

**The Revised Mean Opinion Scale (MOS-R):  
Preliminary Psychometric Evaluation**

TR 29.3414  
March 27, 2001

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## **Abstract**

The original Mean Opinion Scale (MOS) is a seven-item questionnaire commonly used to evaluate speech quality. An earlier psychometric analysis indicated some opportunities to improve its scale reliability and consistency of item structure, prompting the development of a revised MOS (MOS-R) with nine items. The current analysis shows that the MOS-R appears to have achieved its goal of increasing scale reliability, with the improvement especially evident for the Naturalness scale. Factor analysis with the MOS-R indicates that the Speaking Rate item should be part of the Intelligibility scale.

## **ITIRC Keywords**

Mean Opinion Scale  
MOS  
Revised MOS (MOS-R)  
Artificial speech  
Synthetic speech  
Text-to-speech  
Psychometric evaluation



## Contents

Introduction .....	1
MOS Scale Reliability.....	1
The MOS Speaking Rate Item.....	1
A Proposed Revision of the MOS -- the MOS-R.....	2
Purpose of the Current Evaluation .....	3
Method.....	5
Results.....	7
Factor Analyses.....	7
Reliability.....	10
Discussion.....	11
Improvement to Overall Reliability.....	11
Improvement to Reliability of Intelligibility .....	11
Improvement to the Reliability of Naturalness.....	11
Association of Speaking Rate with Intelligibility.....	11
Conclusions .....	11
References.....	13
Appendix A. The MOS (Original Version).....	15
Appendix B. Preliminary MOS-R Database.....	17



## **Introduction**

### **MOS Scale Reliability**

The Mean Opinion Scale (MOS) is the method for evaluating text-to-speech (TTS) quality recommended by the International Telecommunications Union (ITU). The original MOS is a Likert-style questionnaire, typically with seven 5-point scale items addressing the following TTS characteristics: (1) Global Impression, (2) Listening Effort, (3) Comprehension Problems, (4) Speech Sound Articulation, (5) Pronunciation, (6) Speaking Rate, and (7) Voice Pleasantness.

A recent psychometric evaluation (Lewis, 2001) indicated that the version of the MOS derived from Salza et al. (1996) seems to have reasonably good psychometric properties (see Appendix A for a copy of that version of the MOS). Factor analysis of the data analyzed in Lewis (2001) indicated a factor structure similar to that reported by Kraft and Portele (1995), specifically, two factors (Intelligibility and Naturalness) and an unrelated item for Speaking Rate. The reliabilities of the overall MOS and the Intelligibility subscale were acceptable ( $\alpha = .89$  and  $.88$ , respectively), but the reliability of the subscale for was slightly lower ( $\alpha = .81$ ).

Using principles from psychometrics (Nunnally, 1978), it should be possible to improve the reliability of the MOS through appropriate revision. Rather than using 5-point scales with an anchor at each step, overall reliability should slightly improve with a change to 7-point bipolar scales. Because the Naturalness factor had weaker reliability than the Intelligibility factor, it would be reasonable to add at least two more items to the MOS that are likely to tap into the construct of Naturalness.

### **The MOS Speaking Rate Item**

The MOS Speaking Rate item failed to fall onto either the Intelligibility or Naturalness factor in both Lewis (2001) and Kraft and Portele (1995). This might have happened because Speaking Rate is truly independent of either of these constructs, or might have been an artifact due to the unique labeling of the scale points for this item. The other MOS items have scales that have a clear ordinal pattern, such as:

- Excellent
- Good
- Fair
- Poor
- Bad

for the Global Impression item.

The labels for the Speaking Rate item are, in contrast:

- Yes
- Yes, but slower than preferred
- Yes, but faster than preferred
- No, too slow
- No, too fast

which do not have a clear top-to-bottom ordinal relationship. If the item assessing Speaking Rate had the same structure as the other items in the MOS, a factor analysis could determine less ambiguously whether Speaking Rate is independent of Intelligibility and Naturalness, or whether it is actually associated with one of these two subscales of the MOS.

