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Listeners' Sensitivity to the Frequency of Sociolinguistic Variables

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Introduction

Over the past 40 years, studies of linguistic variation have produced a great deal of data on the regular social and stylistic stratification of sociolinguistic variables.[1] Fine-grained differences have been observed and replicated in the production of stable sociolinguistic variables like (ING), (DH), or Spanish (S), with significant differences between four or five social levels and four or five stylistic levels (Labov 1966, Trudgill 1974, Cedergren 1973, Weinberg 1974). Figure 1 is a typical product of such studies: the graphic representation of a cross-tabulation of the social and stylistic stratification of (ING) in NYC. The vertical axis is the frequency of the non-standard apical variant in the

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alternation of /in/ and /ing/ in unstressed syllables, and the horizontal axis orders contextual style by the relative degree of attention paid to speech.[2] The cross-tabulation suggests that if the data sets were expanded further, even finer degrees of differentiation could be achieved. The underlying regularity reflects an independent and linear effect of social status and formality on use of the prestige variant and social status and formality, as shown by this formula

(1) (ING) = a + b * SEC + c * ATS

where SEC = socio-economic class and ATS = attention paid to speech

A multiple regression analysis of the data using SEC and ATS as independent variables produces the results of Table 1. Here the residual factor for SEC is Lower Class, and for ATS, Reading Style. All factors are significant and account for 83% of the variance. Entering these coefficients into formula (1), we obtain the expected values of Figure 2. Indications of a floor effect in Figure 1 are confirmed by the fact that the expected values project below 0. Nevertheless, Figure 2 confirms the expectation of regular and independent effects of style and social class. Since style is an ordinal rather than an interval scale, the even spacing along the horizontal axis is a matter of convention. We can say that each increment in social status is accompanied by an increment in use of the prestige variable and each increment in attention paid to speech is accompanied by a similar increase, with all indications that these relationships are approximately linear.

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[2] It should be clear from the many discussions of the underlying basis of style shifting that this is a way of organizing the style shifting that takes place within the interview context, rather than a theory about the over-all organization of style in every-day life (Eckert and Rickford 19??).

This paper is a first report on an ongoing investigation of the manner in which community members perceive this variation in production. The experiments we will report here are designed to determine whether listeners can discriminate and evaluate the levels of variation of Figure 1. More generally, we are concerned with an understanding of how stable sociolinguistic variables are acquired and operate to affect social categorization in every-day life. We posit the presence of a sociolinguistic monitor that operates on socially marked information consequent to grammatical and phonological processing. Such a monitor would control the effect of frequency of sociolinguistic variables on social judgments and social behavior, and the development of a common normative structure in the speech community

The critical properties of the sociolinguistic monitor [or SLM] that we will investigate are:

- its temporal window: over what span of time do listeners monitor sociolinguistic variation?
- its sensitivity: what is the just noticeable difference in frequencies that the SLM can detect?
- its linearity: is the impact of successive instances of the variable constant or does it vary over time?

Our current research has developed preliminary answers to these questions for one linguistic variable, (ING), These results show a precision and a consistency that make it appropriate to report them here.

The (ING) variable is the alternation of the apical /in/ and velar /ing/ variants in unstressed syllables. The regular stylistic and social stratification of Figure 1 is found across most English speech communities (New England: Fischer 1958; Philadelphia: Cofer 1972; Norwich: Trudgill 1974, Northern Ireland: Douglas-Cowie 1978; Misssouri: Mock 1979; Great Britain and U.S.: Houston 1985; Australia: Peterson 1965; Ulster: Kingsmore 1995).

As a sociolinguistic variable, it is a recognized stereotype ("dropping the g"), and it is overtly and accurately associated with informality.

Newscast Experiment 1: Sensitivity to Frequency

The Newscast experiment was designed to test listener's ability to detect and judge the range of frequency of /in/ and /ing/ variants from 0 to 100%. The test passage is a news broadcast (2) containing ten progressive *–ing* suffixes:

(2) The Newscast passage

- President Bush announced tonight that he was *putting* all available White House resources into support for the new tax cut bill.
- Democratic leaders of the House and Senate are *preparing* compromise legislation.
- Republican spokespersons predicted that record numbers of *working*-class Americans would be *receiving* tax refund checks before the end of the year.
- Senator Edward Kennedy's staff announced that the tax cuts are *creating* a new elite who are excused from *paying* their fair share of the cost of government.
- At the Office of Management of the Budget, officials are *trying* to estimate the size of the deficit that will be produced by the new legislation.
- Federal Reserve Board chairman Alan Greenspan stated that he was not *confirming* that tax cuts would lead to a change in prime interest rates, nor was he *denying* it.
- The Washington Post is *publishing* today a list of all members of Congress who will receive tax refunds greater than $1,000 as a result of the proposed tax cuts.

The stimuli were recorded in a sound-proof booth. The speaker was asked to read the passage first with consistent /ing/ forms for each italicized progressive and then with consistent /in/. The speaker performed as many takes as necessary to obtain natural-sounding speech. The stimuli were then constructed by editing the speech signal in Praat. The best productions of the passage were selected, splicing as needed to produce one best version of the passage. An alternative version for each sentence or phrase containing one token of the variable was produced by replacing the token with the best production of its alternative variant. The phrases and sentences were then concatenated in the order needed to produce the desired sequence of variants of ING. Thus the stimulus passages are exactly the same except for the variable of interest, with frequencies of /ing/ ranging from zero to 100%.

Newscast Experiment 1 was administered to a group of 23 U. of Pennsylvania undergraduates, with instruction shown as (3)

(3) A young woman from Philadelphia has been studying to be a newscaster, and has applied for a job with a local radio station. Here are five versions of a trial newscast that she read to submit with her job application. Would you please rate each one on the following scale by putting a check in one box.

Perfectly professional 1 Try some other line of work

/_____ / _____ / ______ / ______ / ______ / ______ / ______ /

Results of the first group experiment are shown in Figure 3, with mean frequencies of /in/ at 0, 30, 50 , 70 and 100%. The horizontal axis is the percent of /in/, from 0 to 100%, and the vertical axis the mean ratings on the scale just shown, with better performance at the bottom and worse performance at the top. This first experiment was designed to test the effect of sequences of the same variant as opposed to alternating and the two 50% passages had blocks of five /ing/ first (50a) or five /in/ first (50b). The small differences between them show a t-test probability of .066.

Logarithmic progression

An inspection of Figure 3 suggests that the distribution by frequency follows a logarithmic progression. Figure 4 superimposes a logarithmic trend line on Figure 3, with the two 50% ratings averaged together. The slope is 1.44, and the fit is quite close, with an r-square of .97, indicating that 97% of the variance from the over-all mean is explained by the logarithmic function, with only 3% noise. For the trial with zero /in/ forms, the rating of 1.7 is close to “Perfectly professional.” With 30% /in/, the mean reating jumps to 4.1. However, this fit is heavily weighted by one value, the 0% mean. Figure 5 shows that if we exclude this point, the other four are a good fit to a linear relation, $r^2 = .89$.

Newscast Experiment 2 was designed to test the logarithmic relation more closely by inserting two more points with the same speaker at the lower end of the /in/ scale: 10% and 20% and using a single 50% trial with alternating /in/ and /ing/. The result for 36 undergraduate Penn subjects is shown in Figure 6. The fit is excellent, with an r^2 of .96 and a similar slope of 1.52.

Gender differences

The 36 subjects included 25 females and 11 males. Figure 7 shows that both sub-groups follow the logarithmic curve closely, with r^2 of .94 and .99. The females have a lower intercept of 1.66, indicating a greater appreciation of the 0% /in/ performance, and a higher slope of 1.62 as opposed to 1.47 for the males. This fits with other indications that women show steeper slopes of style shifting and put greater weight on sociolinguistic variables of this type (Labov 1966, Trudgill 1974).

T-tests show that the differences between any two male and female values are small, and lack significance. But since they are all in the same direction, we can follow R. A. Fischer (1925) to obtain the over-all significance of the gender difference by adding the logs of each p-values. Minus twice this sum chi-square for the over-all relationship, which is 25, with a probability of .0003.

