%	
353	52.22	1. CAR
78	11.54	2. MINIVAN/VAN
161	23.82	3. PICKUP TRUCK
73	10.80	4. SPORTS UTILITY VEHICLE
4	0.59	5. MOTORCYCLE
7	1.04	0. OTHER (SPECIFY:_____)
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 103 column(s) 48

And how would you rate the quality of the ride of the vehicle you used to drive this section ? Would you say it has a very good, good, average, poor, or very poor ride ?

n	%	
266	39.35	1. VERY GOOD
228	33.73	2. GOOD
151	22.34	3. AVERAGE
23	3.40	4. POOR
7	1.04	5. VERY POOR
1	0.15	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 105 column(s) 49

Do you have a CDL or Commercial Driver's License ?

n	%	
107	15.83	1. YES
567	83.88	2. NO
2	0.30	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 105a column(s) 50

Do you have a motorcycle license ?

n	%	
104	15.38	1. YES
571	84.47	2. NO (skip to q 108)
1	0.15	8. DON'T KNOW/NOT SURE (skip to q 108)
0	0.00	9. REFUSED (skip to q 108)

****

question 105b column(s) 51

How often did you ride a motorcycle in the last year ? Would you say more than once a week, once a week, once a month, once a year, or never ?

n	%	
16	2.37	1. MORE THAN ONCE A WEEK
12	1.78	2. ONCE A WEEK
17	2.51	3. ONCE A MONTH
18	2.66	4. ONCE A YEAR
41	6.07	0. NEVER
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED
572	84.62	^. INAP

****

question 108 column(s) 52-53

What is the highest grade or year of school you completed ?

n	%	
13	1.92	01. EIGHTH GRADE OR LESS
28	4.14	02. SOME HIGH SCHOOL
246	36.39	03. HIGH SCHOOL GRAD OR GED CERTIFICATE
28	4.14	04. SOME TECHNICAL SCHOOL OR VOCATIONAL TRAINING
25	3.70	05. TECHNICAL SCHOOL GRADUATE
156	23.08	06. SOME COLLEGE OR ASSOCIATE DEGREE
136	20.12	07. COLLEGE GRADUATE
44	6.51	08. POST GRAD OR PROFESSIONAL DEGREE
0	0.00	00. OTHER (SPECIFY:_____)
0	0.00	98. DON'T KNOW/NOT SURE
0	0.00	99. REFUSED

****

question 998b column(s) 54

SEX OF RESPONDENT:

n	%	
360	53.25	1. MALE
316	46.75	2. FEMALE

****

question 998e column(s) 55-55

INTERVIEWER: IN WHAT LANGUAGE WAS THIS INTERVIEW DONE ?

n	%	
674	99.70	1. ENGLISH
0	0.00	2. SPANISH
2	0.30	3. MIXED ENGLISH/SPANISH
0	0.00	4. R IS TTY USER/USED WI RELAY OPERATOR
0	0.00	0. OTHER

****

question 998m column(s) 56

SEX OF INTERVIEWER

n	%	
294	43.49	1. MALE
382	56.51	2. FEMALE