

AN EXPERIMENT IN JUDGING INTELLIGENCE BY THE VOICE¹

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The hypothesis that intelligence can be measured by observing the inflection of the voice was suggested by a number of widely different observations. For example, it was observed that in teaching classes in public speaking it was possible to change or improve breathing habits, voice quality, and the control of force, but extremely difficult to change inflection habits. Again, persons have been observed who possessed very limited vocabularies, but who were able to express very complex meanings by the inflection of the few words they used. For example, the exclamation "Oh," may be so inflected as to mean "You will, will you," or "Well, I never thought of that." This use of inflection in conveying ideas explains why it is sometimes possible to get the essential meaning of conversation in a foreign tongue even without being able to understand any of the words that are spoken. In fact, it is entirely possible that, in the evolution of language in the race, differences in pitch variation were used to convey ideas before differences in quality or resonance or vocabulary were evolved. If so, then inflection must be considered as more a part of the original or native behavior of the individual than vocabulary. The idea behind the intelligence test used in this experiment is, therefore, to go back to this fundamental form of behavior rather than to work with the more completely acquired behavior involved in tests which depend upon vocabulary.

A final consideration which seems to justify measuring intelligence by the voice is that behavioristic psychology has so thoroughly identified thought and the more intelligent types of behavior with the language mechanisms. Yet the usual type of intelligence test has measured these language responses through reading and writing, which

¹ The investigation reported in this article is the result of the cooperation between a specialist in public speaking and one in education. The specialist in public speaking is responsible for the origination of the problem and for the actual judging of the subjects, while the specialist in education is responsible for the methodology and experimental technique, and for the formulation and evaluation of the results.

are wholly acquired forms of behavior, instead of through spoken language, which is much more nearly native, or pure inflection, which is even more native and fundamental than spoken vocabulary.

Let us define the term *inflection* as change in pitch within a syllable, word, phrase, sentence, or paragraph in harmony with the idea which the given speech unit is intended to convey. The hypothesis which this experiment was designed to test was that the intelligent person would do two things: (1) Vary the inflection of his voice over a wide range, and (2) control his inflection so that the rises and falls would correspond to the true meaning of the passage spoken; whereas the unintelligent person would speak in a monotone or raise or lower his voice at the wrong time and without due regard to the sense of the passage.

Five types of persons have been observed in connection with public speaking work as regards their inflection. The first is the monotone, who seems to have no appreciation of tone change as related to meaning. The second has more appreciation of the value of tone changes on the lesser speech units, but lacks the power to discriminate; and his patterns tend to involve too regular and too recurrent rhythms. The third type has considerable sense of the necessity of tone change, but tends to overdo it by making the intervals greater than required. The fourth type has the sense of the need of tone changes possessed by the third and, in addition, has a sense of economy. He does not overdo tone changes and his inflections are more subtle. He falls down, however, on the larger speech units and in the suggestion of sustained moods. His shortcoming will not show when he is reading material which involves purely denotative language, but will show in the case, of connotative language, such as poetry. The fifth and highest type has all of the virtues and none of the faults of the other types. He modulates accurately and appropriately on the lesser speech units, and is also able to compose the more complex tonal patterns necessary to the suggestion of the sustained mood or complex idea.

To summarize, the inflectional patterns of different persons comprise two variables: (1) Sensitivity to the need of tone change, and (2) economy, or freedom from random movement in making the changes. The five types outlined above represent the principal combinations met with, and have been made the basis of the ratings reported in this study. The boundaries between the types are not clearly and sharply defined, but represent real distinctions nevertheless.

In rating the students as to inflection for the purpose of determining correlations between inflection and intelligence, it was thought desir-

able to rate a number of other qualities of speech at the same time, in order to utilize the findings as by-products of the main investigation. Each of eight voice factors was, therefore, rated on a five-point scale in the same way as was inflection. The nine qualities rated were as follows: (1) *Inflection*, as described above. (2) *Normal quality*, or the degree to which the person had equalized or balanced resonance in the production of a normal tone. (3) *Pitch accuracy*, or the ability to reflect the purely denotative meaning of the lesser speech units in pitch changes. (4) *Key sense*, or the ability to adjust pitch changes to the larger units of speech so as to maintain a sustained suggestion of mood (both *pitch accuracy* and *key sense* are included in the term *inflection*). (5) *Force sense*, or the ability to control breathing and the expulsion of breath effectively. (6) *Enunciation*, or the clearness and distinctness with which the vowels and consonants are produced. (7) *Rate and phrasing*, or the ability to represent meaning by proper speech punctuation. (8) *Accompanying physical activity*, or the degree to which the total bodily activities are coordinated with the purely vocal activities, or, in other words, the degree to which random movement is eliminated. (9) *Use of language*, or the ability to recognize and pronounce words.