### A Proposed Revision of the MOS -- the MOS-R

The following items form a revised MOS (MOS-R) designed to address the reliability problems of the MOS by:

- Increasing the number of scale steps for each item from five to seven,
- Adding two items expected to associate with the Naturalness scale, and
- Making the structure of the Speaking Rate item consistent with the rest of the items.

1. *Global Impression*: Please rate the sound quality of the voice you heard.

**VERY BAD** 1      2      3      4      5      6      7      **EXCELLENT**

2. *Listening Effort*: Please rate the degree of effort you had to make to understand the message.

**IMPOSSIBLE  
EVEN WITH  
MUCH EFFORT**      1      2      3      4      5      6      7      **NO EFFORT  
REQUIRED**

3. *Comprehension Problems*: Were single words hard to understand?

**ALL WORDS  
HARD TO  
UNDERSTAND**      1      2      3      4      5      6      7      **ALL WORDS  
EASY TO  
UNDERSTAND**

4. *Speech Sound Articulation*: Were the speech sounds clearly distinguishable?

**NOT AT ALL  
CLEAR**      1      2      3      4      5      6      7      **VERY  
CLEAR**

5. *Pronunciation*: Did you notice any problems in the naturalness of sentence pronunciation?

**VERY MANY  
PROBLEMS** 1      2      3      4      5      6      7      **DIDN'T  
NOTICE ANY**



6. *Voice Pleasantness*: Was the voice you heard pleasant to listen to?

**VERY UNPLEASANT**    1    2    3    4    5    6    7    **VERY PLEASANT**

7. *Voice Naturalness*: Did the voice sound natural?

**VERY UNNATURAL**    1    2    3    4    5    6    7    **VERY NATURAL**

8. *Ease of Listening*: Would it be easy to listen to this voice for long periods of time?

**VERY DIFFICULT** 1    2    3    4    5    6    7    **EASY**    **VERY**

9. *Speaking Rate*: Was the speed of delivery of the message appropriate?

**POOR RATE OF SPEECH** 1    2    3    4    5    6    7    **PERFECT RATE OF SPEECH**

**IF UNSATISFACTORY, PLEASE CIRCLE ONE: TOO SLOW or TOO FAST**

### **Purpose of the Current Evaluation**

The purpose of the current evaluation was to determine if the proposed changes to the MOS worked as expected. Specifically, the expected consequences of the revision were:

- The reliability of the overall MOS would improve slightly.
- The revised MOS items 2-5 would continue to form an Intelligibility factor.
- Items 1 and 6-8 would form a Naturalness factor with substantially greater reliability (possibly in excess of .90) than the current Naturalness factor.
- The change in the structure of the Speaking Rate item would make it possible to determine whether that item is truly independent of the other two factors.



## Method

The data analyzed in this report came from three different studies of concatenative TTS voices, each with 16 participants. For all three studies, the participant groups had full factorial crossing of the following independent variables (enhancing the generality of results):

- Gender (half were male, half were female)
- Age (half under 40 years of age, half over 40 years of age)
- Employment (half were employees of a temporary help agency, half were IBM employees)

In all three studies, participants listened to four different TTS voices speaking text from four different text samples and provided MOS-R ratings for each voice. I combined the data from the three independent experiments and performed a separate analysis for each set of ratings within participants across experiments for a total of four independent analyses (see Appendix B for the raw data). Each of these analyses included 48 sets of ratings. Although, strictly speaking, the data should be independent, I also ran an analysis of the combined data from all four sets of ratings per participant per experiment to see how the combined analysis compared with the four independent analyses.

The recommended sample size for a factor analysis is at least five participants per item, making the target sample size for evaluations of the MOS-R 45 participants. The analyses using the data from the three TTS experiments have 48 participants (3 experiments by 16 participants per experiment), so the analyses meet this requirement. These results are preliminary, though, because in some cases the same participant took part in two (but never all three) of the studies.



