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Agenda Item: 7.4.3

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Tampere, November 24 – 28.

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Agenda Item: 7, 13.1

Source: **TSG SA WG4**(*ARCON Corp.)
Title: **3G PS conversation tests (AMR NB and AMR WB) : Report from ARCON for Subjective Testing Lab function**

Document for: Approval

Summary

This document reports on subjective conversational tests for the characterization of 3G AMR-NB and AMR-WB as conducted by ARCON Corporation. These experiments followed the Test Plans presented in Tdoc S4-030564 and Tdoc S4-030565. These tests were conducted in the November 2003 time frame utilizing a testbed supplied by France Telecom R&D and Siemens. No reference or calibration conditions were included in the design of either experiment. Results for both the narrowband and wideband are presented in tabular and graphic form.

1.0 Introduction

ARCON Corporation's Digital Speech Testing Laboratory performed listening assessments as detailed in Tdoc S4-030564 and Tdoc S4-030565. The experiment design for these experiments is described in Section 3.0 of the noted documents. The evaluation methodology used was Conversational Testing. The testbed supplied by FT and Siemens is discussed in the noted documents and its use is detailed in the FT document *Guide for Installation And Usage of the Material*. Noise files utilized during testing were supplied by FT. No Host Laboratory was utilized for this test series.

2.0 Experimental Design

The test conditions for the AMR-NB experiment are included with the results in Table 7.1. The conditions for the AMR-WB experiment are included with the results in Table 7.2.

3.0 Communicator Environment

The communicators were placed in two separate acoustic isolation rooms. The ambient sound pressure level within Room-A is 20.0dB SPL-A. The ambient sound pressure level within Room-B is 26.0dB SPL-A. Room-A dimensions are 10' x 12' x 7.5'. Room-B dimensions are 2.5' x 3.5x 5.5'. Both rooms are capable of providing background noise. In Room-A the Hoth environmental noise was introduced through speakers placed along one wall. In Room-B the Hoth environmental noise was introduced through a specially designed speaker array built into the ceiling of the chamber. These same speaker systems were used for the environmental noise conditions.

3.1 Environmental Noise

Environmental Noise was fed into the room with the required Hoth spectrum to represent typical room noise at the required 30dBA level measured with a precision sound level meter, used with the "A" weighting and the "fast" meter characteristic. In order to obtain accurate measurement resolution, the spectrum was measured at an overall SPL of 40dB SPL-A. Overall sound level was then reduced to 30dBA.
For the asymmetric acoustic noise conditions (#19 - #24) of each experiment, the noise fields were generated utilizing the noise files provided by FT. The required SPLs were set for each room. Limited spectral matching was conducted to equalize the room spectra to that of the noise file.

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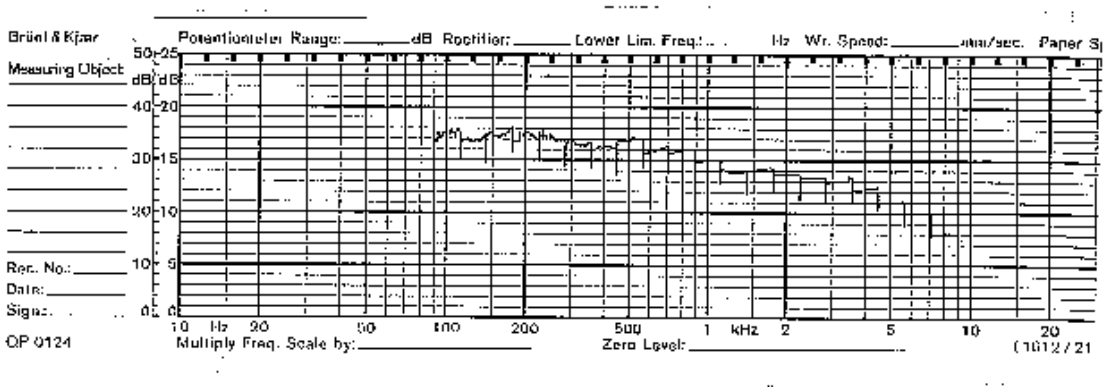


Figure 3.1 Strip Recording of Room Noise: 1/3 Octave Spectra

3.2 Testbed

The Testbed arrived at ARCON Corp. from France Telecom R&D by international carrier on Tuesday November 11 at 10AM. The delay was primarily due to US Customs Regulations and the misinterpretation of shipping information by the carrier and/or their agents. Due to the late arrival (6 days) of the Testbed, several test sessions needed to be scheduled and several test subjects were lost. The Testbed was reassembled and evaluated within one day. During the initial setup of the Testbed and its incorporation into ARCON's laboratory environment an audio "hum" was discovered on one side of the communicators headset system. The cause of this hum was traced to the grounding of one of the XLR adapters supplied with the Testbed to a metal support within one of the soundrooms. This was corrected by isolating the adapter. There was not effect the testing.

There were several problems with the Radio Air Interface (PC2 and PC4) portion of the Testbed. During testing this subsystem experienced 5 failures. This was not the *PDU Lost* failure noted in the Testbed documentation. These failures always occurred at the start of a test condition and were recoverable. There was no effect on the testing itself. Since multiple communicator pairs were being evaluated during a single day, these PCs were not being reinitialized with each subject pair. ARCON modified the procedure used such that the full Testbed was reinitialized with each communicator pair. After this change, there were no more Testbed failures.

4.0 Testing Procedures

The Test Plans for these experiments provide freedom to the various Test Laboratories in conducting the Conversational Tests. Test conditions, sample conversational scenarios and randomizations of both the conditions and scenarios are provided. These randomizations treat the acoustic background noise conditions separate from the channel impairment conditions. The number of communicator pairs is set at 16 for both experiments. Separate communicators are required for each experiment. There is no direction provided as to the makeup of the communicators or their pairing. Recommended timing and scheduling for the experiments was not provided. The directions to the subjects and the subjective questionnaire was provided.

Where not specific, the expertise of the ARCON Corporation test facility was used. Where clarification to instructions was needed the expertise of the ARCON Corporation testing personnel was used. ARCON used the grouping and randomization sequences specified. The test schedule was designed to maximize listener performance and minimize listener fatigue. The test conditions were separated into four blocks with each block containing six conditions. All acoustic noise conditions were in block four. The communication scenarios were structured to last 3.5 minutes each. Each block required 25 to 30 minutes to complete. A communicator session lasted four hours. Subjects swapped listening rooms between test blocks. The scenario structure implies a *calling party* and a *called party*. The subjects swapped called/caller modes with each condition.

4.1 Subject Issues

The subjective assessment was performed using 16 communicator pairs (nominally balanced between male and female subjects; no effort was made to balance male/female subjects within pairs). Final counts on male vs. female subjects was 14 male, 18 female for the AMR-NB and 15 male, 17 female for the AMR-WB. Familiarity within communicator pairs was not required or specifically excluded except from married pairs whom were no allowed.

After hearing screens and all paper work were completed, the appropriate introduction and training was conducted. Listeners read along as scripted instructions were read aloud. The scripted instructions included information about use of the data entry unit, headset placement, in addition to the specifics required by the test plan. Two training scenarios were conducted in full communicator mode with the Testbed set in a neutral mode. Questions were answered as needed during training only in reference to the use of the data entry units and specifics regarding the conduct of the test such as breaks and overall length. No information was provided which might influence decision-making.

4.2 Data Entry Units (DEU)

Conventional laptop computers were used as Data Entry Units with the subjects. Each subject had access to a DEU in each listening chamber. The DEUs were left in the chambers and the subjects entered their personal ID information at the start of each block. A Visual Basic program provided the actual user interface. Three separate interactive screen displays directed the subject and collected the required information. Samples of these screen displays are provided in Figures 4.1, 4.2 and 4.5 – 4.9. In addition, the VB program linked to MSWord documents that provided the specific scenario requirements.

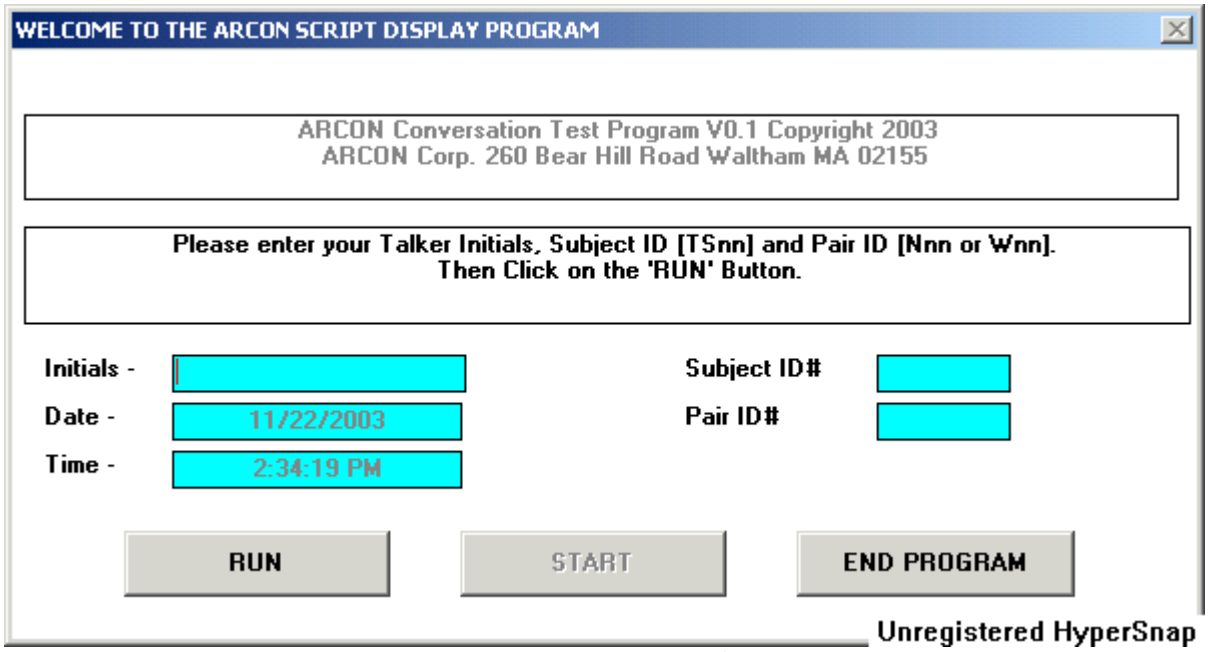


Figure 4.1 – Main Program Screen

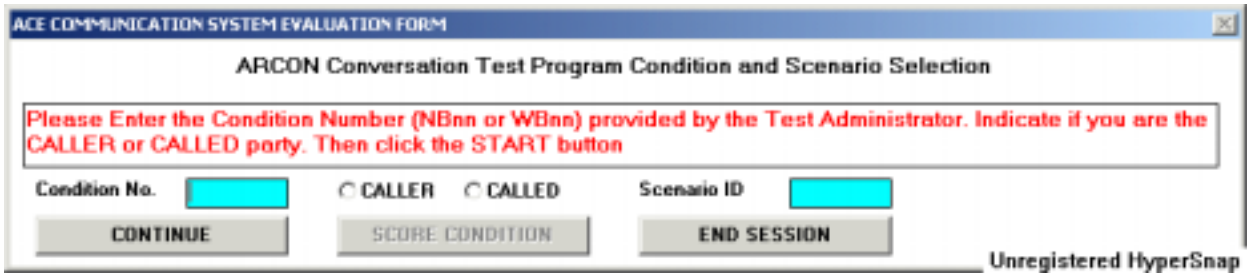


Figure 4.2 – Condition/Scenario Screen

4.3 Conversational Scenarios

The Test Plan documents recommend the use of Scenarios as detailed in ITU-T SG 12 COM12-35 "Development of scenarios for short conversation test", 1997. There are only two sample scenarios. ARCON followed the structure of these sample scenarios and developed 24 additional scenarios. Care was taken to assure that these additional scenarios followed the same format, had equivalent exchange of information and were general in nature.