Testing individual subjects: Newscast Experiment 3

In the group experiments, subjects had available a choice of seven ratings, and could not register distinctions smaller than these. Newscast Experiment 3 used individual subjects and a technique of magnitude estimation (Bard et al. 1996) which allows subject to determine their own scale of similarities and differences. The speaker, SA, was the same as in Experiments 1 and 2. Figure 8 shows the format for Trial 1 of Newscast Experiment 4. Subjects initiate each of the newscast trials by clicking on “Play”, and as they listen, move the slider on a continuous scale to the right or left as they hear the person reading the sentences with varying frequencies of /in/ and /ing/. The scale on the right, extending to “Perfectly professional” showed higher values up to 1000. To the left, the slider descended to a value of 0. A later report will deal with the coordination of subject movements with the timing of the (ING) variants: here we will be concerned only with the final slider position, and how the pattern compares to the group experiments with seven discrete choices.

Figure 9 displays the overall results for 56 individual subjects. The match with the logarithm relation is equally close, with r^2 of .94. Four different orders of the stimuli was systematically varied across subjects. The most aberrant point at 50% /in/ may be connected with the fact that this 50% value was heard first in all orders as a point of reference.

In Figure 10, we see that in Experiment 3, both genders replicate the logarithmic curve, with the same high r^2 values. Both show the relatively higher rating for the 50% trial. The gender differences in Experiment 3 (Figure 10) are not quite the same as in Experiment 2. Women again penalize the high frequencies of /in/ more than men do, but in contrast they award a higher rating for the consistent use of /ing/. The series of non-significant differences again add up to a significant one (excluding the first value). The over-all pattern is that of a steeper slope of evaluation for women (-177 vs. -140), which is characteristic of women's behavior with the vowel variables of NYC (Labov 1966, Ch. 8)

Evaluation of (ING) in the South

The design of the current research project on the evaluation of sociolinguistic variation includes several variables with limited regional distribution. The (ING) variable however is quite general in the English-speaking world. To test the generality of the logarithmic relationship exhibited by subjects in Philadelphia, we turned two our two other sites: Columbia, South Carolina and Durham, New Hampshire.

The regional composition of the subject pool for Experiment 2 carried out at Penn is shown in the first two columns of Table 2. The wide geographic range and the large number of students with mixed background is characteristic of this university. At the same time, there are relatively few subjects from New England or the South.

It is well established that the level of /in/ use in the Southern U.S. is higher than in the North (Houston 1985). The apical variant is freely used by educated Southerners even in formal situations. One may therefore ask if the same evaluative norms operate in the South as in the North, and if there are differences, whether the logarithmic relationship will be modified in Southern contexts. Weldon replicated Newscast Experiment 2 with students at the University of South Carolina in Columbia, using the same stimuli and format. The third and fourth columns of Table 2 show the regional distribution of the USC subjects for Experiment . It is immediately apparent that the regional concentration is much greater. Three quarters of the group are from the South, and three quarters of these are from South Carolina.

Figure 11 shows that the USC judges produced a logarithmic relationship with an r^2 of .96, the same correlation as in Philadelphia. The evaluation of the frequency range of (ING) is therefore governed by the same factors that operate among the Penn subjects. There however two differences between the two regions. When we superimpose the ratings of USC subjects on the results for Philadelphia in Figure 12, a significant difference in the slopes of the curves appears. The Columbia subjects exhibit a lower slope than Philadelphia, indicating that a reduction in the evaluation of (ING) variants. The major difference is that greater uses of are downgraded less, indicating that the pressure to use /ing/ in formal settings is much less than in the North. This matches observations of the relatively high use of /in/ in formal contexts by Southern speakers.

The Columbia subjects also differ from the Philadelphia subjects in regard to gender. No differences appear in the reactions of male and female judges in the Columbia experiment.

Experiment 4: Southern evaluations of Northern vs. Southern speakers

Differences in the evaluation of (ING) is only one of many differences between Northern and Southern speech patterns.We now raise the question as to how the evaluation of (ING) interacts with such differences. All of the results presented so far for Experiment 2 are evaluations of the performance of SA, a conservative speaker of the Chicago dialect.[3] To explore further the general mechanism that produces the logarithmic progressions of Experiments 1-3, Experiment 4 embedded the alternation of /in/ and /ing/ in a radically different context, speech embodying the characteristic regional features of the South. For this purpose, Weldon recorded JB, a local white educated speaker raised in the city of Columbia. Like SA, JB was instructed to read the newscast text in his native speech pattern, but consistent /ing/ for the progressive participles in one reading, and consistent /in/ in a second reading. The newscast trials were then prepared by splicing JB's /in/ and /ing/ in the various proportions into [Sherry: characterize the carrier speech pattern as primarily from the /in/ or /ing/ reading].

The most marked dialect features in which JB's speech differed from that of SA are as follows:

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[3] We have no reason to believe that the Chicago articulations of the (ING) variants differs from that produced by speakers in other regions of the U.S.

a. Monophthongization of /ay/ before voiced segments (variable)

b. Moderate activation of the Southern Shift (Labov, Ash and Boberg 2006) in centralized and lowered nucleus of /ey/ and fronted and raised /e/, along with slight inglides for /e/ and /i/.

c. Strongly fronted nucleus of /aw/ and /uw/, with moderate fronting of /ow/ as compared to back of center nuclei for all /Vw/ vowels for SA.

d. Fronted /ʌ/ as opposed to back forms for SA.

e. The characteristic voice qualifier of the southern Piedmont area.

Weldon carried out the Experiment 4 with a group of 55 USC undergraduates judges, who evaluated the seven Newscast trials with varying frequency of (ING) spoken by JB. Figure 13 displays a remarkable coincidence of the results of Experiment 3S and 4S. The figure superimposes the evaluations of the (ING) trials performed by JB and those performed by the Northern speaker SA. Both results once again show a closefit to the logarithmic progressions with r^2s of .96 and .98. Both show the characteristic shallow slopes first observed in Experiment 3S, with observe coefficients not far from 1. Thus Columbia judges differed from the Philadelphia judges in their evaluation of (ING) in a manner independent of the constant dialect characteristics in the seven trials. It is therefore evident that the experiments succeeded in isolating the effects on the sociolinguistic monitor of the variable (ING). The underlying pattern of response to shifting levels of (ING) is independent of the speaker and their other sociolinguistic characteristics.

Evaluation of (ING) by University of New Hampshire subjects

The third regional site for the current research is the University of New Hampshire at Durham. Nagy carried out Experiment 2 at the University of New Hampshire, tp pbtaom UNH students' evaluation of variable frequencies of the use of /in/ by SA, the same speaker as in Experiments 1 and 2 in Philadelphia. The results shown in Figure 14 were a marked deviation from previous experiments. It is immediately obvious that the responses did not follow the logarithmic progression found in other areas. The mean ratings of 70% and 100% /in/ are much lower than would be expected—that is closer to the "Pefectly professional" rating than in Philadelphia or Columbia.

Before concluding that New Hampshire subjects were exceptional in this respect, Naomi replicated Experiment 2 under the exact same conditions with two other groups of students. The combined results shown in Figure 15 returned us to the expected logarithmic progression, with an r^2 of .92. At the same time, we recognize that the New Hampshire subjects exhibit a shallower slope of differentiation (1.07), similar to that found at Columbia (1.17, 1.04). Unlike Columbia, the UNH students replicated the characteristic difference between males and females in Figure 16, with females showing a steeper slope of social marking of /in/, 1.14 for women as against .73 for males.

All three replications of Experiment 2 in New Hampshire indicate that the New Englanders, like Southerners, are more moderate than the Philadelphia in their use of the 7-point scale to penalize speakers for their use of /in/ in the broadcast trials. The slopes of the logarithmic progression are in the neighborhood of 1.0, and do not approach the 1.5 region characteristic of the Philadelphia speakers.

Understanding the logarithmic progression.

The logarithmic progresion found in Figures 4, 6, 7, 9, 10, 11, 12, 13, 15, 16 cannot be derived from any of the data on speech production. These uniform results must depend upon some fundamental property of speech perception, perhaps specific to the sociolinguistic monitor, perhaps based on more general properties of perception. The question arises, why a logarithmic progression? One direction of explanation is suggested by the fact tha the logarithm is the integral of 1/x as in (3), suggesting that the function 1/x plays a role in generating this relationship.