## Results

### Factor Analyses

Figure 1 shows the scree plots from the five analyses (labeled A-D plus Combined). The patterns are very similar. Table 1 contains the eigenvalues from each analysis and the number of factors indicated by a parallel analysis (Covert & McNelis, 1988). Because the parallel analysis for Analysis A suggested three factors but the remaining analyses suggested two factors, Table 2 shows both the two- and three-factor solutions after varimax rotation for each analysis, with relatively larger factor loadings shown in bold (bold italics indicates relatively large factor loadings on more than one factor). Table 3 shows the percentage of variance explained for each analysis for both two- and three-factor solutions.

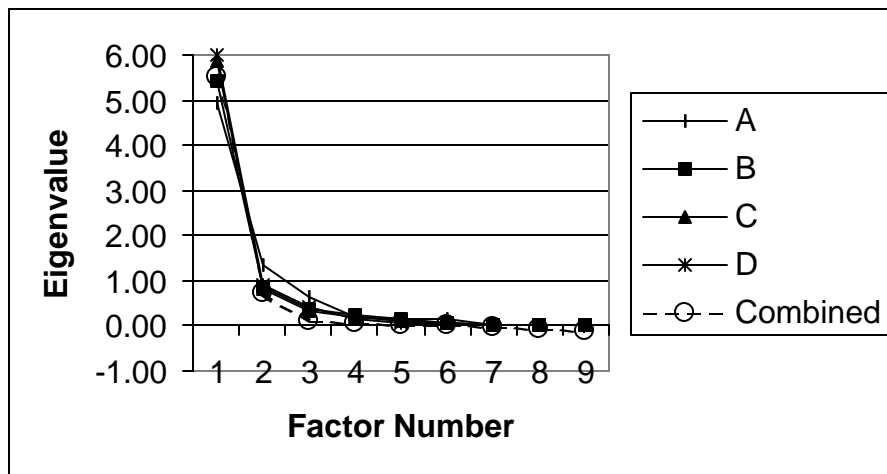


Figure 1. Scree Plots from Factor Analyses

Table 1. Eigenvalues and Recommended Number of Factors

Eigenvalue	A	B	C	D	Combined
1	4.93	5.43	5.85	6.00	5.53
2	1.36	0.84	0.80	0.91	0.71
3	0.62	0.37	0.32	0.42	0.12
4	0.20	0.25	0.20	0.15	0.07
5	0.14	0.14	0.10	0.06	0.04
6	0.13	0.08	0.05	0.05	0.02
7	0.02	0.03	0.03	0.01	-0.03
8	0.01	0.00	0.01	0.00	-0.09
9	0.00	0.00	0.00	0.00	-0.13
<b>Number of Factors</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

Table 2. Two and Three-Factor Varimax-Rotated Solutions  
Analysis A

Item	Fac1	Fac2		Fac1	Fac2	Fac3
1	<b>0.46</b>	0.37		0.18	0.26	<b>0.71</b>
2	<b>0.76</b>	0.32		0.51	0.21	<b>0.74</b>
3	<b>0.81</b>	0.09		<b>0.83</b>	0.10	0.21
4	<b>0.86</b>	0.19		<b>0.87</b>	0.20	0.24
5	<b>0.68</b>	0.43		<b>0.50</b>	0.37	<b>0.52</b>
6	0.19	<b>0.93</b>		0.10	<b>0.88</b>	0.30
7	0.33	<b>0.83</b>		0.30	<b>0.85</b>	0.19
8	0.25	<b>0.87</b>		0.22	<b>0.87</b>	0.19
9	<b>0.59</b>	0.26		<b>0.56</b>	0.26	0.21