A list of the scenario topic is as follows:

Pizza	Air Flight
Library Book	Hotel
Taxi	Package Shipment
Cruise	Groceries
Business Phone information	Street Directions
Meeting	Lunch
Dentist	Movies
Investment	Real Estate
Used Car	Sports Tickets
Dog	Car Service
Train Reservation	Car Rental
Vacation	Hike
Museum	Camera

All scenarios had specific CALLER and CALLED tasks. A sample CALLER description file is presented in Figure 4.3. A sample CALLED descriptor file is presented in Figure 4.4.

Scenario 13: Dentist

name: Dr. White's Office

	**Dental Hygienist Schedule** 12/1 Monday 4pm 12/2 Tuesday 2pm, 4pm 12/3 Wednesday full 12/4 Thursday 2pm 12/7 Monday full 12/8 Tuesday 1pm, 3pm, 4pm 12/9 Wednesday 9am, 10am, 2pm, 4pm 12/10 Thursday 9am, 10am, 11am
	**Date and time** **Name** **Address**
	**Benefits of Tooth Whitening**

Figure 4.3 CALLED Scenario Descriptor File

Scenario 13: Dentist

Caller's name: Tom or Teresa

	**Schedule Dental Cleaning**
	**Within 2 weeks, late afternoon preferred.**
	**What time is available?**
	**Name - Tom or Teresa** **Address – 732 West St., Andover MA**
	**Benefits of Tooth Whitening**

Figure 4.4 CALLER Scenario Descriptor File

4.4 Subjective Questionnaire

The Test Plans provided the following Subjective Questions within the Directions to Subjects Annex.

Question 1: How do you judge the quality of the voice of your partner?
Excellent
Good
Fair
Poor
Bad

Question 2: Do you have difficulties to understand some words?
All the time
Often
Some time to time
Rarely
Never

Question 3: How did you judge the conversation when you interacted with your partner?
Excellent interactivity - (similar to face-to-face situation)
Good interactivity - (in few moments, you were talking simultaneously, and you had to interrupt yourself)
Fair interactivity - (sometimes, you were talking simultaneously, and you had to interrupt yourself)
Poor interactivity - (often, you were talking simultaneously, and you had to interrupt yourself)
Bad interactivity - (it was impossible to have an interactive conversation)

Question 4: Did you perceive any impairment (noises, cuts,…)? In that case, was it:
No impairment
Slight impairment, but not disturbing
Impairment slightly disturbing
Impairment disturbing
Very disturbing Impairment

Question 5: How do you judge the global quality of the communication?
Excellent
Good
Fair
Poor
Bad

ARCON made some minor modifications to these questions and the categories (see questions 2, 3 and 4). These changes can be seen in the following figures that represent the various Question Screen Displays of the DEU program.

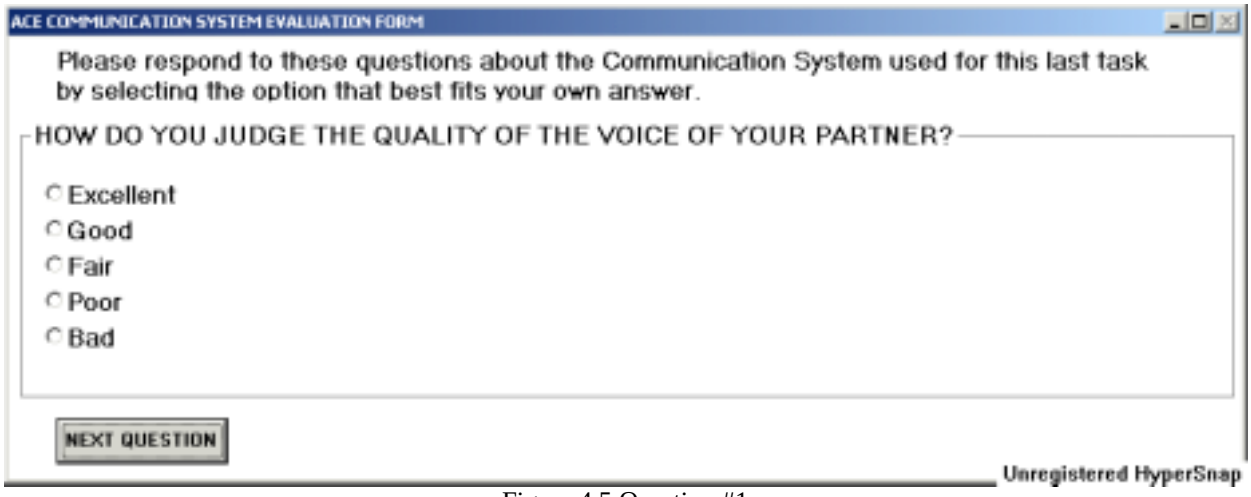


Figure 4.5 Question #1

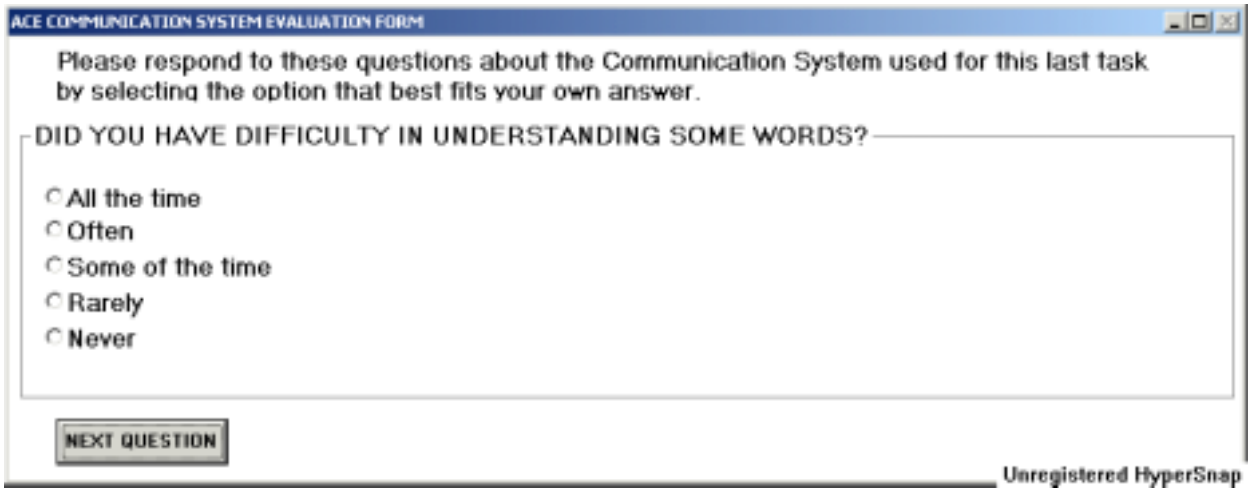


Figure 4.6 Question #2 (MODIFIED)

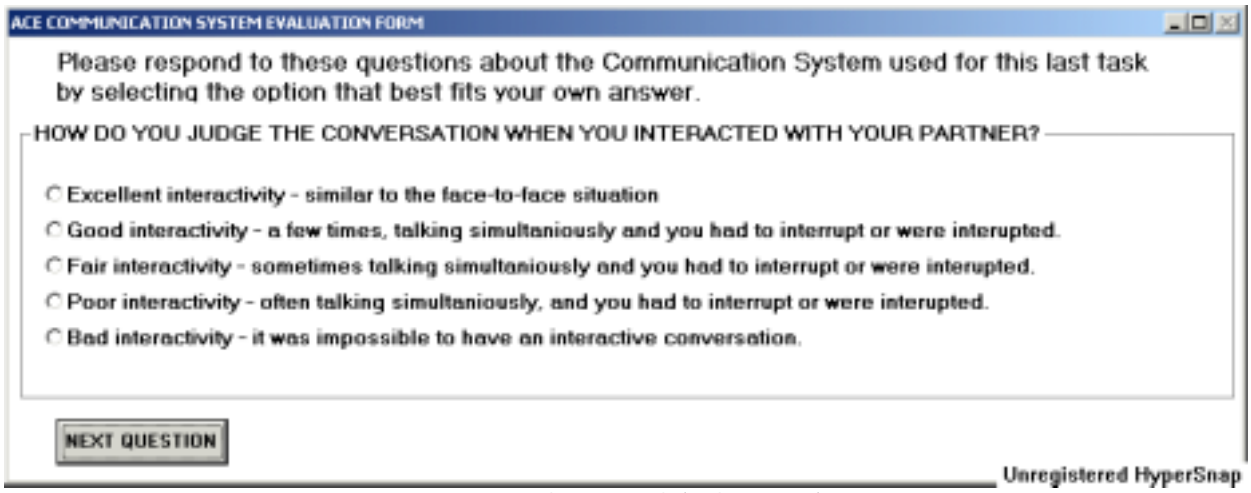


Figure 4.7 Question #3 (MODIFIED)

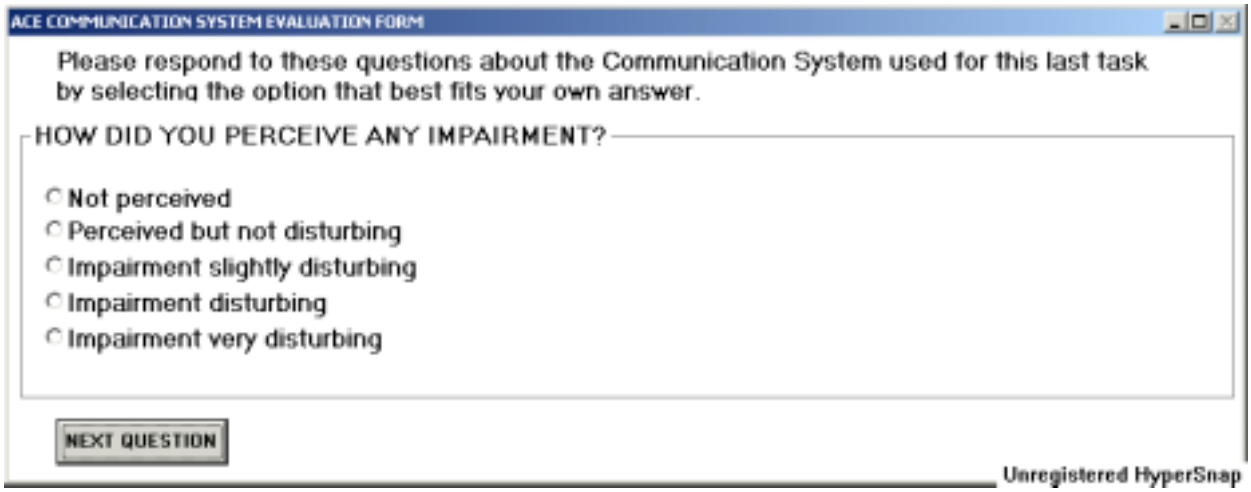


Figure 4.8 Question #4 (MODIFIED)