(4)

$$\ln(x) = \int_1^n \frac{dx}{x}$$

In all of the results shown so far, the first occurrence of /in/ in a series has the greatest effect upon the evaluation of the speaker's performance, and each successive occurrence has a proportionately lower effect. If we acknowledge that /in/ is a deviation from expected performance in the newscast trials, we can say that the negative rating increases for each deviation by the proportionate increase in the sum of deviations. Given one deviation, the second represents a 100% increase in the sum, the third a 50% increase, the 11^{th} a 10% increase. In other words, a given deviation increases the effect by 1 over the current sum of deviations.

If we are asked to predict the effect of any one occurrence of an apical variant in the Newscast experiment, we begin with the hypothesis that the effect of the ith deviation on the perception of the distance from the norm is a function of the proportional increase in the total number of deviations, so that Delta-E, the change in the over-all effect, equals b/(i-1).

(4)

$$\Delta E = \frac{b}{i-1}$$

The inverse function is multiplied by b, a factor that is equivalent to the slope of the logarithmic or linear curve. As we have seen, this can vary from region to region without any change in the lawful relationship found generally.

If the impact coefficient is 1, the 4th deviation adds 1/3 to the total effect, the 5th deviation 1/4, and so on. If we ask, how can we predict the rating given to any one trial in the (ING) experiment, we sum these calculations in the manner shown in (5), beginning with another coefficient a. This is the rating given to a trial with no deviations—the best effort.

(5)

$$E = a + \frac{b}{1} + \frac{b}{2} + \frac{b}{3} \ldots = a + b * \left(1 + \frac{1}{2} + \frac{1}{3} \ldots\right)$$

or

(6) $$E = a + b * S$$

We abbreviate the proportional increase series as S = ½ + 1/3 + ¼. . .. What then is the relationship between the logarithmic function and the series S? It turns out that the logarithm progression is a close approximation to the sum of that series. S does not converge, but increases to infinity. The sum for a given number of terms is approximated by ln(n) + γ. where g = .5772156649. . . (Euler's constant). Figure 17 shows how the logarithmic function modified by Euler's constant merges with the cumulative sum E. The E series fits the logarithmic function with an r^2 of .9975. The logarithmic calculation of course fits itself perfectly There is a gap at the beginning but at 20 terms, there is no discernible difference. Table 3 generates the results of Experiment 2 in Philadelphia by the E function with the initial constant *a* set at 2.00 (that is, the second box on the seven-point scale) and the impact coefficient *b* set at 1.25. Chi-square of the difference between these two series is very small, indicating no significant difference between them.

Figure 18 plots the calculations of Table 3. The two curves are indistinguishable.. The logarithmic fits obtained in the reports of the experiments are practically identical with the proportional series calculations of the E function.

Findings on the Sociolinguistic Monitor

The results of the experiments reported here can be summed up under four characterizations of the sociolinguistic monitor, or SLM:

- Within the limited range of our experiments, the temporal window of the SLM is reasonably wide: it operates continuously across the time frame of the experiment.
- Our subjects show a striking consistency in their evaluation of sociolinguistic variables, clearly sensitive to differences in frequency as small as 10%.
- Response of the SLM to sociolinguistic variants is not symmetrical: it is sensitive primarily to the number of marked forms rather than the number of unmarked forms.

- The response of the SLM is not linear, but proportional to the increase in the number of marked forms observed.

We have also examined the sensitivity of the monitor to internal constraints on the variable, which we will present in reports to come. In our continuing research, we are expanding the range of variables at the three sites, examining responses to variation in postvocalic /r/ and the monophthongization of /ay/, and responses of subjects of varying ethnicity, age and education. Experiments with individual subjects will allow us to specify the nature and timing of their response to individual deviations over time. The preliminary results presented here should provide a framework for the further study of the perception of linguistic variation and the operation of the sociolinguistic monitor.

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Figure 1. Social and stylistic stratification of (ING) in NYC (Labov 1966).

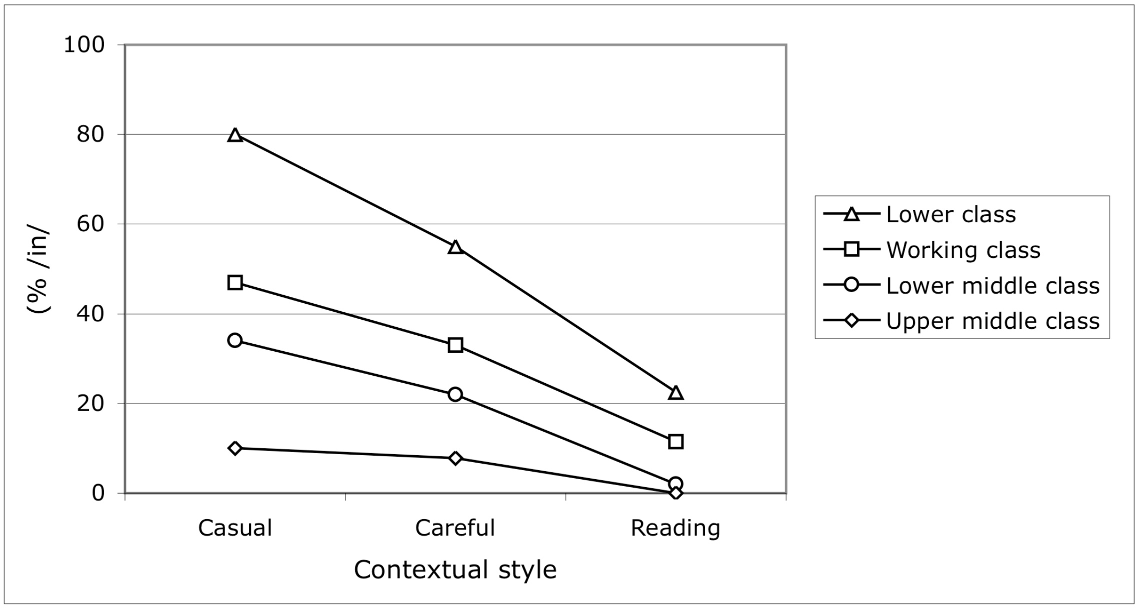

Figure 2. Expected values for (ING) in NYC produced by equation (1) with data supplied by Table 1.

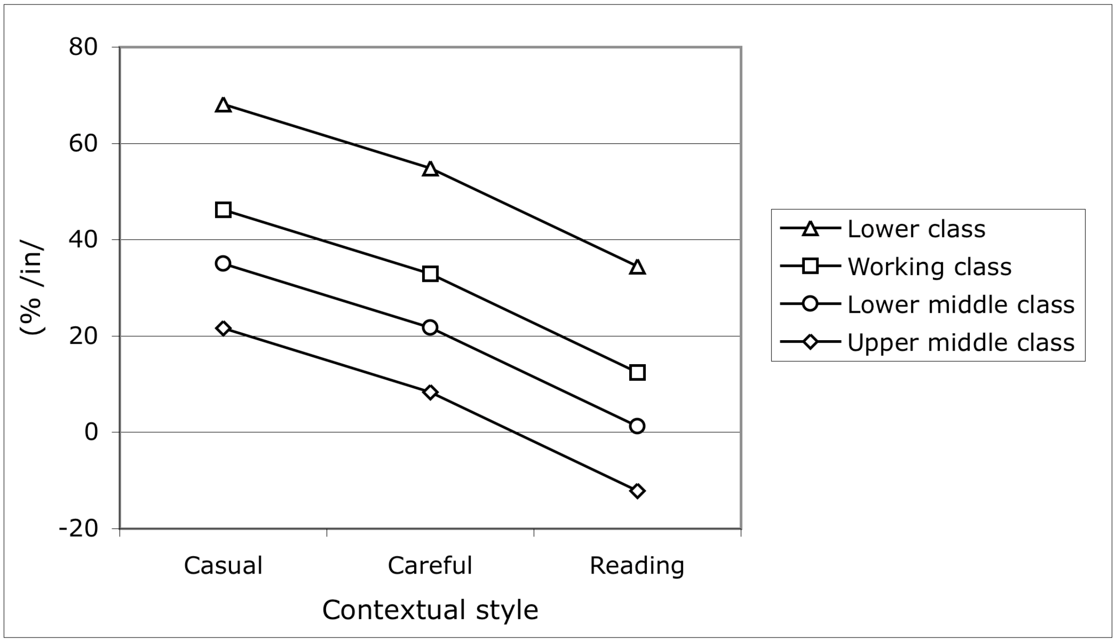

Figure 3. Mean ratings for Experiment 1. Site: Philadelphia. Speaker: SA. N=23.