Analysis B

Item	Fac1	Fac2		Fac1	Fac2	Fac3
1	0.48	<b>0.57</b>		<b>0.49</b>	<b>0.48</b>	0.31
2	0.39	<b>0.76</b>		0.38	<b>0.55</b>	<b>0.50</b>
3	0.23	<b>0.77</b>		0.20	<b>0.89</b>	0.27
4	0.37	<b>0.75</b>		0.33	0.47	<b>0.61</b>
5	0.35	<b>0.66</b>		0.27	0.33	<b>0.70</b>
6	<b>0.86</b>	0.36		<b>0.84</b>	0.21	0.36
7	<b>0.84</b>	0.39		<b>0.84</b>	0.32	0.26
8	<b>0.89</b>	0.34		<b>0.87</b>	0.23	0.30
9	0.36	0.30		0.33	0.10	0.37

Analysis C

Item	Fac1	Fac2		Fac1	Fac2	Fac3
1	<b>0.68</b>	0.45		0.44	<b>0.66</b>	0.25
2	<b>0.91</b>	0.31		0.29	<b>0.76</b>	0.49
3	<b>0.85</b>	0.33		0.30	<b>0.86</b>	0.27
4	0.44	<b>0.60</b>		<b>0.61</b>	0.46	0.11
5	<b>0.53</b>	<b>0.54</b>		<b>0.51</b>	0.44	0.33
6	0.32	<b>0.82</b>		<b>0.80</b>	0.22	0.32
7	0.50	<b>0.75</b>		<b>0.72</b>	0.38	0.41
8	0.29	<b>0.87</b>		<b>0.88</b>	0.28	0.14
9	<b>0.60</b>	0.35		0.27	0.38	<b>0.68</b>

Analysis D

Item	Fac1	Fac2		Fac1	Fac2	Fac3
1	<b>0.64</b>	0.49		<b>0.59</b>	0.44	0.31
2	0.32	<b>0.84</b>		0.32	<b>0.88</b>	0.12
3	0.35	<b>0.83</b>		0.25	<b>0.76</b>	0.44
4	<b>0.57</b>	<b>0.54</b>		0.37	0.43	<b>0.73</b>
5	<b>0.75</b>	0.30		<b>0.62</b>	0.19	<b>0.56</b>
6	<b>0.81</b>	0.36		<b>0.83</b>	0.34	0.19
7	<b>0.95</b>	0.24		<b>0.87</b>	0.21	0.37
8	<b>0.77</b>	0.48		<b>0.79</b>	0.47	0.19
9	0.28	<b>0.74</b>		0.27	<b>0.71</b>	0.22

Table 2. Two and Three-Factor Varimax-Rotated Solutions (Cont.)

**Combined**

Item	Fac1	Fac2		Fac1	Fac2	Fac3
1	<b>0.56</b>	<b>0.51</b>		<b>0.50</b>	0.43	0.37
2	<b>0.78</b>	0.36		0.32	<b>0.89</b>	0.34
3	<b>0.85</b>	0.23		0.23	<b>0.54</b>	<b>0.61</b>
4	<b>0.70</b>	0.39		0.34	0.29	<b>0.78</b>
5	<b>0.57</b>	0.48		0.46	0.31	<b>0.52</b>
6	0.32	<b>0.88</b>		<b>0.87</b>	0.25	0.23
7	0.40	<b>0.83</b>		<b>0.83</b>	0.24	0.35
8	0.38	<b>0.83</b>		<b>0.82</b>	0.27	0.29
9	<b>0.53</b>	0.32		0.31	0.38	0.37

Table 3. Percentage Explained Variance for Two and Three-Factor Solutions

Analysis	2-Factor	3-Factor	Difference
A	67.1	74.2	7.1
B	67.2	71.7	4.5
C	71.8	75.6	3.8
D	74.8	80.2	5.4
Mean	70.2	75.4	5.2
Combined	69.4	73.6	4.6

Parallel analysis indicated a three-factor solution for only one of the analyses (Analysis A), with two-factor solutions indicated for the other analyses. This is consistent with the analysis of the percentage explained variance for two- and three-factor solutions for each analysis shown in Table 3. Any time you increase the dimensionality of a solution by adding a factor, the percentage of explained variance will increase (Cliff, 1987). The question is whether adding the new factor increases the percentage of explained variance enough to justify the acceptance of the additional factor. Due to the nature of factor analysis, there is no way to address this question with a test of statistical significance (Cliff, 1987). The combination of the high percentage of parallel analyses indicating two-factor solutions and the relatively small percentage of additional variance explained by the three-factor solutions indicate that the MOS-R most likely has two factors. Examination of the two-factor varimax-rotated solutions suggests that the most appropriate association of items with factors is Items 1-5 and 9 with the Intelligibility factor and Items 6-8 with the Naturalness factor.