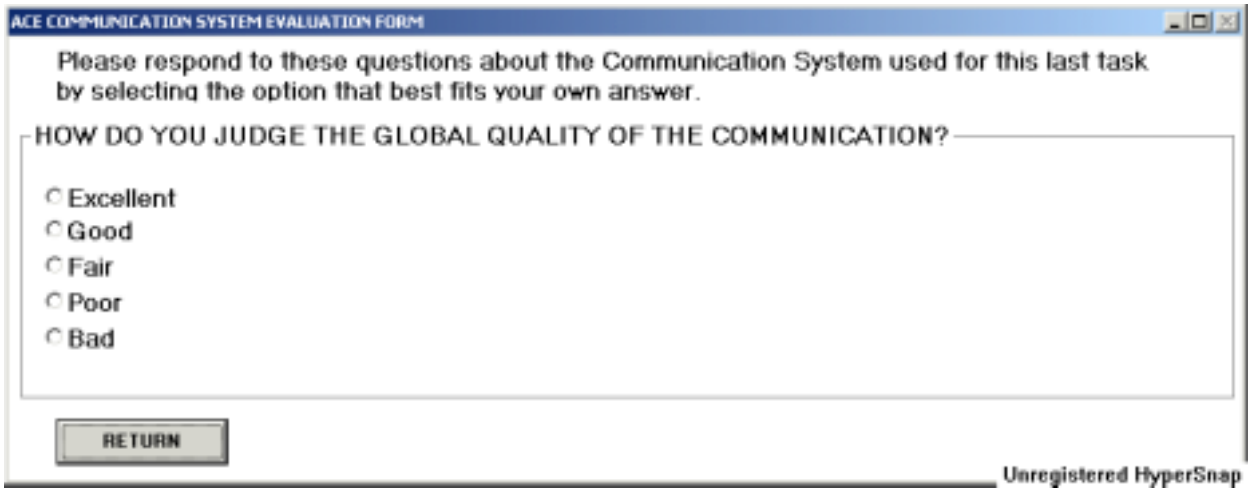


Figure 4.9 Question #5

5.0 Audio Presentation

The Testbed provided audio presentation. No attempt was made to tap into the audio stream. This maintained the integrity of the Testbed but also limited the ability of the experimenters to monitor the performance of the system, the condition variability and the communicators. The presentation level to the communicators was checked and found to be as required. The individual headphone volume adjustments were checked at the start of each test block. The subjects were not told to use these adjustments. Initial evaluation of the volume indicated that the highband speech signal had an artificial quality at maximum headphone gain. The headphone gain for the HB test was set approximately 10% below maximum headset volume. For the LB tests the headset adjustment was set at its maximum setting.

The headsets themselves had limited adjustment capability for some subjects with small heads. A foam pad was introduced to both headsets to eliminate this problem. Subjects were told to leave their right ear uncovered during testing. The test administrator visually checked this for this. Headset microphone placement was set in front of and at “two fingers” from the subject’s mouth.

The test administrator, to provide directions to the communicators, used a separate talkback system. This talkback system could be set for listen-only and was used in this mode to monitor the communicators. This provided useful information during subject training,

6.0 Scoring

The five questions and their categorical designations were presented by laptop computers in each room.. Listener responses were collected and stored within these computers. The questions were not available until the full 3.5 minute scenario was completed by both communicators. Question 2 was presented in the form required by the Test Plan. This presentation is in the opposite order from all other questions. To simplify analysis, the numeric value for Question 2 was modified such that it followed the logical order for the remaining questions, i.e. all values range from 5 – highest performance to 1 – lowest performance.

Upon completion of each communicator pair, individual test condition files were transferred to a single large file for the statistical analyses reported here and for presentation for global analyses.

7.0 Results

Average scores and standard deviations across all communicators for each condition are provided in Table 7.1 for AMR-NB and in Table 7.2 for AMR-WB. The 95% Confidence Interval is also provided for each condition. For the asymmetric acoustic noise conditions #19 - #24, the symmetrically combined room scores are provided (i.e. #19Room-A + #20 RoomB) along with the separate Room-A and Room-B scores for each of these conditions. PLEASE NOTE - THE QUESTION 2 RESULTS HAVE BEEN MODIFIED TO AGREE IN DIRECTION WITH ALL OTHER QUESTIONS.

Figure 7.1 provides the results for Conditions #1 to #18 for AMR-NB. Figure 7.2 provides the results for the asymmetric acoustic noise conditions #19 to #24 for AMR-NB. Figure 7.3 provides the results for Conditions #1 to #18 for AMR-WB.

Figure 7.4 provides the results for the asymmetric acoustic noise conditions #19 to #24 for AMR-WB. The 95% C.I. error bars for Question #5 are included on all these figures.

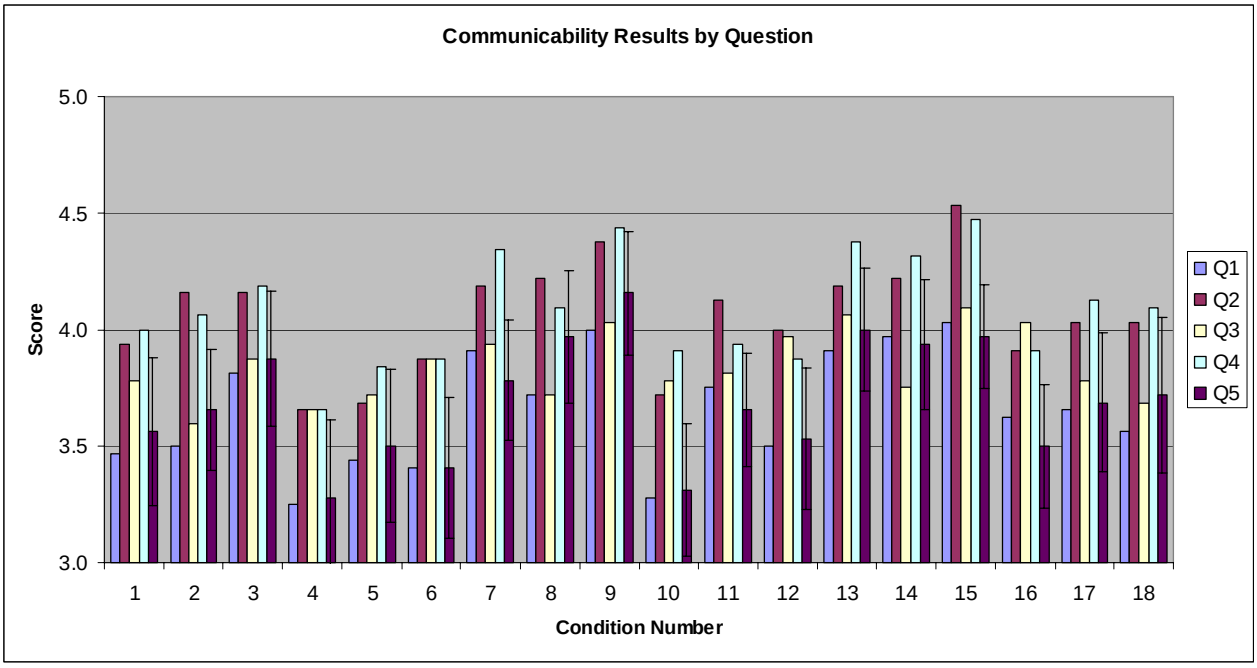


Figure 7.1 AMR-NB Conditions #1 - #18 (All Questions)

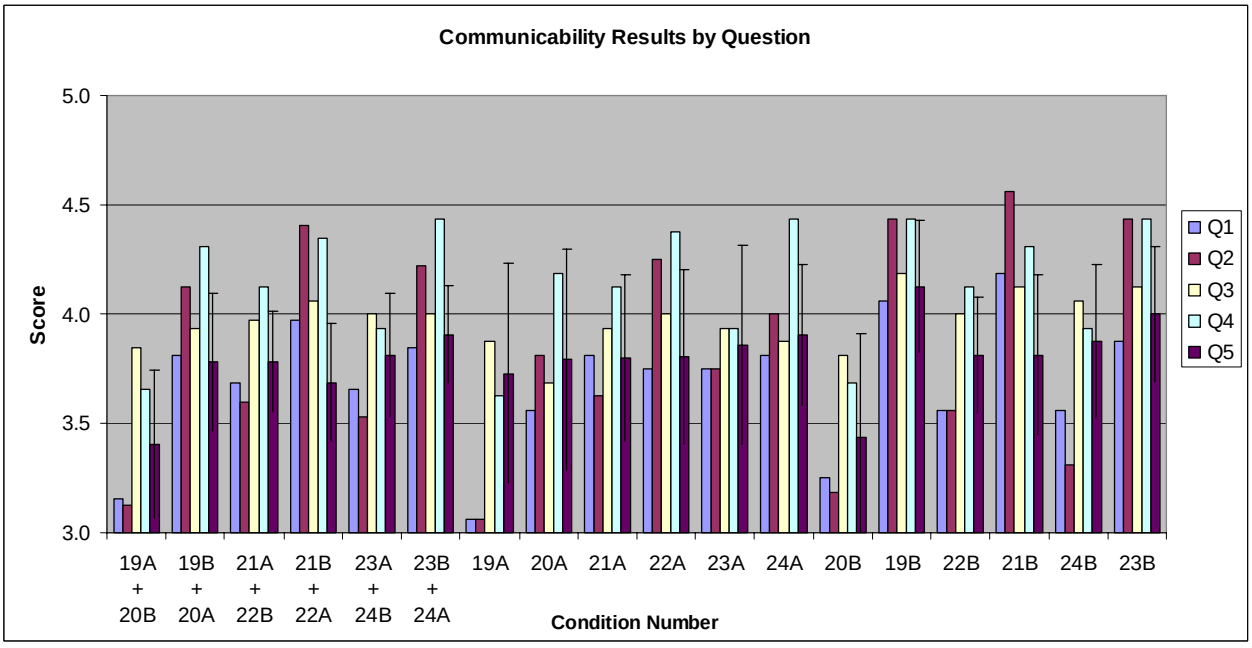


Figure 7.2 AMR-NB Acoustic Noise Conditions (All Questions)

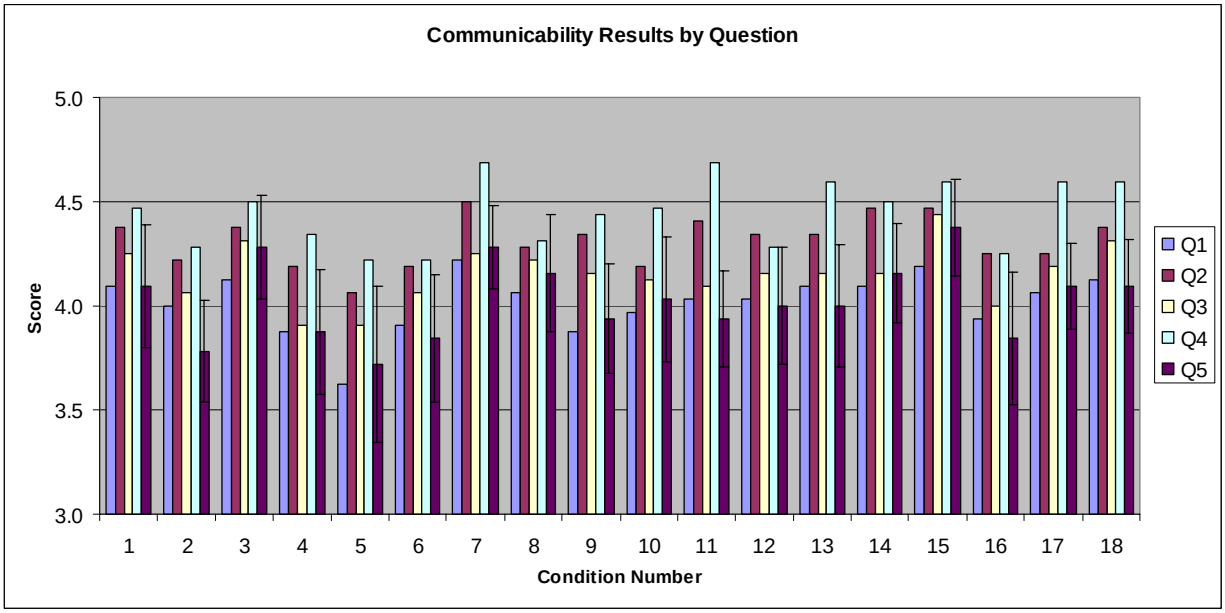


Figure 7.3 AMR-WB Conditions #1 - #18 (All Questions)