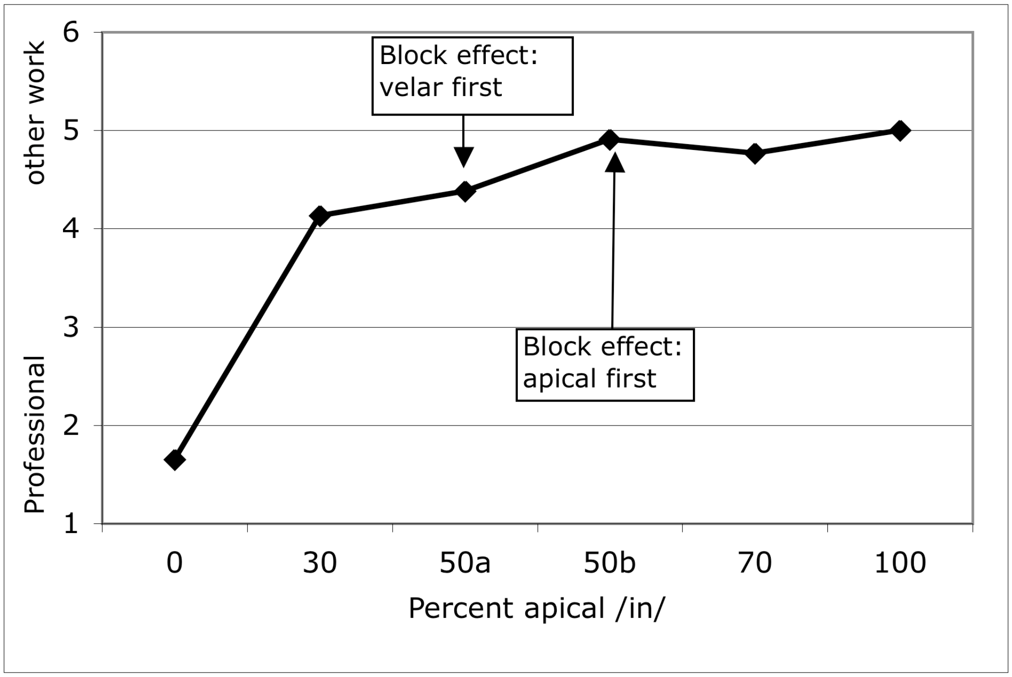

Figure 4. Fit to logarithmic progression of data of Figure 3.

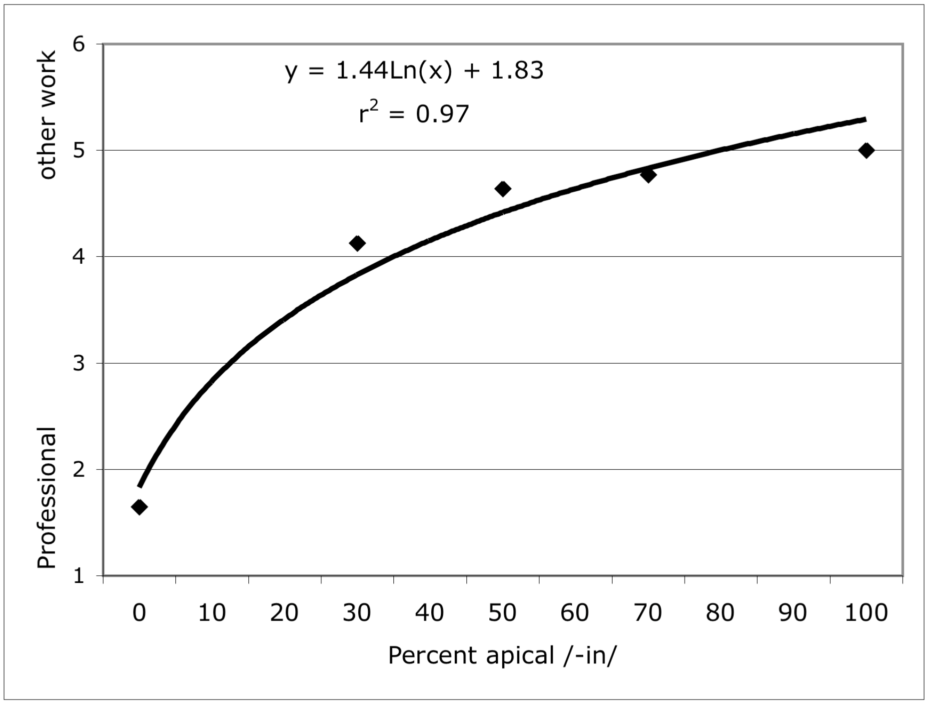

Figure 5. Approximation of Figure 4 to a linear relation with the zero point excluded.

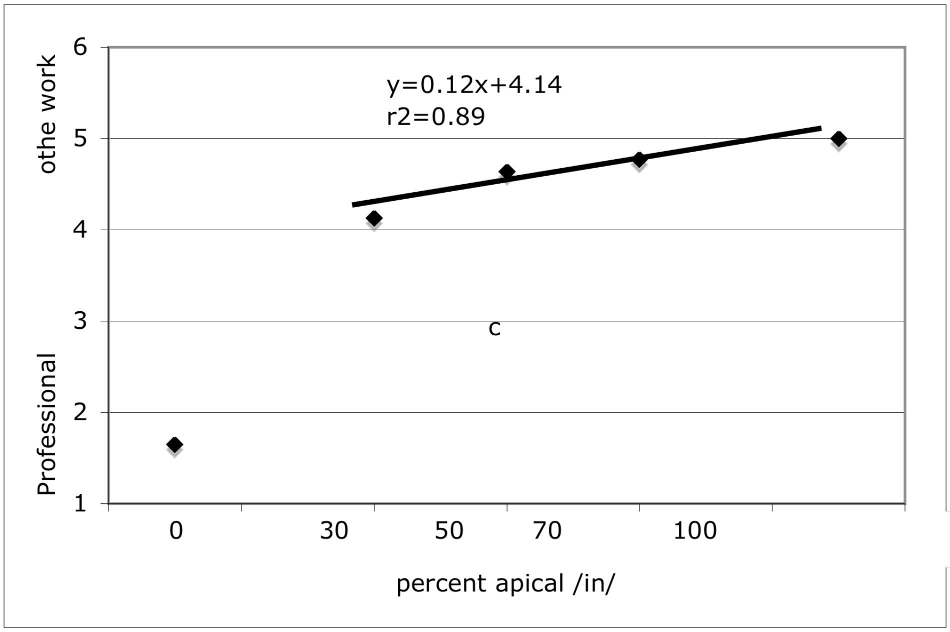

Figure 6. Mean ratings of Newcast Experiment 2 with logarithmic progression. Site: Philadelphia. N = 36.