## Reliability

Given the preceding assignment of items to factors, Table 4 shows the estimates of reliability (coefficient alpha) for the overall MOS-R and each of its factors (subscales). The table also shows the reliability estimates from Lewis (2001) for the original MOS and the percentage of improvement relative to the means from Analyses A-D.

*Table 4. MOS-R Reliability Estimates*

<b>Analysis</b>	<b>Overall</b>	<b>Intelligibility</b>	<b>Naturalness</b>
<i>A</i>	0.90	0.88	0.94
<i>B</i>	0.92	0.86	0.95
<i>C</i>	0.94	0.91	0.92
<i>D</i>	0.94	0.90	0.95
<i>Mean</i>	0.92	0.89	0.94
<i>Combined</i>	0.93	0.89	0.95
<i>Original</i>	0.89	0.88	0.81
<i>Improved</i>	4%	1%	16%



## Discussion

As mentioned in the Introduction, the expected results for the MOS-R were:

- The reliability of the overall MOS would improve.
- The revised MOS Items 2-5 would continue to form an Intelligibility factor.
- Items 1 and 6-8 would form a Naturalness factor with substantially greater reliability (possibly in excess of .90) than the current Naturalness factor.
- The change in the structure of the Speaking Rate item would make it possible to determine whether that item is truly independent of the other two factors.

### Improvement to Overall Reliability

As expected, the overall reliability of the MOS-R is slightly better (4%) than the original MOS, with the estimated reliability of the MOS-R being .92 relative to .89 for the original MOS.

### Improvement to Reliability of Intelligibility

The Intelligibility factor for the MOS-R included, as expected, Items 2-5. An unexpected result was the apparent association of Item 1 with the Intelligibility factor rather than the Naturalness factor (see the two-factor solutions for Analyses A-C and Combined). In all the analyses (especially the Combined analysis), Item 1 loaded strongly on both factors, which is consistent with its content (“*Global Impression*: Please rate the sound quality of the voice you heard.”) Overall, it seemed to load most strongly on the Intelligibility factor. Including Item 1 in the Intelligibility factor resulted in an estimated subscale reliability of .89, a 1% improvement over the estimate for the Intelligibility subscale of the original MOS.

### Improvement to the Reliability of Naturalness

The Naturalness factor included, as expected, Items 6-8 (but did not include Item 1). The resulting estimate of reliability was .94, a 16% improvement over the reliability measured for the Naturalness subscale of the original MOS (.81). This change to the MOS improved the reliability of the Naturalness subscale to a great enough extent that there is no need to add any additional items.

### Association of Speaking Rate with Intelligibility

The revised format for the Speaking Rate item led it to generally align with the Intelligibility factor. Had it continued to remain independent of both of the other factors (as in Lewis, 2001), then it would be necessary to add more items to the MOS-R for the purpose of enhancing the measurement of an apparent third factor. Because the Speaking Rate item does not appear to be independent of Intelligibility, there is no need to design additional items for this purpose.

### Conclusions

Keeping in mind that these results are preliminary, the findings are generally consistent with expectation. It is reasonable to continue using the 9-item MOS-R rather than the original MOS for future studies that evaluate listener ratings of artificial voices.