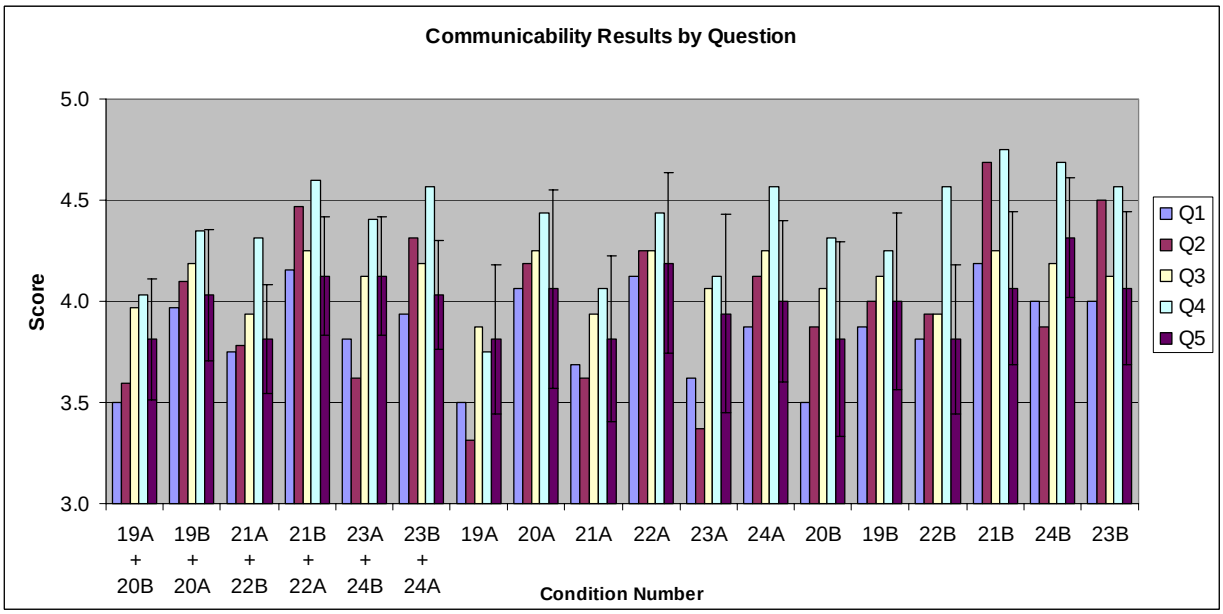


Figure 7.4 AMR-WB Acoustic Noise Conditions (All Questions)

Figure 7.5 provides results of questions #1 to #4 by percent channel errors for the coder rates and delays in the AMR-NB experiment. Figure 7.6 provides results of questions #1 to #4 by coder and delay for the channel conditions in the AMR-NB experiment. Figure 7.7 provides the results of question #5 by percent channel errors and coder/delay conditions in the AMR-NB experiment. Figure 7.8 provides results for questions #1 to #4 for the acoustic noise conditions in the AMR-NB experiment. Figure 7.9 provides the results of question #5 for the acoustic noise conditions in the AMR-NB experiment. Results are provided for the combined noise states of each acoustic noise environment and for the noise and quiet states of each listening chamber (i.e. RoomA, RoomB).

Figure 7.10 provides results of questions #1 to #4 by percent channel errors for the coder rates and delays in the AMR-WB experiment. Figure 7.11 provides results of questions #1 to #4 by coder and delay for the channel conditions in the AMR-WB experiment. Figure 7.12 provides the results of question #5 by percent channel errors and coder/delay conditions in the AMR-WB experiment. Figure 7.13 provides results for questions #1 to #4 for the acoustic noise conditions in the AMR-WB experiment. Figure 7.14 provides the results of question #5 for the acoustic noise conditions in the AMR-WB experiment. AS with the NB results, the combined noise states and the “room” states are provided.

Table 7.1 AMR-NB Communicability Results

NARROW BAND TEST CONDITIONS

	Noise		Experimental factors				Condition	Q1			Q2			Q3			Q4			Q5		
Condition	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode (kbit/s)	delay (ms)		Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.
1	No	No	.01	0%	6.7	300	NB01	3.47	0.98	0.34	3.94	1.16	0.40	3.78	0.91	0.31	**4.00**	0.98	0.34	3.56	0.91	0.32
2	No	No	.01	0%	12.2	500	NB02	3.50	0.76	0.26	**4.16**	0.85	0.29	3.59	0.87	0.30	**4.06**	0.80	0.28	3.66	0.75	0.26
3	No	No	.01	0%	12.2	300	NB03	3.81	0.93	0.32	**4.16**	1.02	0.35	3.88	0.98	0.34	**4.19**	0.74	0.26	3.88	0.83	0.29
4	No	No	.01	3%	6.7	300	NB04	3.25	1.02	0.35	3.66	1.18	0.41	3.66	1.07	0.37	3.66	0.94	0.32	3.28	0.96	0.33
5	No	No	.01	3%	12.2	500	NB05	3.44	1.05	0.36	3.69	0.93	0.32	3.72	0.96	0.33	3.84	0.77	0.27	3.50	0.95	0.33
6	No	No	.01	3%	12.2	300	NB06	3.41	0.95	0.33	3.88	1.07	0.37	3.88	0.83	0.29	3.88	0.83	0.29	3.41	0.87	0.30
7	No	No	.001	0%	6.7	300	NB07	3.91	0.73	0.25	**4.19**	0.78	0.27	3.94	0.80	0.28	**4.34**	0.75	0.26	3.78	0.75	0.26
8	No	No	.001	0%	12.2	500	NB08	3.72	0.89	0.31	**4.22**	0.83	0.29	3.72	0.81	0.28	**4.09**	0.89	0.31	3.97	0.82	0.28
9	No	No	.001	0%	12.2	300	NB09	**4.00**	0.80	0.28	**4.38**	0.79	0.27	**4.03**	0.69	0.24	**4.44**	0.67	0.23	**4.16**	0.77	0.27
10	No	No	.001	3%	6.7	300	NB10	3.28	0.81	0.28	3.72	0.99	0.34	3.78	0.66	0.23	3.91	0.78	0.27	3.31	0.82	0.28
11	No	No	.001	3%	12.2	500	NB11	3.75	0.72	0.25	**4.13**	0.75	0.26	3.81	0.82	0.28	3.94	0.76	0.26	3.66	0.70	0.24
12	No	No	.001	3%	12.2	300	NB12	3.50	0.88	0.30	**4.00**	0.88	0.30	3.97	0.69	0.24	3.88	0.91	0.31	3.53	0.88	0.30
13	No	No	.0005	0%	6.7	300	NB13	3.91	0.82	0.28	**4.19**	1.03	0.36	**4.06**	0.80	0.28	**4.38**	0.71	0.25	**4.00**	0.76	0.26
14	No	No	.0005	0%	12.2	500	NB14	3.97	0.82	0.28	**4.22**	1.07	0.37	3.75	0.98	0.34	**4.31**	0.82	0.28	3.94	0.80	0.28
15	No	No	.0005	0%	12.2	300	NB15	**4.03**	0.59	0.21	**4.53**	0.62	0.22	**4.09**	0.59	0.20	**4.47**	0.57	0.20	3.97	0.65	0.22
16	No	No	.0005	3%	6.7	300	NB16	3.63	0.87	0.30	3.91	1.03	0.36	**4.03**	0.74	0.26	3.91	0.93	0.32	3.50	0.76	0.26
17	No	No	.0005	3%	12.2	500	NB17	3.66	0.97	0.34	**4.03**	0.97	0.33	3.78	0.94	0.33	**4.13**	0.66	0.23	3.69	0.86	0.30
18	No	No	.0005	3%	12.2	300	NB18	3.56	0.80	0.28	**4.03**	0.90	0.31	3.69	0.90	0.31	**4.09**	0.86	0.30	3.72	0.96	0.33
19A + 20B	From Car		.0005	3%	12.2	300	NB20	3.16	1.14	0.39	3.13	1.21	0.42	3.84	0.92	0.32	3.66	0.94	0.32	3.41	0.98	0.34
19B + 20A	To Car		.0005	3%	12.2	300	NB19	3.81	0.78	0.27	**4.13**	0.91	0.31	3.94	0.76	0.26	**4.31**	0.78	0.27	3.78	0.91	0.31
21A + 22B	From Cafeteria		.0005	0%	6.7	300	NB22	3.69	0.64	0.22	3.59	0.91	0.32	3.97	0.54	0.19	**4.13**	0.71	0.25	3.78	0.66	0.23
21B + 22A	To Cafeteria		.0005	0%	6.7	300	NB21	3.97	0.82	0.28	**4.41**	0.76	0.26	**4.06**	0.62	0.21	**4.34**	0.65	0.23	3.69	0.78	0.27
23A + 24B	From Street		.0005	0%	12.2	500	NB24	3.66	0.94	0.32	3.53	1.24	0.43	**4.00**	0.76	0.26	3.94	0.98	0.34	3.81	0.82	0.28
23B + 24A	To Street		.0005	0%	12.2	500	NB18	3.84	0.63	0.22	**4.22**	0.75	0.26	**4.00**	0.76	0.26	**4.44**	0.67	0.23	3.91	0.64	0.22
19A	Car		.0005	3%	12.2	300	NB19	3.06	1.18	0.58	3.06	1.24	0.61	3.88	1.02	0.50	3.63	1.02	0.50	3.73	1.02	0.50
20A	No		.0005	3%	12.2	300	NB20	3.56	0.81	0.40	3.81	0.75	0.37	3.69	0.79	0.39	**4.19**	0.75	0.37	3.79	1.03	0.51
21A	Cafeteria		.0005	0%	6.7	300	NB21	3.81	0.54	0.27	3.63	0.89	0.43	3.94	0.57	0.28	**4.13**	0.62	0.30	3.80	0.77	0.38
22A	No		.0005	0%	6.7	300	NB22	3.75	0.93	0.46	**4.25**	0.86	0.42	**4.00**	0.52	0.25	**4.38**	0.62	0.30	3.80	0.81	0.40
23A	Street		.0005	0%	12.2	500	NB23	3.75	1.00	0.49	3.75	1.06	0.52	3.94	0.77	0.38	3.94	1.00	0.49	3.86	0.93	0.46
24A	No		.0005	0%	12.2	500	NB24	3.81	0.66	0.32	**4.00**	0.82	0.40	3.88	0.72	0.35	**4.44**	0.73	0.36	3.91	0.66	0.32
20B		Car	.0005	3%	12.2	300	NB20	3.25	1.13	0.55	3.19	1.22	0.60	3.81	0.83	0.41	3.69	0.87	0.43	3.44	0.96	0.47
19B		No	.0005	3%	12.2	300	NB19	**4.06**	0.68	0.33	**4.44**	0.96	0.47	**4.19**	0.66	0.32	**4.44**	0.81	0.40	**4.13**	0.62	0.30
22B		Cafeteria	.0005	0%	6.7	300	NB22	3.56	0.73	0.36	3.56	0.96	0.47	**4.00**	0.52	0.25	**4.13**	0.81	0.40	3.81	0.54	0.27
21B		No	.0005	0%	6.7	300	NB21	**4.19**	0.66	0.32	**4.56**	0.63	0.31	**4.13**	0.72	0.35	**4.31**	0.70	0.35	3.81	0.75	0.37
24B		Street	.0005	0%	12.2	500	NB24	3.56	0.89	0.44	3.31	1.40	0.69	**4.06**	0.77	0.38	3.94	1.00	0.49	3.88	0.72	0.35
23B		No	.0005	0%	12.2	500	NB23	3.88	0.62	0.30	**4.44**	0.63	0.31	**4.13**	0.81	0.40	**4.44**	0.63	0.31	**4.00**	0.63	0.31