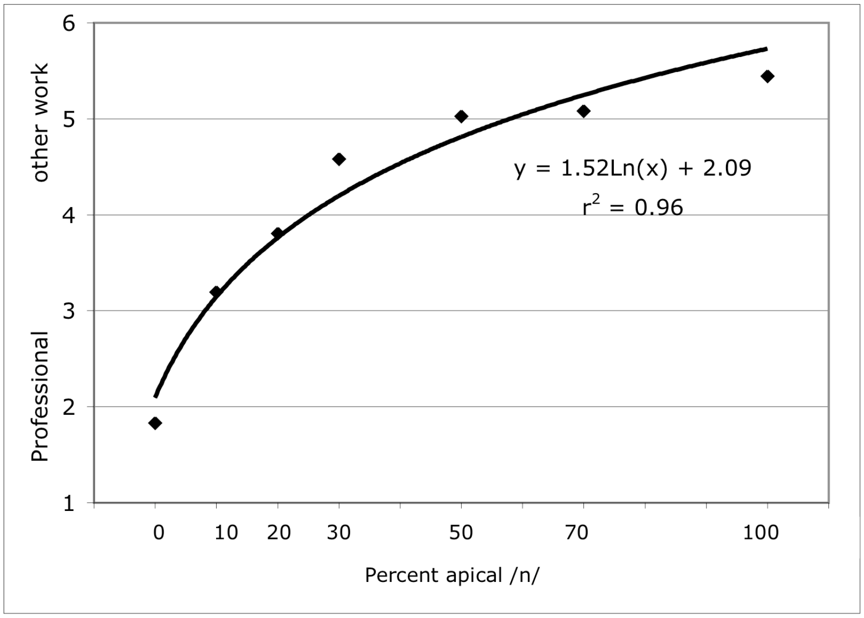

Figure 7. Gender differences in Newscast Experiment 2.

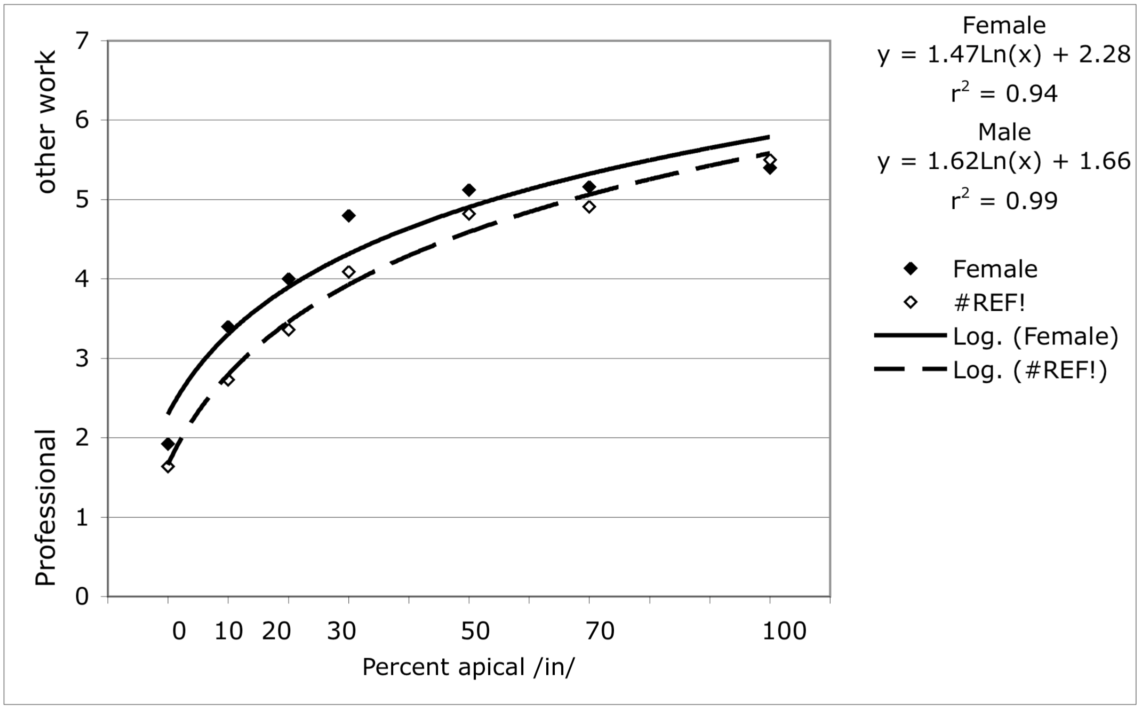

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Figure 8. Design of individual Newscast Experiment 3 (Trial 1).

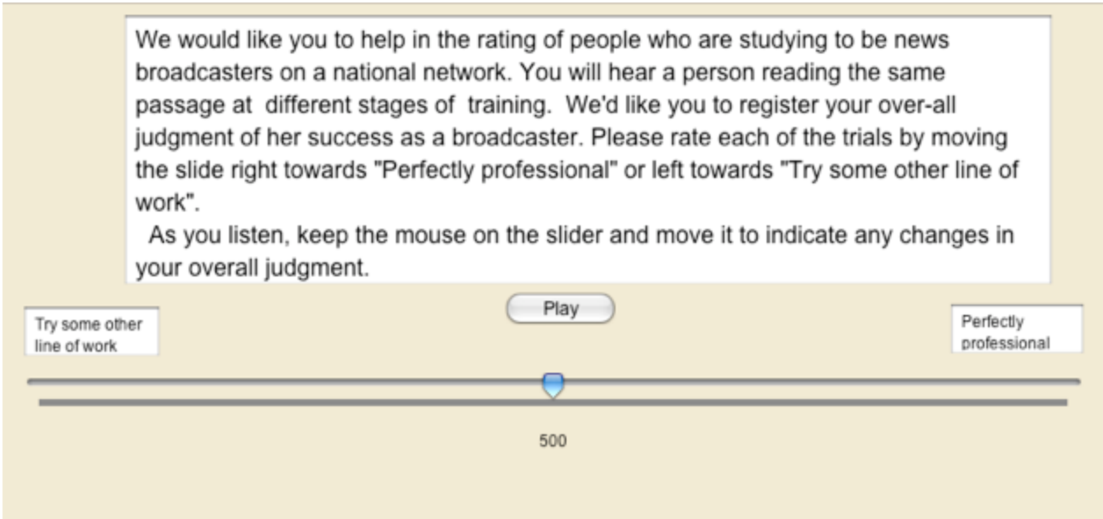

Figure 9. Mean ratings of individual subjects for Newscast Experiment 3

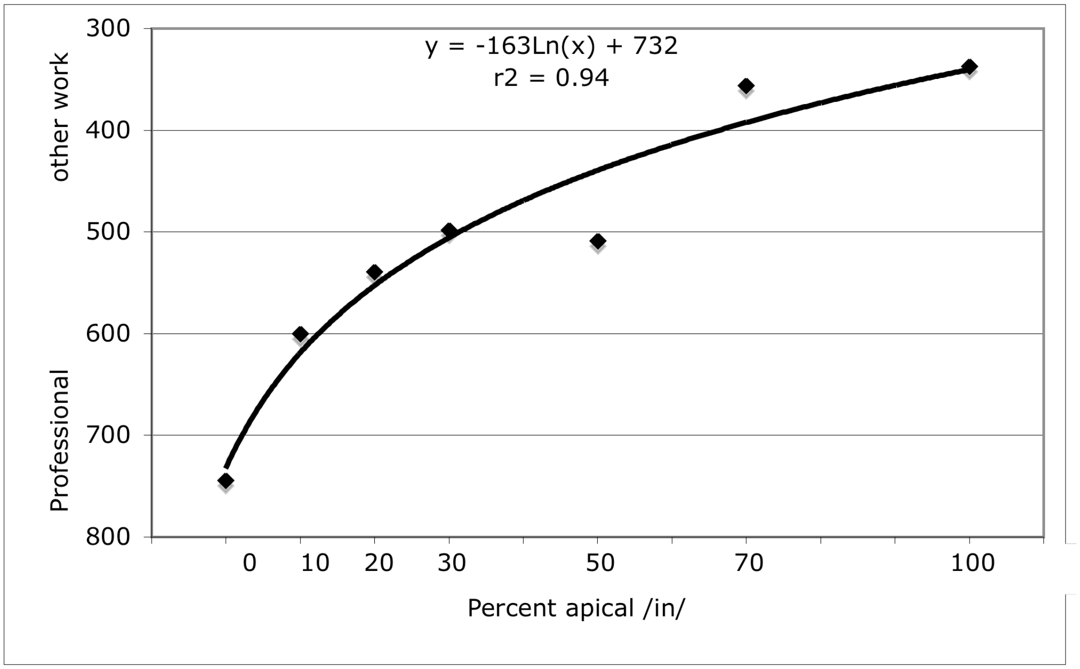

Figure 10. Mean ratings of individual subjects in Newscast Experiment 3 by gender.