Ratings of the above list of voice qualities were made by having students read orally three selections in the presence of the judge, who was a public speaking teacher. The passages read were *Hamlet's Advice to the Players*, a selection from R. L. Stevenson's *Apology for Idlers*, and one from R. G. Ingersoll's oration at his brother's tomb. The three passages combined included about 500 words. These passages were chosen because they call for variety in inflection and are difficult to read. They give ample opportunity to display one's vocal capacities. The only directions given were to go to the front of the room and read the passages as well as possible, and without stopping to ask the pronunciation of words or any other questions.

Fifty-six students were rated. They were selected from the classes taught by the writers of this report, with only two restrictions. These were that only second-year students were chosen whose records for intelligence tests were on file. The previous scholastic standings and intelligence scores of the students chosen were unknown to the judge at the time the ratings were made. Of the 56 students rated, 27 were boys and 29 girls. The judge was acquainted with 30 out of the 56 while 26 were complete strangers to him. The intelligence test scores which were available were from the *Thurstone Test*, pub-

lished by the National Research Council, and used for the year 1924-25. The score used was the Median Percentile Rank, the only general average available for the test as a whole.

TABLE I.—INTERCORRELATIONS OF THE NINE VOICE FACTORS FOR 56 STUDENTS AND FOR 26 UNKNOWN STUDENTS (THE CORRELATIONS FOR THE UNKNOWN STUDENTS ARE IN ITALICS)

	Inflection	Normal quality	Pitch accuracy	Key sense	Force sense	Enunciation	Rate and phrasing	Accompanying physical activity	Use of language
Inflection.....	...	.34	.67	.14	.57	.36	.40	.27	.52
	.22	<i>.86</i>	<i>.36</i>	<i>.68</i>	<i>.43</i>	<i>.30</i>	<i>.28</i>	<i>.47</i>	
Normal quality.....	.34	.....	.33	.28	.21	.49	.30	.41	.48
	.22	<i>.30</i>	<i>.34</i>	<i>-.09</i>	<i>.32</i>	<i>.19</i>	<i>.05</i>	<i>.36</i>	
Pitch accuracy.....	.67	.33	.....	.33	.36	.44	.41	.34	.60
	<i>.86</i>	<i>.30</i>	<i>.11</i>	<i>.47</i>	<i>.36</i>	<i>.34</i>	<i>.33</i>	<i>.62</i>	
Key sense.....	.14	.28	.33	.....	.25	.16	.21	.50	.17
	<i>.36</i>	<i>.34</i>	<i>.11</i>	<i>.21</i>	<i>.13</i>	<i>.13</i>	<i>.34</i>	<i>.30</i>	
Force sense.....	.57	.21	.36	.25	.....	.26	.28	.36	.30
	<i>.68</i>	<i>-.09</i>	<i>.47</i>	<i>.31</i>	<i>.31</i>	<i>.26</i>	<i>.36</i>	<i>.41</i>	
Enunciation.....	.36	.49	.44	.16	.26	.....	.31	.29	.58
	<i>.43</i>	<i>.32</i>	<i>.36</i>	<i>.13</i>	<i>.31</i>	<i>.02</i>	<i>.01</i>	<i>.33</i>	
Rate and phrasing.....	.40	.30	.41	.21	.28	.31	.....	.50	.36
	<i>.30</i>	<i>.19</i>	<i>.34</i>	<i>.13</i>	<i>.26</i>	<i>.02</i>	<i>.43</i>	<i>.23</i>	
Accompanying physical activity.	.27	.41	.34	.50	.36	.29	.50	.....	.47
	<i>.23</i>	<i>.06</i>	<i>.33</i>	<i>.34</i>	<i>.36</i>	<i>.01</i>	<i>.43</i>	<i>.33</i>	
Use of language.....	.52	.48	.60	.17	.30	.58	.36	.47	.....
	<i>.47</i>	<i>.35</i>	<i>.52</i>	<i>.30</i>	<i>.41</i>	<i>.32</i>	<i>.23</i>	<i>.32</i>	

The results of the ratings may be presented under three divisions, as follows: (1) Intercorrelations between the nine voice factors. (2) Correlations of the nine voice factors with scholarship and intelligence.