## References

- Cliff, N. (1987). *Analyzing multivariate data*. San Diego, CA: Harcourt Brace Jovanovich.
- Covert, M. D., & McNelis, K. (1988). Determining the number of common factors in factor analysis: A review and program. *Educational and Psychological Measurement*, 48, 687-693.
- Kraft, V., & Portele, T. (1995). Quality evaluation of five German speech synthesis systems. *Acta Acustica*, 3, 351-365.
- Landauer, T. K. (1988). Research methods in human-computer interaction. In M. Helander (Ed.), *Handbook of human-computer interaction*. New York: Elsevier.
- Lewis, J. R. (2001). *Psychometric properties of the Mean Opinion Scale* (Tech. Report in press). West Palm Beach, FL: International Business Machines Corp.
- Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.
- Salza, P. L., Foti, E., Nebbia, L., & Oreglia, M. (1996). MOS and pair comparison combined methods for quality evaluation of text to speech systems. *Acta Acustica*, 82, 650-656.



## Appendix A. The MOS (Original Version)

The seven items (from Salza et al., 1996) of the original MOS are:

1. *Global Impression:* Your answer must indicate how you rate the sound quality of the voice you have heard.

Excellent

Good

Fair

Poor

Bad

2. *Listening Effort:* Your answer must indicate the degree of effort you had to make to understand the message.

No effort required

Slight effort required

Effort required

Major effort required

Message not understood with any feasible effort

3. *Comprehension Problems:* Your answer must indicate if you found single words hard to understand.

None

Few

Some

Many

Every word

4. *Speech Sound Articulation:* Your answer must indicate if the speech sounds are clearly distinguishable.

Yes, very clearly

Yes, clearly enough

Fairly clear

No, not very clear

No, not at all

5. *Pronunciation*: Your answer must indicate if you noticed any anomalies in the naturalness of sentence pronunciation.

- No
- Yes, but not annoying
- Yes, slightly annoying
- Yes, annoying
- Yes, very annoying

6. *Speaking Rate*: Your answer must indicate if you found the speed of delivery of the message appropriate.

- Yes
- Yes, but slower than preferred
- Yes, but faster than preferred
- No, too slow
- No, too fast

7. *Voice Pleasantness*: Your answer must indicate if you found the voice you have heard pleasant.

- Very pleasant
- Pleasant
- Fair
- Unpleasant
- Very unpleasant

## Appendix B. Preliminary MOS-R Database

Listener	A1	A2	A3	A4	A5	A6	A7	A8	A9
1	5	5	6	4	5	3	2	3	5
2	5	6	6	6	6	6	6	5	6
3	4	5	4	4	3	3	3	3	6
4	3	5	5	5	3	3	3	3	6
5	4	5	6	5	3	2	2	2	6
6	5	6	7	7	5	5	4	5	6
7	4	6	6	6	5	5	4	5	6
8	4	7	7	7	7	2	1	3	7
9	4	4	5	5	4	3	1	2	5
10	5	5	5	4	4	5	5	5	5
11	3	5	6	4	3	3	2	4	3
12	5	6	6	6	6	6	6	6	6
13	4	5	6	5	3	2	2	2	5
14	4	3	4	2	2	2	2	3	4
15	3	4	3	4	2	3	2	3	6
16	3	2	2	1	1	4	1	3	1
17	6	6	5	6	6	6	6	6	5
18	2	4	5	5	3	3	3	2	7
19	2	2	4	4	2	2	2	2	3
20	4	5	5	5	3	3	3	3	6
21	6	6	6	6	6	5	5	5	6
22	4	4	5	5	4	4	4	4	6
23	3	4	5	5	3	2	2	1	5
24	6	7	7	7	4	6	7	7	7
25	4	5	5	5	4	2	3	3	4
26	6	6	5	4	6	6	5	6	6
27	3	6	6	4	4	3	3	3	5
28	6	6	6	6	6	6	6	6	7
29	4	3	4	4	3	2	3	2	4
30	3	5	5	6	3	3	3	5	3
31	5	6	4	4	4	4	3	3	6
32	7	7	5	5	4	2	1	1	2
33	2	3	2	3	3	5	3	5	3
34	4	5	5	4	5	3	3	3	6
35	3	4	5	4	3	3	2	3	6
36	4	6	5	4	4	4	4	4	7
37	2	5	5	5	5	5	4	4	5
38	5	6	6	4	3	4	4	3	3
39	5	5	4	3	3	4	5	6	6
40	3	3	4	3	3	2	1	1	4
41	4	7	7	7	7	5	4	4	6
42	3	3	5	4	4	3	3	3	3
43	5	5	3	3	3	3	1	1	5
44	6	4	4	6	5	3	4	3	5
45	3	3	4	3	4	4	3	3	4
46	4	5	2	3	5	4	3	4	4
47	1	2	2	1	1	2	2	1	2
48	2	3	7	6	3	3	4	4	6