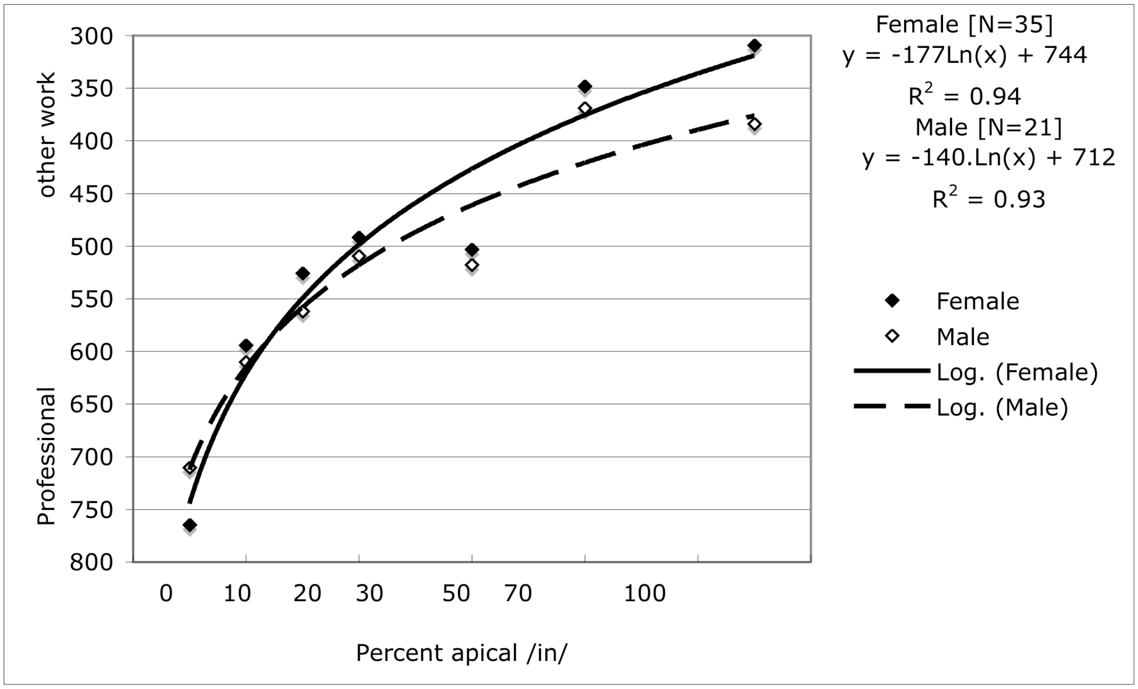

Figure 11. Mean ratings for Newscast Experiment 2S at USC [N=56]

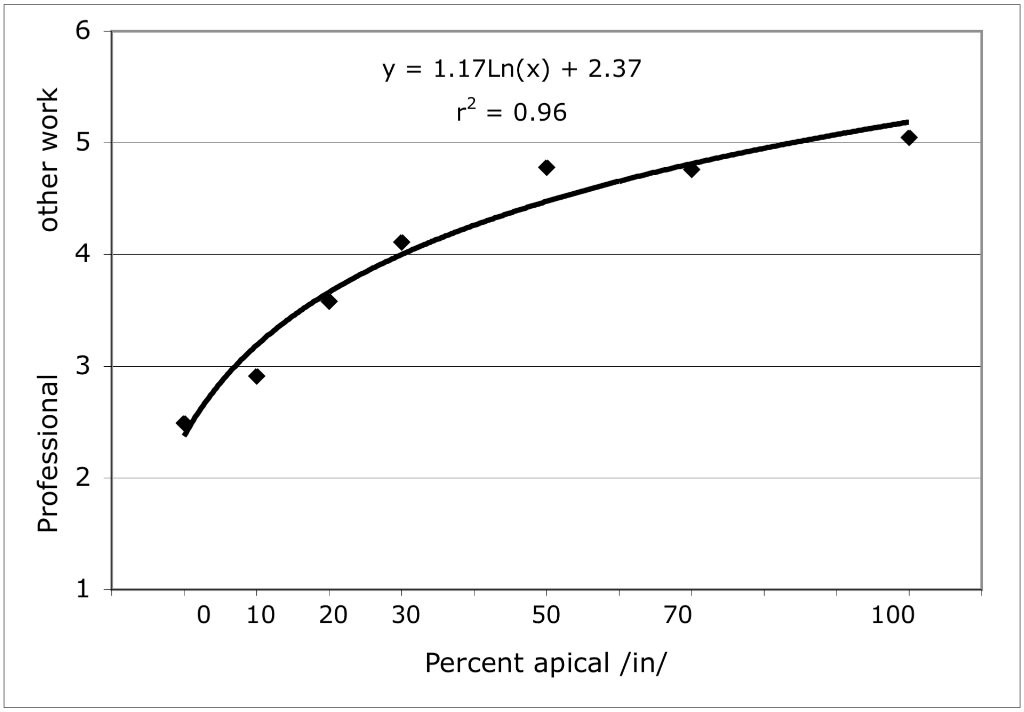

Figure 12. Comparison of Experiment 2 (Philadelphia) with Experiment 2S (Columbia)

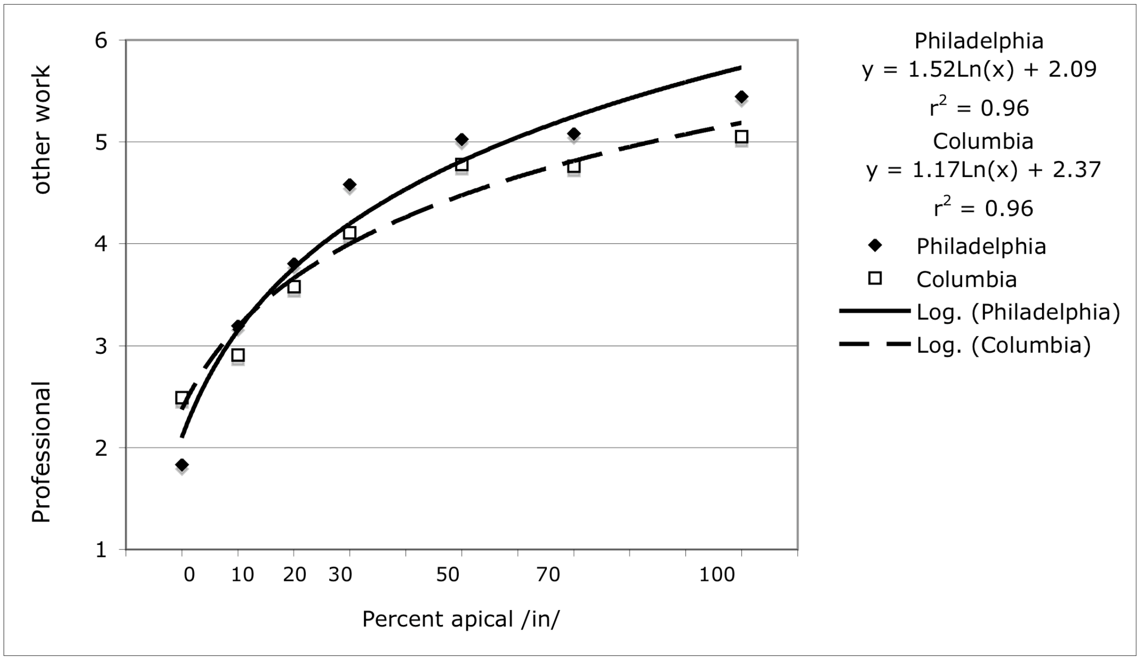

Figure 13. Mean Columbia ratings of Columbia speaker JB in Experiment 4S compared to mean Columbia ratings of Northern speaker SA in Experiment 3s