Table 7.2 AMR-WB Communicabilty Results

WIDEBAND TEST CONDITIONS

	Noise		Experimental factors				Conditio	Q1			Q2			Q3			Q4			Q5		
Condition	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode (kbit/s)			Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.	Score	S.D.	C.I.
1	No	No	.01	0%	12.65	RoHC	WB01	4.09	0.82	0.28	**4.38**	0.91	0.31	**4.25**	0.67	0.23	**4.47**	0.67	0.23	4.09	0.86	0.30
2	No	No	.01	0%	12.65		WB02	4.00	0.72	0.25	**4.22**	0.83	0.29	4.06	0.72	0.25	**4.28**	0.77	0.27	3.78	0.71	0.24
3	No	No	.01	0%	15.85	RoHC	WB03	4.13	0.87	0.30	**4.38**	0.91	0.31	**4.31**	0.69	0.24	**4.50**	0.72	0.25	**4.28**	0.73	0.25
4	No	No	.01	3%	12.65	RoHC	WB04	3.88	0.83	0.29	4.19	0.93	0.32	3.91	0.82	0.28	**4.34**	0.83	0.29	3.88	0.87	0.30
5	No	No	.01	3%	12.65		WB05	3.63	0.94	0.33	4.06	0.95	0.33	3.91	0.89	0.31	**4.22**	0.91	0.31	3.72	1.08	0.38
6	No	No	.01	3%	15.85	RoHC	WB06	3.91	0.89	0.31	4.19	0.90	0.31	4.06	0.72	0.25	**4.22**	0.91	0.31	3.84	0.88	0.31
7	No	No	.001	0%	12.65	RoHC	WB07	**4.22**	0.66	0.23	**4.50**	0.72	0.25	**4.25**	0.67	0.23	**4.69**	0.59	0.21	**4.28**	0.58	0.20
8	No	No	.001	0%	12.65		WB08	4.06	0.80	0.28	**4.28**	0.81	0.28	**4.22**	0.66	0.23	**4.31**	0.64	0.22	4.16	0.81	0.28
9	No	No	.001	0%	15.85	RoHC	WB09	3.88	0.79	0.27	**4.34**	0.75	0.26	4.16	0.72	0.25	**4.44**	0.62	0.21	3.94	0.76	0.26
10	No	No	.001	3%	12.65	RoHC	WB10	3.97	0.78	0.27	4.19	0.93	0.32	4.13	0.71	0.25	**4.47**	0.72	0.25	4.03	0.86	0.30
11	No	No	.001	3%	12.65		WB11	4.03	0.65	0.22	**4.41**	0.67	0.23	4.09	0.64	0.22	**4.69**	0.59	0.21	3.94	0.67	0.23
12	No	No	.001	3%	15.85	RoHC	WB12	4.03	0.69	0.24	**4.34**	0.83	0.29	4.16	0.77	0.27	**4.28**	1.08	0.38	4.00	0.80	0.28
13	No	No	.0005	0%	12.65	RoHC	WB13	4.09	0.78	0.27	**4.34**	0.87	0.30	4.16	0.72	0.25	**4.59**	0.56	0.19	4.00	0.84	0.29
14	No	No	.0005	0%	12.65		WB14	4.09	0.64	0.22	**4.47**	0.67	0.23	4.16	0.63	0.22	**4.50**	0.67	0.23	4.16	0.68	0.23
15	No	No	.0005	0%	15.85	RoHC	WB15	4.19	0.69	0.24	**4.47**	0.67	0.23	**4.44**	0.56	0.20	**4.59**	0.56	0.19	**4.38**	0.66	0.23
16	No	No	.0005	3%	12.65	RoHC	WB16	3.94	0.84	0.29	**4.25**	0.92	0.32	4.00	0.62	0.22	**4.25**	0.84	0.29	3.84	0.92	0.32
17	No	No	.0005	3%	12.65		WB17	4.06	0.62	0.21	**4.25**	0.67	0.23	4.19	0.64	0.22	**4.59**	0.56	0.19	4.09	0.59	0.20
18	No	No	.0005	3%	15.85	RoHC	WB18	4.13	0.75	0.26	**4.38**	0.79	0.27	**4.31**	0.59	0.21	**4.59**	0.61	0.21	4.09	0.64	0.22
19A + 20B	From Car		.0005	3%	12.65	RoHC	WB20	3.50	0.98	0.34	3.59	0.98	0.34	3.97	0.78	0.27	4.03	0.78	0.27	3.81	0.86	0.30
19B + 20A	To Car		.0005	3%	12.65	RoHC	WB19	3.97	0.93	0.32	4.09	1.17	0.41	4.19	0.74	0.26	**4.34**	0.79	0.27	4.03	0.93	0.32
21A + 22B	From Cafeteria		.0005	0%	12.65		WB22	3.75	0.84	0.29	3.78	0.83	0.29	3.94	0.88	0.30	**4.31**	0.78	0.27	3.81	0.78	0.27
21B + 22A	To Cafeteria		.0005	0%	12.65		WB21	4.16	0.77	0.27	**4.47**	0.80	0.28	**4.25**	0.62	0.22	**4.59**	0.61	0.21	4.13	0.83	0.29
23A + 24B	From Street		.0005	0%	15.85	RoHC	WB24	3.81	0.97	0.33	3.63	1.13	0.39	4.13	0.66	0.23	**4.41**	0.67	0.23	4.13	0.83	0.29
23B + 24A	To Street		.0005	0%	15.85	RoHC	WB23	3.94	0.76	0.26	**4.31**	0.82	0.28	4.19	0.74	0.26	**4.56**	0.56	0.20	4.03	0.78	0.27
19A	Car		.0005	3%	12.2	300	WB19	3.50	1.10	0.54	3.31	0.95	0.46	3.88	0.89	0.43	3.75	0.68	0.33	3.81	0.75	0.37
20A	No		.0005	3%	12.2	300	WB20	4.06	0.77	0.38	4.19	0.98	0.48	**4.25**	0.86	0.42	**4.44**	0.73	0.36	4.06	1.00	0.49
21A	Cafeteria		.0005	0%	6.7	300	WB21	3.69	0.79	0.39	3.63	0.81	0.40	3.94	1.00	0.49	4.06	0.85	0.42	3.81	0.83	0.41
22A	No		.0005	0%	6.7	300	WB22	4.13	0.81	0.40	**4.25**	0.93	0.46	**4.25**	0.77	0.38	**4.44**	0.73	0.36	4.19	0.91	0.45
23A	Street		.0005	0%	12.2	500	WB23	3.63	0.96	0.47	3.38	1.20	0.59	4.06	0.68	0.33	4.13	0.72	0.35	3.94	1.00	0.49
24A	No		.0005	0%	12.2	500	WB24	3.88	0.72	0.35	4.13	0.81	0.40	**4.25**	0.77	0.38	**4.56**	0.51	0.25	4.00	0.82	0.40
20B		Car	.0005	3%	12.2	300	WB20	3.50	0.89	0.44	3.88	0.96	0.47	4.06	0.68	0.33	**4.31**	0.79	0.39	3.81	0.98	0.48
19B		No	.0005	3%	12.2	300	WB19	3.88	1.09	0.53	4.00	1.37	0.67	4.13	0.62	0.30	**4.25**	0.86	0.42	4.00	0.89	0.44
22B		Cafeteria	.0005	0%	6.7	300	WB22	3.81	0.91	0.45	3.94	0.85	0.42	3.94	0.77	0.38	**4.56**	0.63	0.31	3.81	0.75	0.37
21B		No	.0005	0%	6.7	300	WB21	4.19	0.75	0.37	**4.69**	0.60	0.30	**4.25**	0.45	0.22	**4.75**	0.45	0.22	4.06	0.77	0.38
24B		Street	.0005	0%	12.2	500	WB24	4.00	0.97	0.47	3.88	1.02	0.50	4.19	0.66	0.32	**4.69**	0.48	0.23	**4.31**	0.60	0.30
23B		No	.0005	0%	12.2	500	WB23	4.00	0.82	0.40	**4.50**	0.82	0.40	4.13	0.72	0.35	**4.56**	0.63	0.31	4.06	0.77	0.38

Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?