Listener	B1	B2	B3	B4	B5	B6	B7	B8	B9
1	4	4	5	3	2	2	3	3	6
2	4	6	6	5	6	4	3	3	6
3	5	4	4	2	3	7	6	6	3
4	2	5	4	5	3	3	3	3	6
5	4	4	6	5	5	2	2	2	6
6	4	6	6	4	3	4	4	3	6
7	3	2	4	2	1	1	1	1	2
8	7	7	5	7	5	7	5	7	7
9	4	5	5	4	5	3	2	2	5
10	5	6	4	5	5	5	4	3	4
11	3	7	6	4	5	3	3	3	3
12	5	5	5	5	5	5	5	5	5
13	3	5	4	3	2	4	3	3	4
14	2	4	4	2	3	3	2	2	5
15	4	5	3	5	2	3	2	4	6
16	7	7	7	6	3	6	5	5	4
17	6	7	7	7	7	7	7	7	7
18	7	7	7	7	6	7	6	7	7
19	3	2	4	5	3	2	1	2	2
20	4	5	5	5	3	3	3	3	6
21	5	5	6	6	6	4	4	4	5
22	3	3	4	3	2	3	2	3	6
23	6	6	7	6	6	5	5	5	6
24	7	7	7	7	6	6	5	7	7
25	5	6	6	6	4	4	4	4	7
26	4	5	4	5	5	5	4	3	5
27	6	7	7	7	5	6	5	6	3
28	6	6	6	6	6	6	6	6	6
29	3	2	3	4	3	2	3	2	4
30	4	5	4	5	5	4	3	4	4
31	5	7	7	6	6	5	5	6	7
32	7	7	7	6	6	7	7	5	5
33	3	3	4	4	3	5	3	4	2
34	5	5	6	5	7	3	3	2	6
35	5	6	6	6	5	5	4	5	5
36	6	6	6	5	5	5	5	6	7
37	2	5	5	5	5	5	4	4	5
38	4	7	6	6	4	4	3	4	3
39	6	5	5	5	5	6	6	7	6
40	4	6	6	5	4	3	3	3	4
41	6	7	7	7	6	4	3	3	4
42	5	5	6	6	4	4	2	2	1
43	5	5	4	4	4	2	2	1	4
44	4	3	4	3	2	1	1	1	5
45	3	4	5	4	4	3	3	3	4
46	5	6	3	4	7	5	2	4	5
47	3	5	5	2	3	1	2	2	1
48	2	6	5	7	6	6	5	5	7