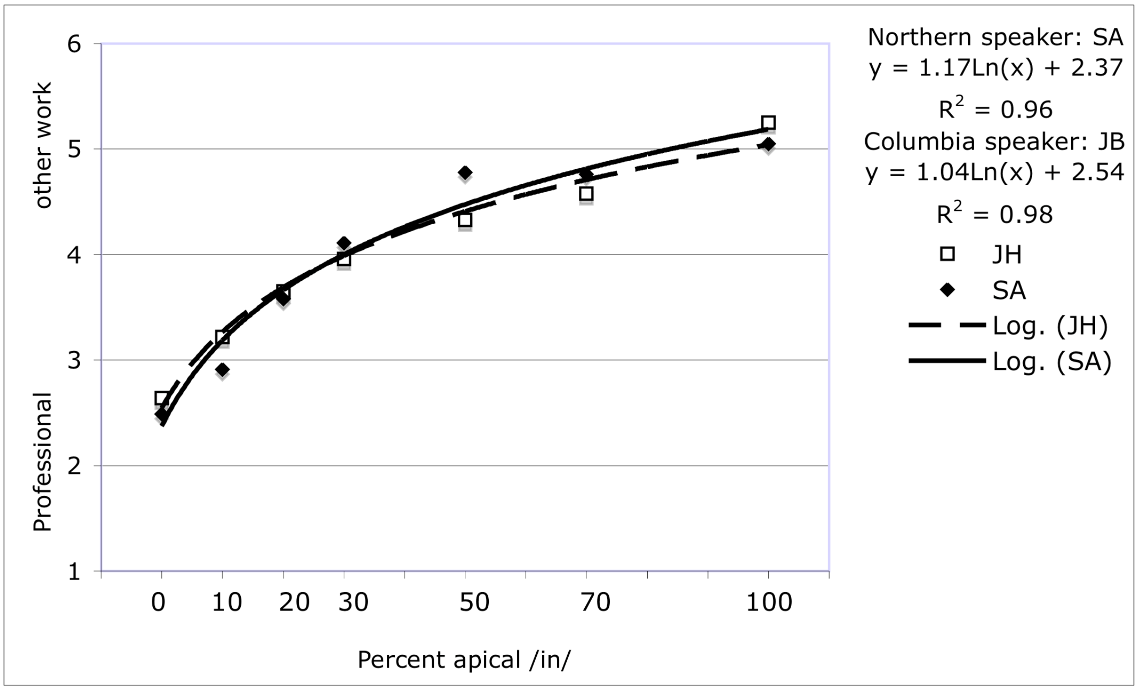

Figure 14. Mean ratings of University of New Hampshire students in Experiment 2N.

Speaker: SA. N = 51. Feb 17, 2005.

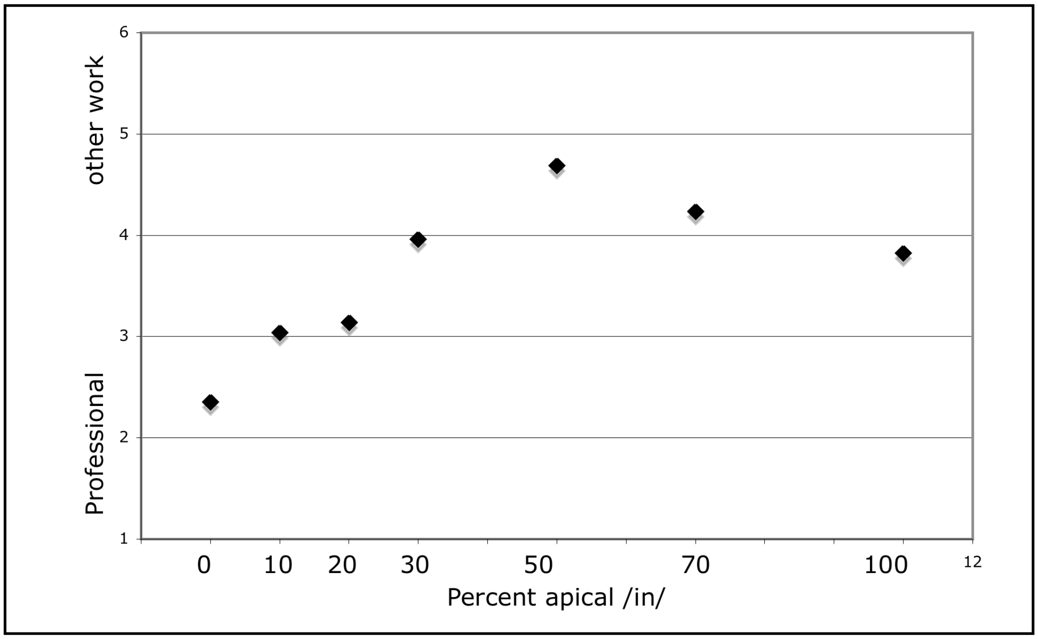

Figure 15. Replication of Experiment 2N at University of New Hampshire. Speaker: SA. N=33. Oct 13, 2005.

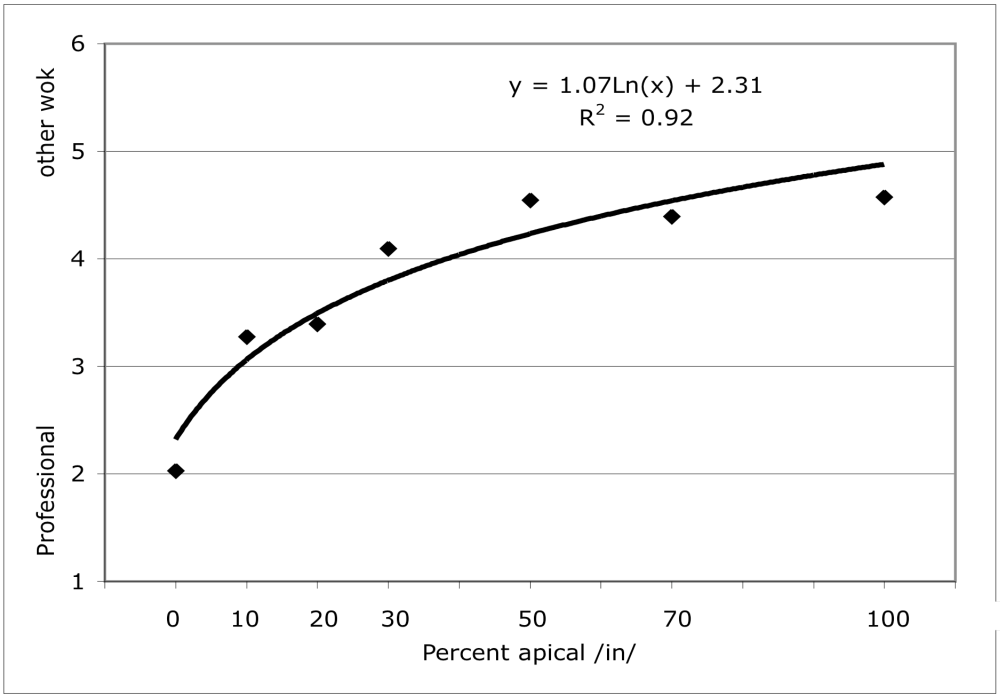

Figure 16. Mean ratings of replicated Experiment 2N at University of New Hampshire by gender.