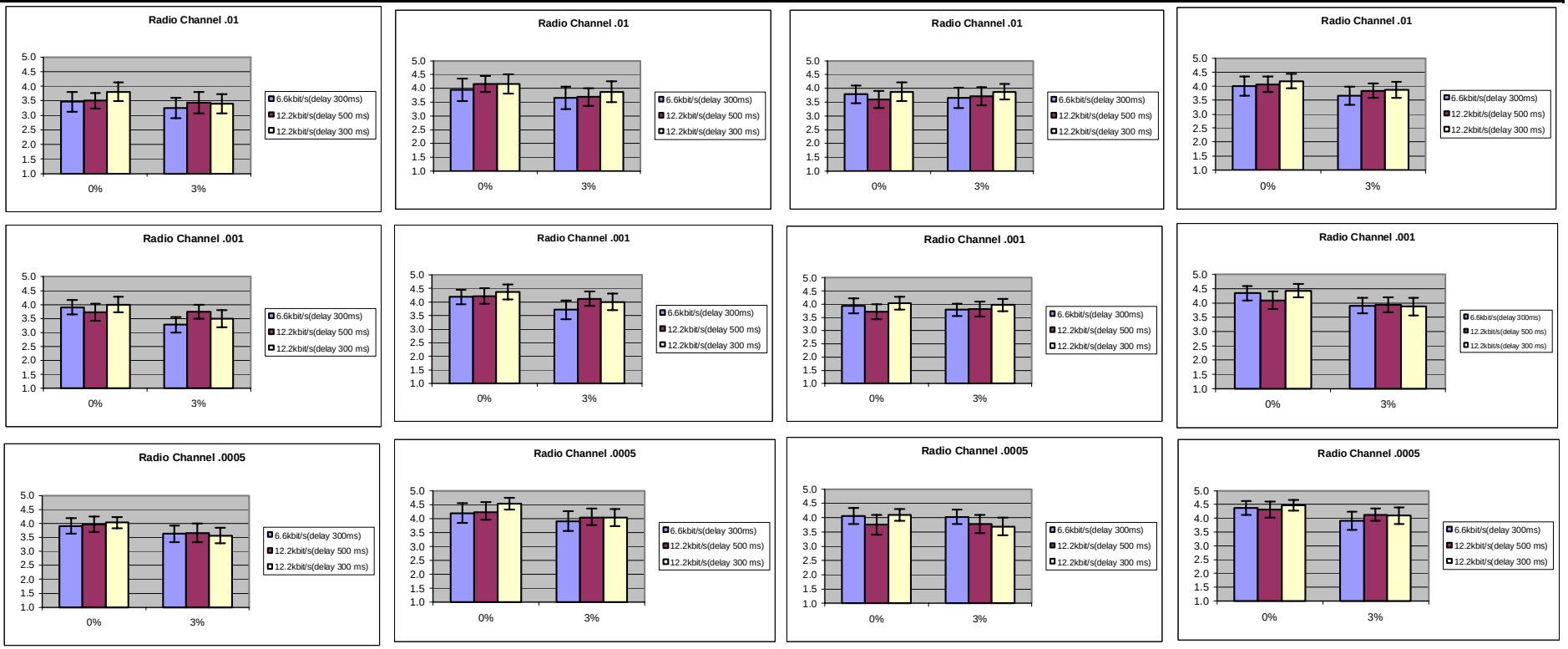


Figure 7.5 AMR-NB Conditions #1 to #18, Questions #1 to #4

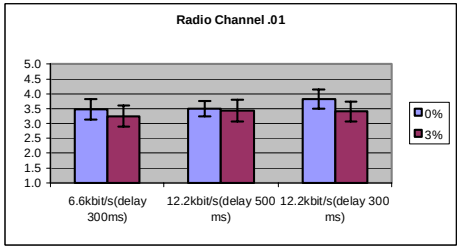
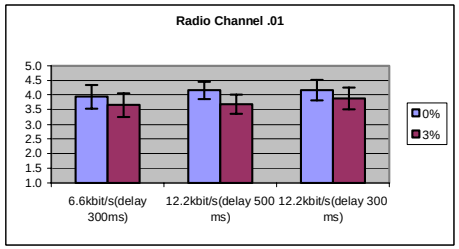
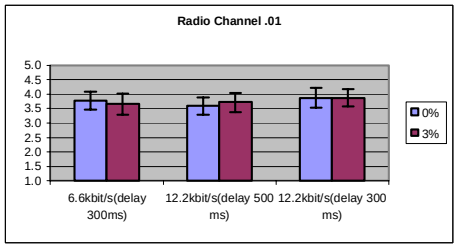
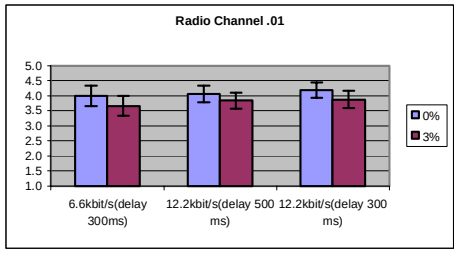
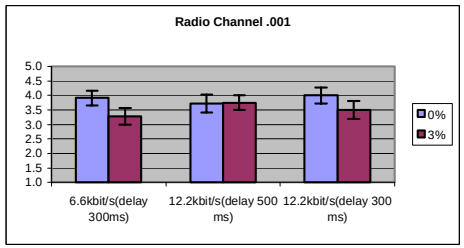
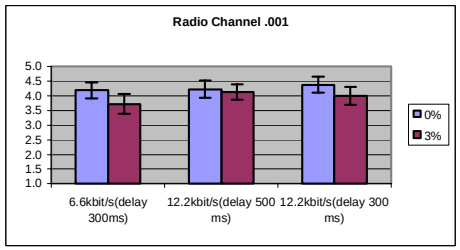
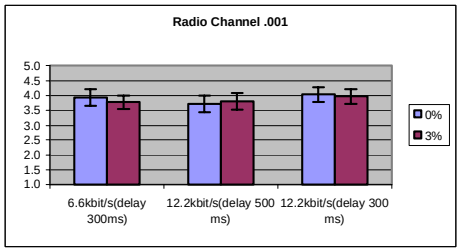
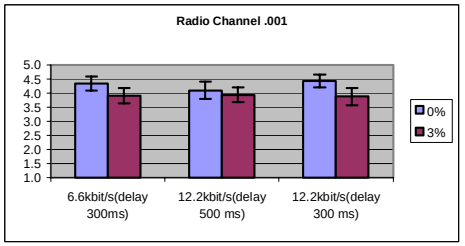
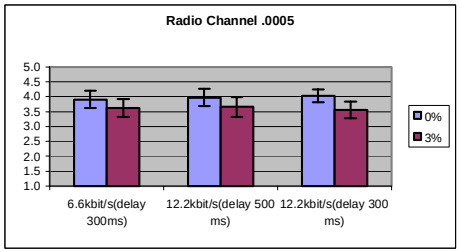
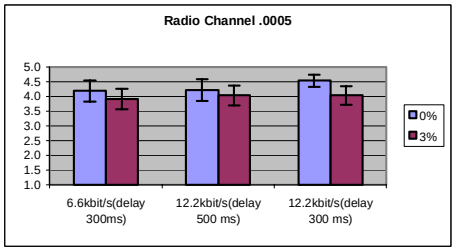
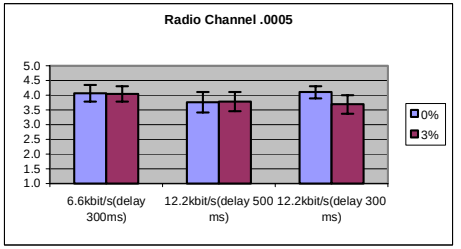
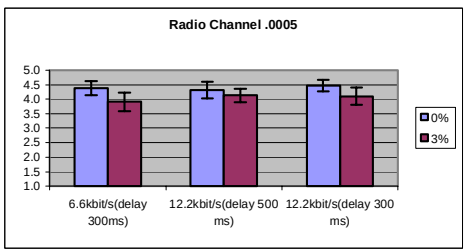
Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?
			
			
			

Figure 7.6 AMR-NB Conditions #1 to #18, Questions #1 to #4

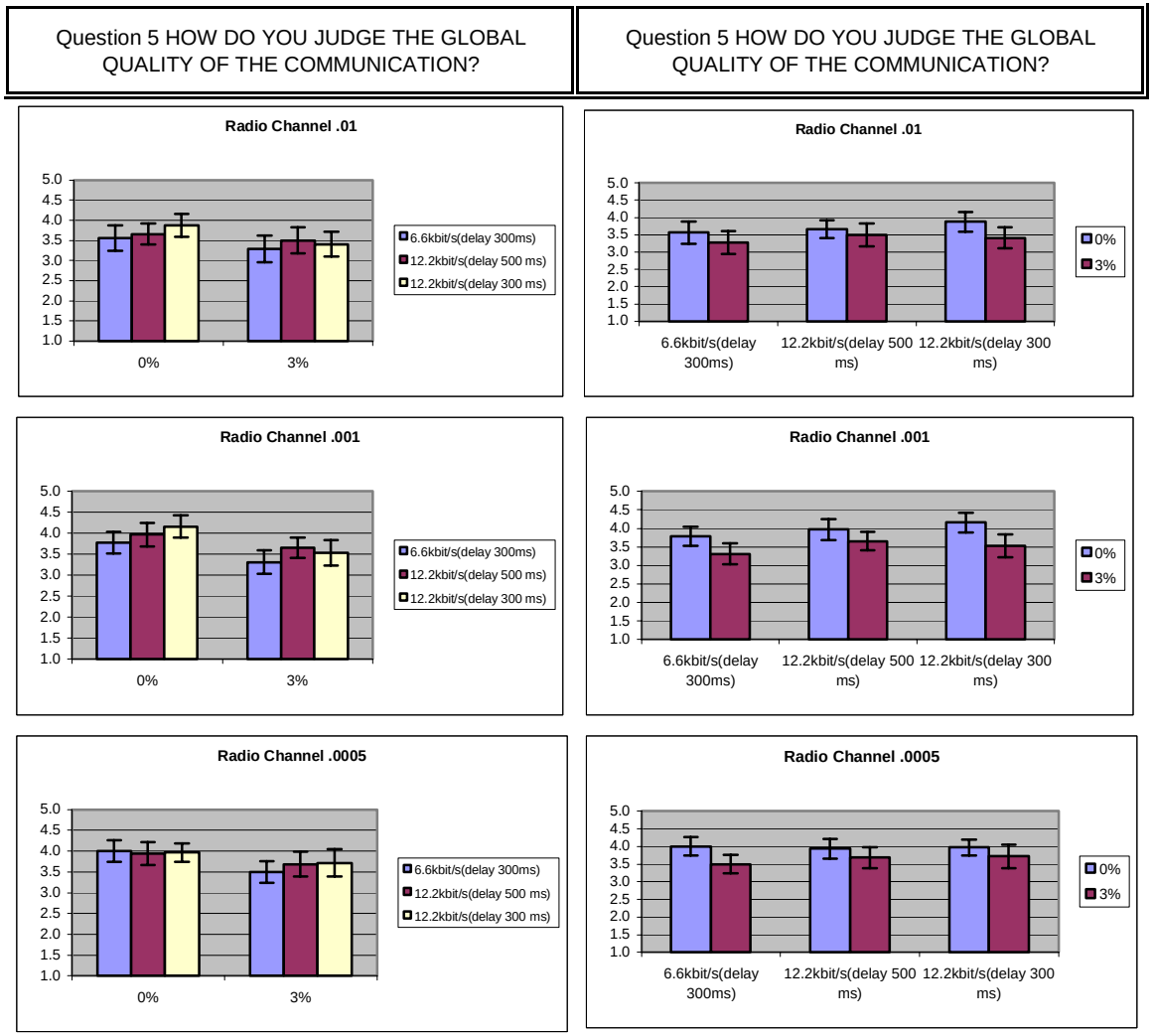


Figure 7.7 AMR-NB Conditions #1 to #18, Question #5

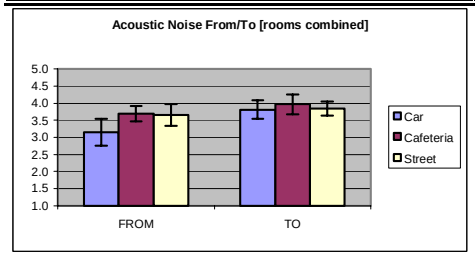
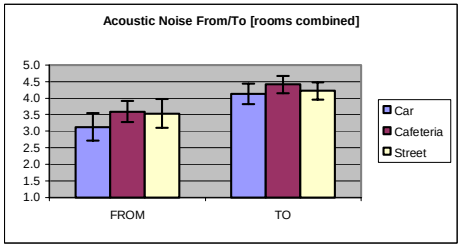
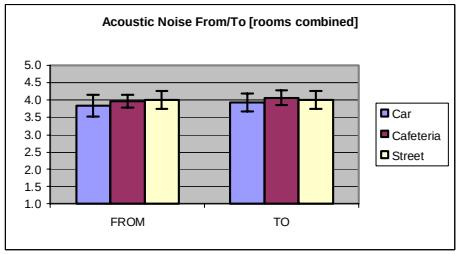
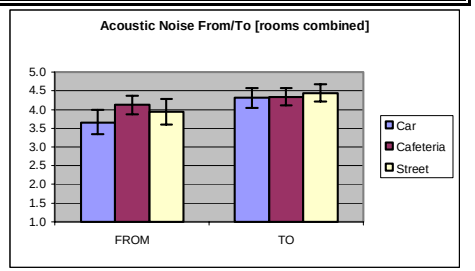
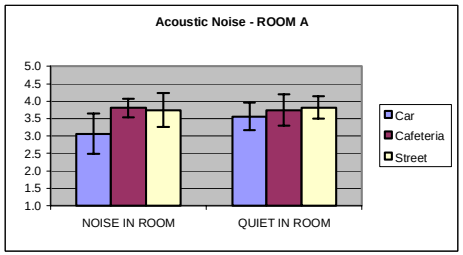
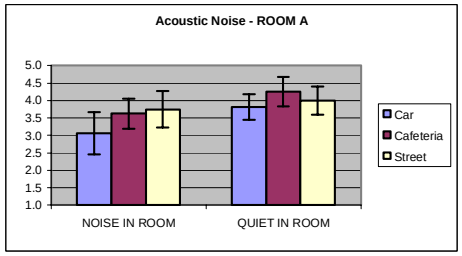
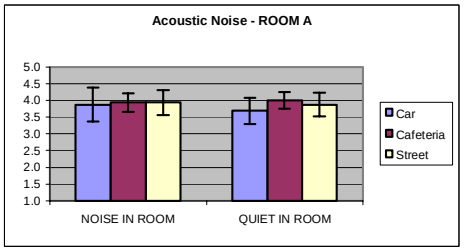
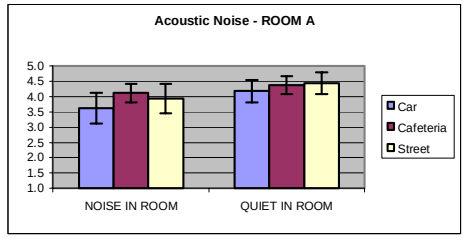
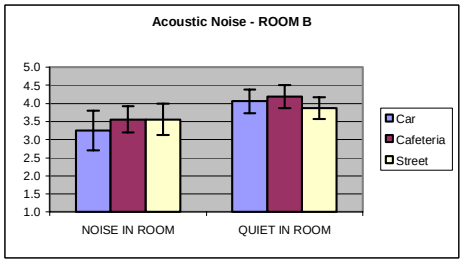
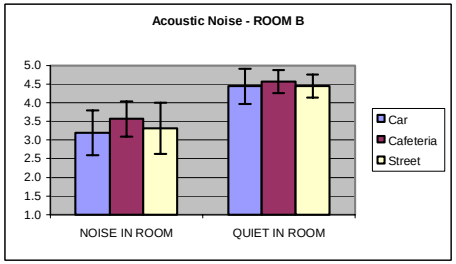
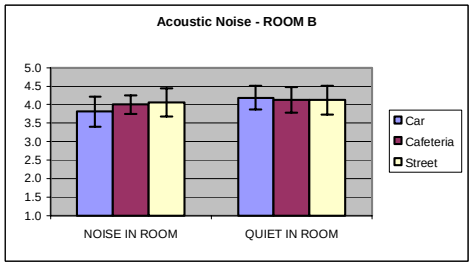
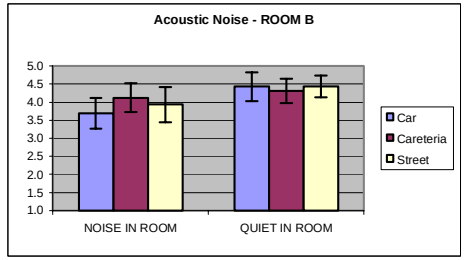
Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?
			