Listener	C1	C2	C3	C4	C5	C6	C7	C8	C9
1	5	5	5	5	4	7	6	6	6
2	6	6	5	6	6	5	5	5	6
3	3	3	3	3	2	4	3	2	5
4	4	6	6	5	3	4	3	3	6
5	5	6	6	5	3	3	5	5	6
6	6	7	6	6	7	7	7	7	7
7	6	6	5	6	5	5	4	6	6
8	7	7	7	7	4	6	7	7	6
9	6	6	5	5	4	3	3	4	7
10	7	6	7	5	7	7	7	7	7
11	6	7	7	4	4	6	5	6	5
12	6	7	7	7	6	6	7	7	7
13	3	4	4	3	4	2	2	3	4
14	5	6	6	5	5	5	4	5	6
15	6	6	7	7	4	6	4	5	6
16	2	2	2	4	1	4	1	4	3
17	6	5	6	6	4	5	6	5	6
18	3	6	6	5	4	4	4	5	7
19	4	3	4	6	4	5	3	5	3
20	4	5	5	5	3	4	3	3	5
21	5	6	6	6	4	4	5	5	5
22	6	6	6	7	6	6	6	5	7
23	7	6	6	5	3	4	3	4	6
24	5	7	7	7	5	5	3	4	7
25	5	7	7	6	6	5	5	5	6
26	7	7	7	6	7	7	6	6	6
27	6	7	6	5	3	7	5	5	5
28	6	6	6	6	6	6	6	6	6
29	4	3	4	5	3	2	3	3	4
30	5	4	6	6	4	3	2	6	2
31	6	7	7	6	7	7	6	6	7
32	2	3	2	4	3	3	1	2	4
33	4	4	3	4	4	4	3	3	3
34	6	6	6	6	5	5	5	5	7
35	6	6	6	6	5	6	6	6	4
36	6	7	6	6	5	6	5	7	7
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38	6	6	6	6	4	6	6	6	5
39	7	7	7	7	7	7	7	7	6
40	4	5	4	4	3	2	2	3	4
41	7	7	7	7	5	4	5	4	5
42	6	6	6	6	6	6	6	6	6
43	6	5	5	4	3	2	2	1	4
44	5	4	4	3	3	2	4	2	5
45	4	5	5	5	5	3	3	4	4
46	5	6	5	5	4	5	3	5	5
47	5	6	7	3	5	2	2	1	5
48	5	6	6	5	4	4	5	5	6

Listener	D1	D2	D3	D4	D5	D6	D7	D8	D9
1	5	6	6	6	6	5	5	5	6
2	3	6	5	5	6	3	3	2	5
3	3	3	6	6	6	3	2	2	3
4	3	5	4	5	3	3	2	3	6
5	6	6	6	6	6	5	6	5	6
6	3	4	4	4	3	3	2	2	6
7	2	4	4	3	2	1	1	1	5
8	4	7	7	4	2	2	1	3	7
9	4	5	5	5	4	2	2	2	6
10	6	6	7	6	5	6	6	5	5
11	4	7	6	3	2	5	3	4	6
12	5	5	5	5	5	5	5	5	5
13	2	2	3	4	3	2	3	2	3
14	4	3	4	2	2	1	1	3	4
15	5	6	6	5	4	4	3	4	6
16	1	2	2	1	1	1	1	1	1
17	6	6	6	6	6	5	6	5	6
18	6	7	7	7	7	7	6	6	7
19	2	3	4	5	1	2	1	1	5
20	4	5	5	5	3	4	3	3	6
21	7	7	7	7	7	6	6	6	6
22	5	5	5	6	5	5	4	4	6
23	2	6	6	5	3	2	2	2	5
24	3	7	7	7	3	4	3	6	7
25	5	6	6	5	5	5	5	5	6
26	4	6	5	6	5	5	4	5	5
27	3	7	4	3	3	4	2	3	3
28	5	5	5	5	5	5	6	6	6
29	4	3	3	4	2	3	3	2	5
30	4	6	5	5	3	4	4	5	3
31	5	6	5	5	5	4	4	5	7
32	1	1	1	2	3	2	1	1	1
33	2	3	3	4	3	6	4	4	3
34	6	6	6	7	7	7	6	6	6
35	5	5	4	5	4	6	5	4	6
36	5	6	4	4	5	5	5	5	7
37	7	7	7	7	7	7	7	7	7
38	6	6	5	5	3	6	6	6	6
39	4	4	5	5	7	6	6	6	5
40	5	6	6	6	5	5	5	5	5
41	4	7	7	4	4	7	4	6	7
42	6	6	6	6	4	5	5	5	5
43	6	6	4	4	4	6	2	4	6
44	7	5	4	5	4	4	4	3	4
45	4	4	4	4	4	3	3	3	4
46	4	4	3	3	3	3	2	3	4
47	7	7	7	7	7	7	7	7	7
48	6	5	5	6	3	3	2	3	5