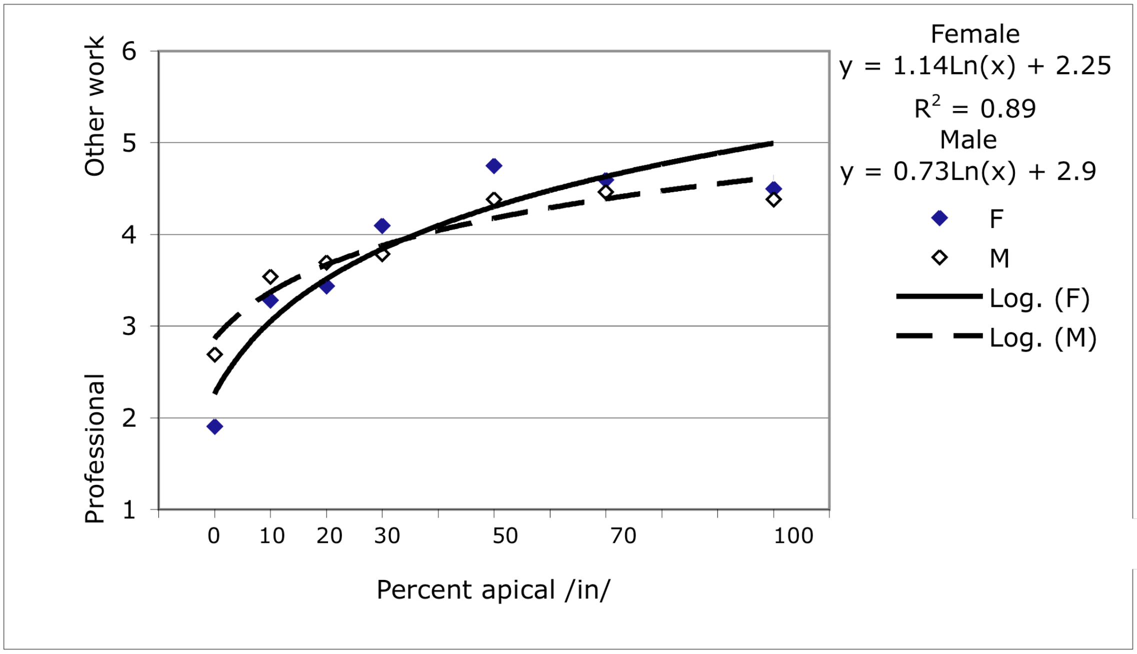

Figure 17. Comparison of logarithmic function modified by Euler's constant g with the proportional error function E. g= .5772156649..

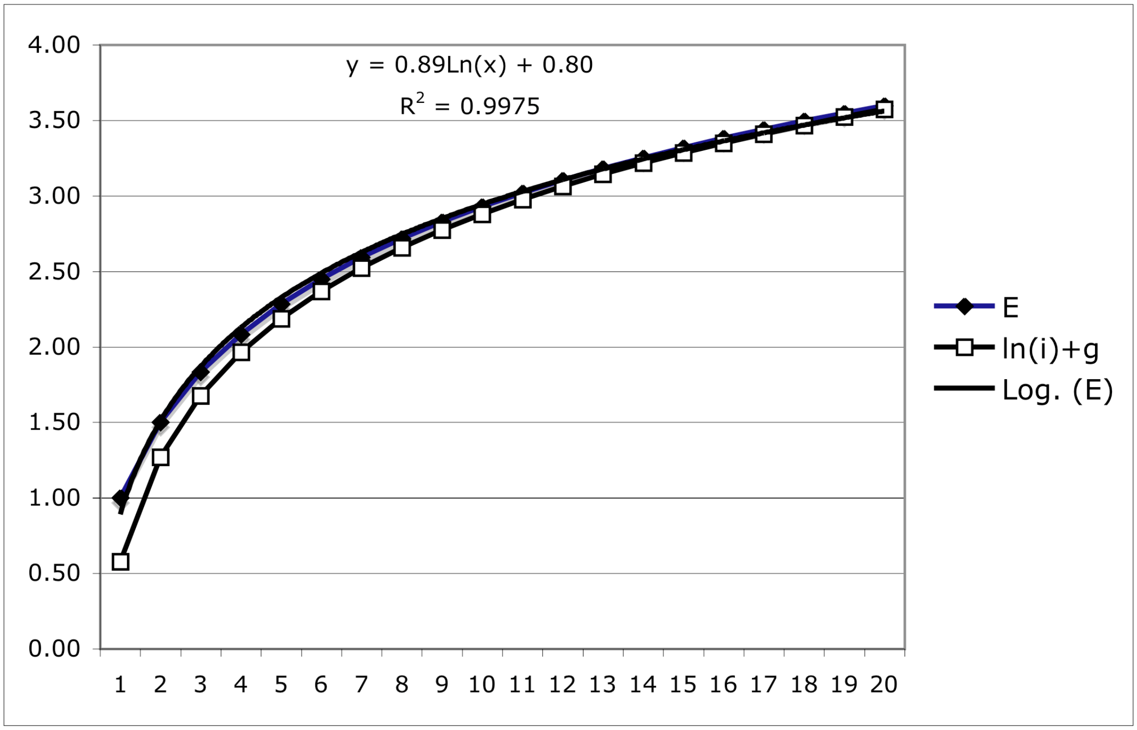

Figure 18. Comparison of the E function with a = 2.00 and b= 1.25 with the results of Experiment 2.

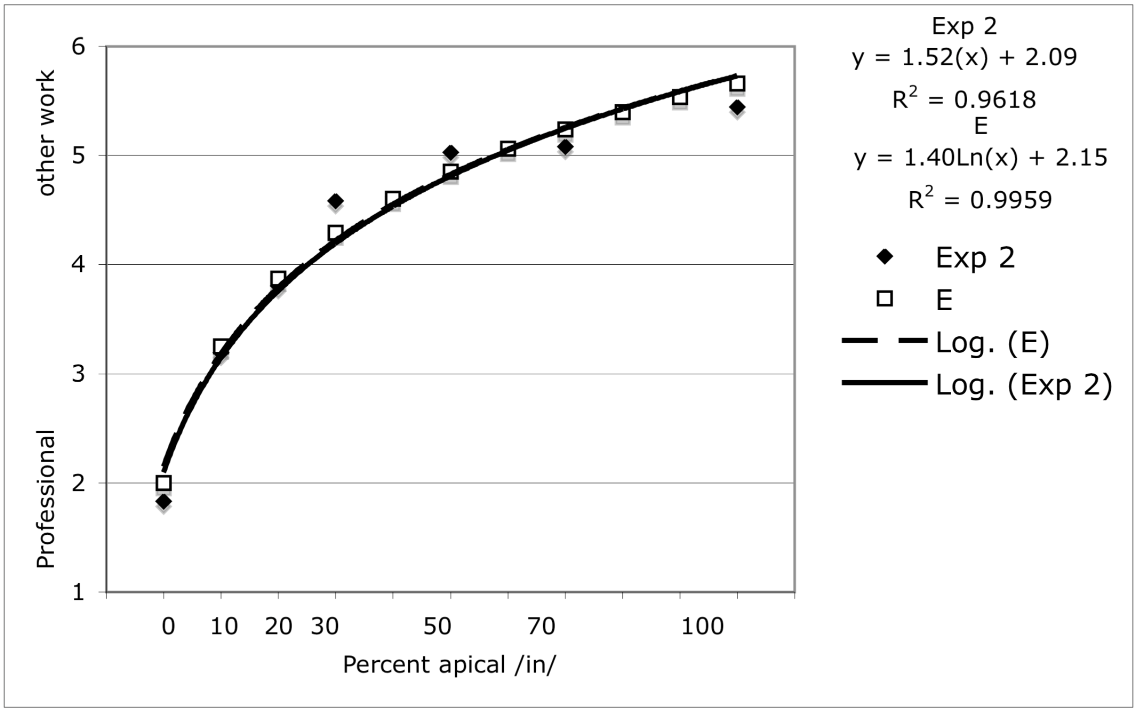

Table 1. Multiple regression analysis of data of Figure 1.

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	34	6.8	5.01	0.0024
Upper Middle Class	-47	7.9	-5.86	0.0011
Lower Middle Class	-33	7.9	-4.18	0.0058
Working Class	-22	7.9	-2.77	0.0324
Casual speech	33	6.9	4.91	0.0027
Careful speech	20	6.9	2.97	0.0249

Table 2. Regional distribution of subjects for Experiment 2

	U. of Penn		USC		UNH	
Mid-Atlantic		14		2		0
Philadelphia and suburbs	8					
NYC and suburbs	4					
Other Mid-Atlantic	2					
New England		1				43
New Hampshire					25	
Massachusetts					9	
Oher New England					9	
North		2				3
Midland		1		1		
South		6		41		
Columbia			8			
Charleston			2			
Other South Carolina		3	24			
Other South			7			
West		3		2		
Canada		1				1
Mixed		8		9		4
Total		39		55		51

Table 3. Generation of the results of Experiment by the E function with initial contant = 2 and impact coefficient = 2.00

percent /in/	E	Experiment 2
00	2.00	1.83
10	3.25	3.19
20	3.88	3.81
30	4.29	4.58
40	4.60	
50	4.85	5.03
60	5.06	
70	5.24	5.08
80	5.40	
90	5.54	
100	5.66	5.44

Chi-sq = .056, n.s.