			
			

Figure 7.8 AMR-NB Acoustic Noise Conditions #19 to #24, Questions #1 to #4

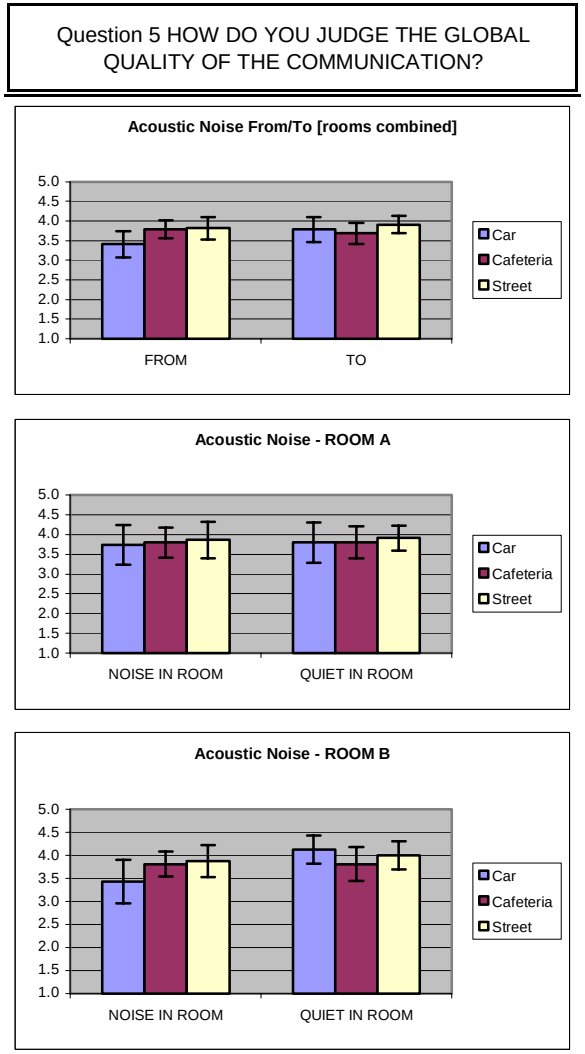


Figure 7.9 AMR-NB Acoustic Noise Conditions #19 to #24, Questions #5

Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?

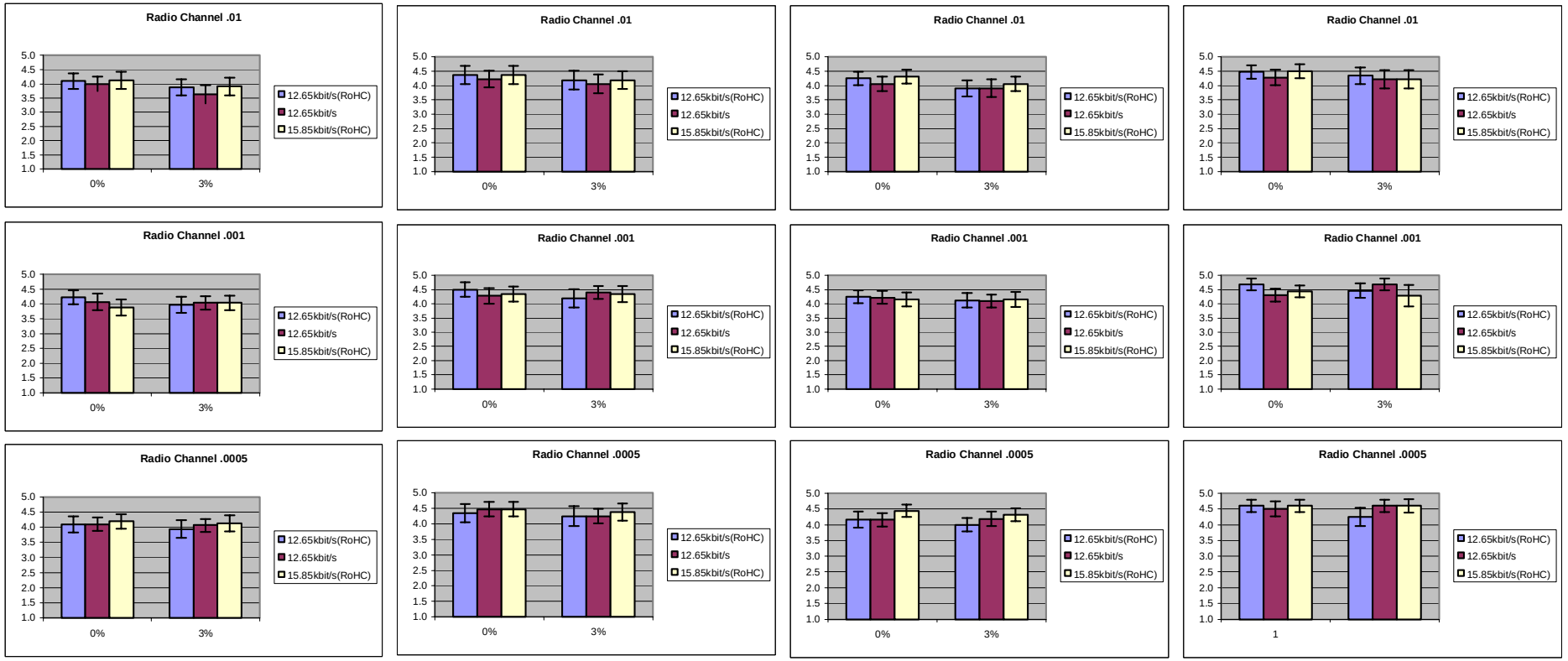


Figure 7.10 AMR-WB Conditions #1 to #18, Questions #1 to #4

Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?

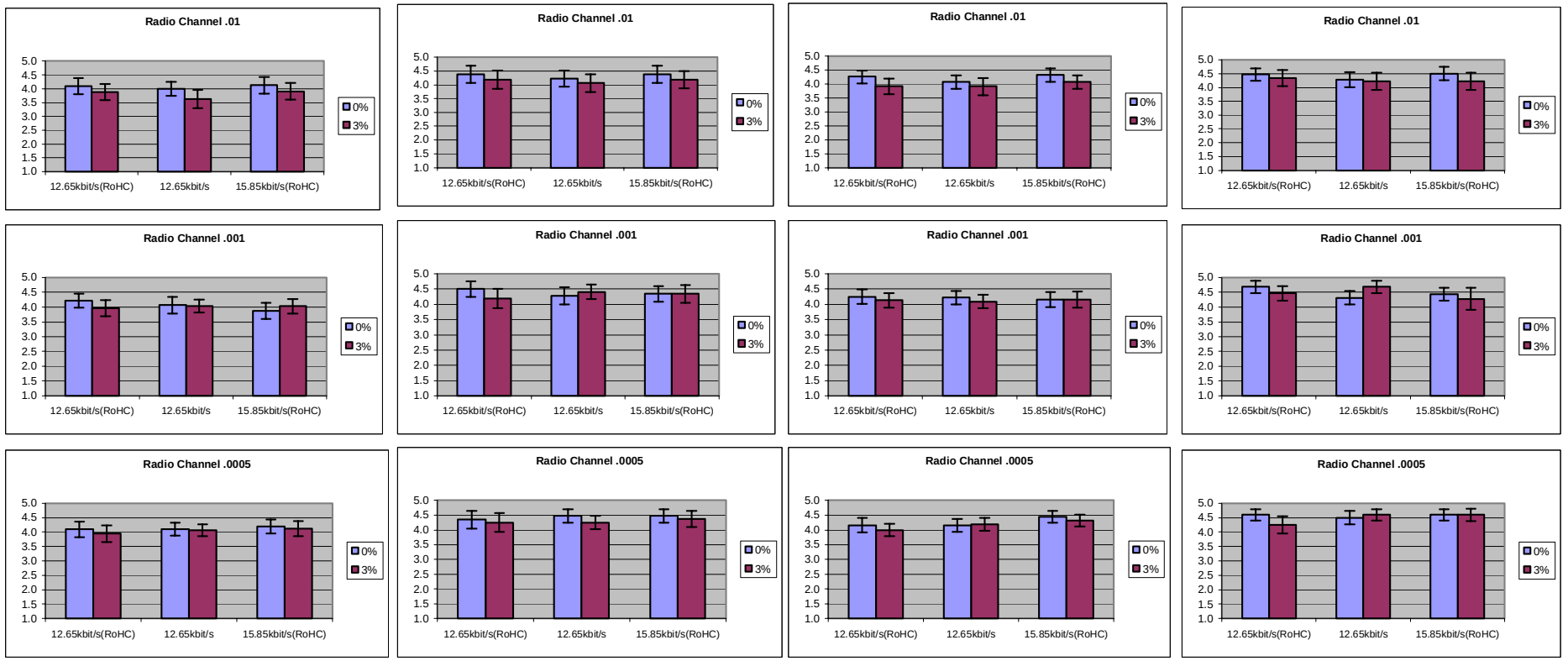


Figure 7.11 AMR-WB Conditions #1 to #18, Questions #1 to #4

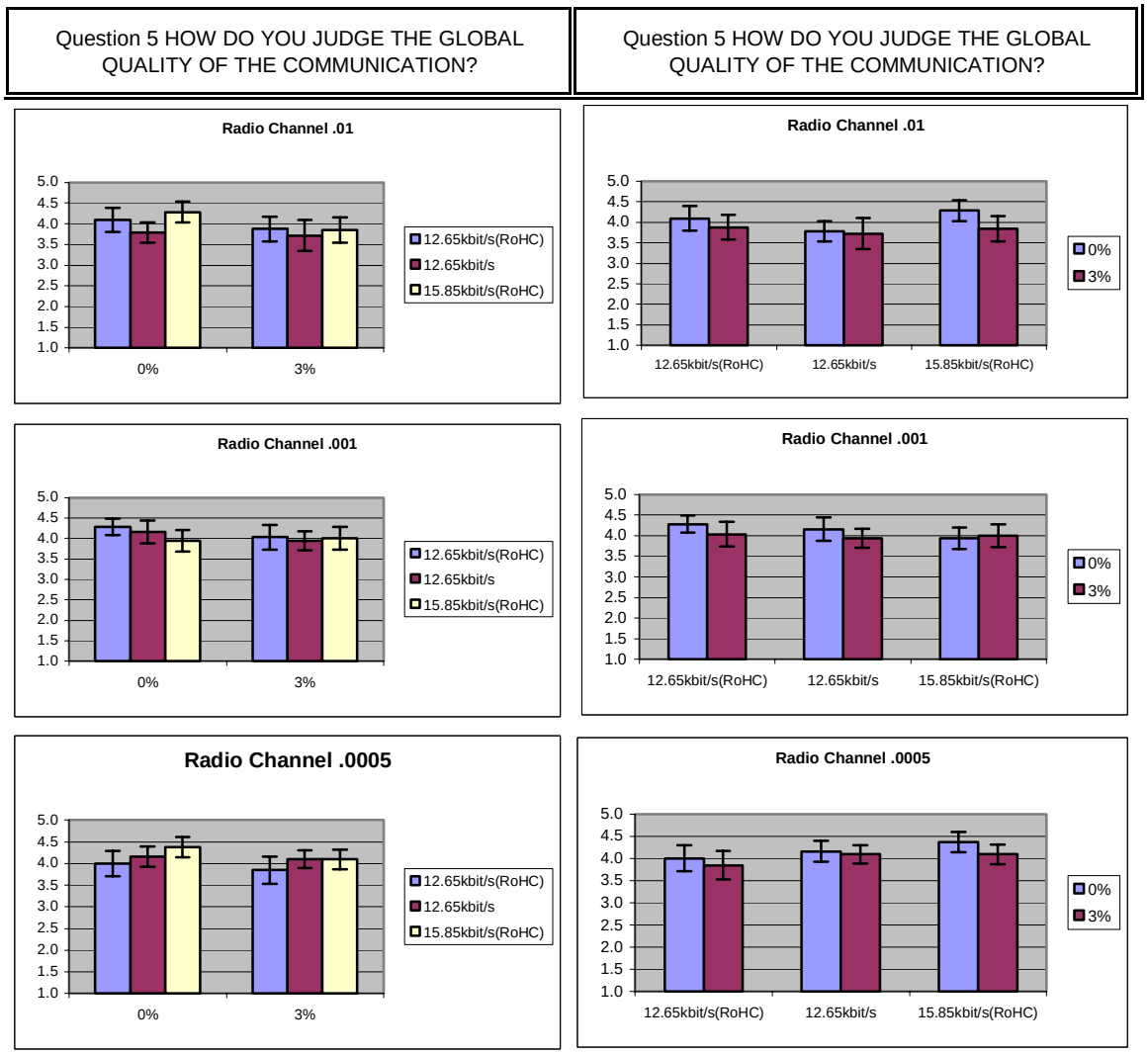


Figure 7.12 AMR-WB Conditions #1 to #18, Question #5

Question 1 HOW DO YOU JUDGE THE QUALITY OF THE VOICE OF YOUR PARTNER?	Question 2 DID YOU HAVE DIFFICULTY IN UNDERSTANDING SOME WORDS? **[RESPONCES REVERSED FROM ANSWERS GIVEN]**	Question 3 HOW DO YOU JUDGE THE CONVERSATION WHEN YOU INTERACTED WITH YOUR PARTNER?	Question 4 HOW DID YOU PERCEIVE ANY IMPAIRMENT?

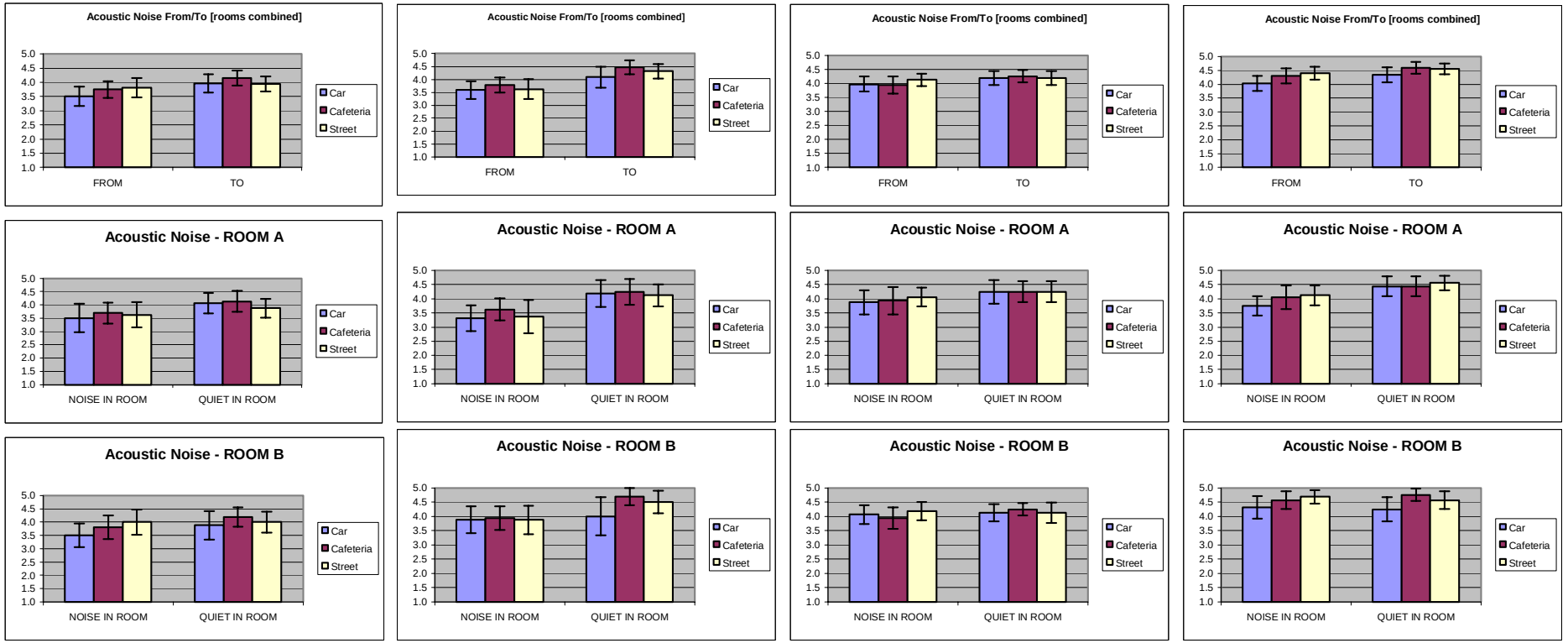


Figure 7.13 AMR-WB Acoustic Noise Conditions #19 to #24, Questions #1 to #4

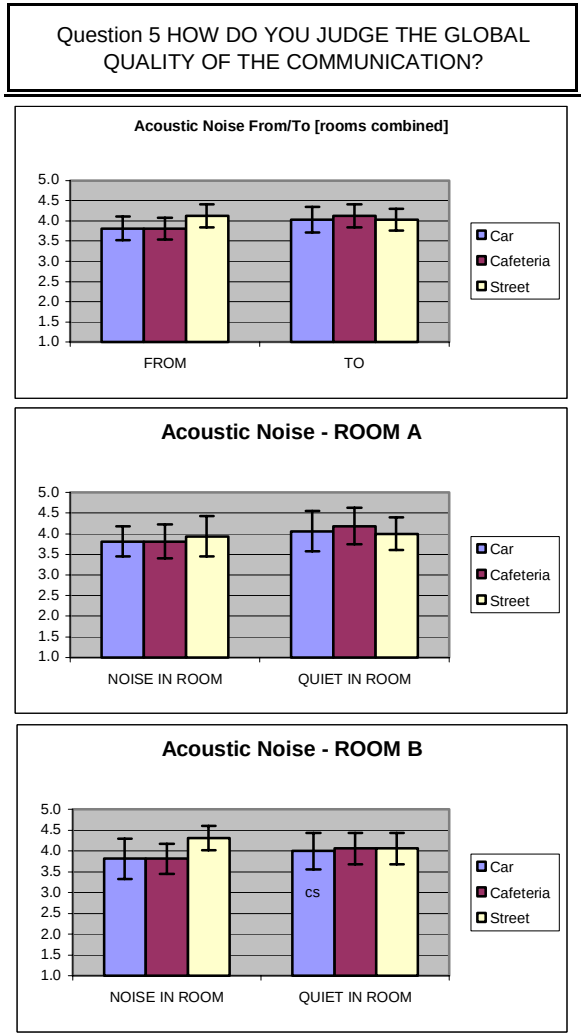


Figure 7.14 AMR-NB Acoustic Noise Conditions #19 to #24, Questions #5

8.0 Conclusions & Recommendations

ARCON Corporation conducted 3G AMR-NB and AMR-WB Conversational Characterization Experiments as directed by the Test Plans. The setup of the testbed eliminated the ability to monitor system and subject performance during testing. It is recommended that this functionality be provided in future communicability test efforts. The recommended test scenario method provided for a reasonable balance within the conversations. For a few communicator pairs, the conversational dynamics was lower that optimal. This could have an affect on the interaction question (#3). If the system had allowed for the recording of the conversations, this could have been studied post testing. It is recommended that this capability be provided in future communicability test efforts.

A survey of the results of both the wideband and narrowband experiments indicates to ARCON that the subjects had a problem with Question #4, impairments. During training several subjects asked for a definition of *impairment*. ARCON held a debriefing session after the training scenarios and before the test conditions. At this debriefing all subjects were told that an impairment was any artifact in either their partners speech or in background of the call that was unnatural for a good quality phone conversation. ARCON recommends that this question be clarified before use in future communicability efforts or that specific instruction be developed to describe the meaning of *impairment* to a naïve subject.

Several subjects questioned the meaning of *global* as used in Question #5. ARCON described the meaning of Question #5 to be an evaluation of the overall quality of the communication system using the subject's experience with both landline and cell phone systems. The subjects were explicitly told that the quality was that of the communication and not that of the task (i.e. scenario). ARCON recommends that this question be reworded before use in future communicability efforts.

Even a brief analysis of both the wideband and narrowband results reveals that there are very few significantly different scores within the separate questions across the various conditions. This fact makes it difficult to base judgments on the characterization results. Specific systematic trends are seen across the conditions and these trends are as expected. Higher scores for 0% vs. 3% errors, improved performance with coder rate, reduced performance with increased delay and other systematic trends demonstrate the power of the communicability test methodology. However, if the Test Plans had provided for a wider context of performance by including some extremes or calibration distortions, ARCON believes that significance could have been found within the trends that were seen. ARCON recommends that a method be explored for expanding the context of future communicability tests.

The asymmetric acoustic noise conditions (#19 to #24) demonstrate a strong trend for a higher performance measure by the communicator in the quiet environment receiving coded speech originating in the noisy environment. For ARCON's results this trend can be seen for all questions in the Car and Cafeteria acoustic environments. It is not as evident for the Street environment. With the exception of Question #4, there does not seem to be any *room* effect. Since the two chambers used at ARCON were of much different size, it was expected that a room effect may exist. The sound system in ARCON's smaller chamber was specifically designed for the chamber and seems to have done an excellent job. Since intelligibility can be effected by noise at the coder or transmitter side more than quality and since noise suppression systems typically reduce intelligibility while improving quality, it was expected that Question #2 would provide different results from the other questions. This was not seen.

References

Tdoc S4-030564 *Test Plan for the AMR Narrow-Band Packet Switched Conversation Test*

Tdoc S4-030565 *Test Plan for the AMR Wide-Band Packet Switched Conversation Test*