Multiple correlations in which certain factors are combined and

correlated with certain other factors. These will be discussed in turn. Since the results might be expected to differ somewhat in the case of students who were known to the judge, as contrasted with students who were complete strangers, separate calculations have been made for the unknown students alone. This obviates the possibility that positive correlations found to exist are due to judging on the basis of previous knowledge about the subjects instead of by inflection and vocal factors alone.

TABLE II.—CORRELATIONS OF THE NINE VOICE FACTORS WITH SCHOLARSHIP AND INTELLIGENCE (CORRELATIONS FOR INTELLIGENCE IN ITALICS)

Nine voice factors	56 stu- dents	27 boys	29 girls	30 known stu- dents	26 un- known stu- dents	17 known boys	13 known girls	10 un- known boys	16 un- known girls
Inflection.....	.47 <i>.34</i>	.57 <i>.51</i>	.38 <i>.17</i>	.40 <i>.21</i>	.57 <i>.53</i>	.60 <i>.51</i>	-.10 <i>-.22</i>	.46 <i>.58</i>	.66 <i>.50</i>
Normal quality.....	.21 <i>.02</i>	.35 <i>.33</i>	.00 <i>-.16</i>	.15 <i>-.08</i>	.38 <i>.13</i>	.24 <i>.14</i>	-.25 <i>-.28</i>	.47 <i>.62</i>	.21 <i>.67</i>
Pitch accuracy.....	.34 <i>.01</i>	.44 <i>.27</i>	.18 <i>-.26</i>	.28 <i>-.17</i>	.52 <i>.23</i>	.38 <i>.13</i>	-.04 <i>-.58</i>	.51 <i>.50</i>	.44 <i>.21</i>
Key sense.....	.24 <i>-.09</i>	.31 <i>.06</i>	.34 <i>-.18</i>	.20 <i>-.30</i>	.37 <i>.10</i>	.26 <i>-.12</i>	-.15 <i>-.46</i>	.47 <i>.05</i>	.36 <i>-.01</i>
Force sense.....	.33 <i>.15</i>	.45 <i>.36</i>	.15 <i>.47</i>	.30 <i>.17</i>	.40 <i>.43</i>	.45 <i>-.01</i>	-.22 <i>-.34</i>	.42 <i>.63</i>	.40 <i>.32</i>
Enunciation.....	.08 <i>.15</i>	.17 <i>.29</i>	.19 <i>.08</i>	-.02 <i>.02</i>	.11 <i>.34</i>	.16 <i>.19</i>	-.47 <i>-.09</i>	.22 <i>.70</i>	.04 <i>.27</i>
Rate and phrasing.....	.27 <i>-.02</i>	.45 <i>.20</i>	.02 <i>-.20</i>	.30 <i>-.06</i>	.23 <i>-.02</i>	.50 <i>.10</i>	-.03 <i>-.18</i>	.31 <i>.40</i>	.20 <i>-.24</i>
Accompanying physical activity	.25 <i>-.08</i>	.29 <i>.13</i>	.06 <i>-.22</i>	.22 <i>.25</i>	.17 <i>.05</i>	.30 <i>-.06</i>	-.26 <i>-.42</i>	.26 <i>.36</i>	.34 <i>-.04</i>
Use of language.....	.34 <i>.23</i>	.59 <i>.57</i>	.09 <i>.08</i>	.25 <i>.03</i>	.46 <i>.45</i>	.44 <i>.41</i>	-.18 <i>-.29</i>	.39 <i>.69</i>	.41 <i>.37</i>

Table I presents the intercorrelations between the nine voice factors for the whole group and also for the students who were unknown to the judge at the time of the ratings. Two things are to be noted especially. First, the factors are positively correlated, there being only one negative coefficient in the table and it unimportant. Second,

the factors which correlate most highly with *inflection* are *pitch accuracy, force sense, and use of language*. If the reader will keep this in mind he will note later on that these are the factors which have the highest correlation with scholarship.

Table II gives the correlations of the nine voice factors with scholarship and intelligence respectively. Examination of the correlations with scholarship shows uniformly positive correlations except for the 13 known girls, in whose case the coefficients are uniformly negative. This peculiarity is due in part to the difficulty of judging familiar voices, but since it did not occur in the case of known boys we must seek for some other additional cause. The best we can do is to say that it is due to chance or to special causes unknown—probably the former, since the number of cases is so very small.

The correlations with intelligence are distinctly lower than with scholarship, and in many cases negative. This is due to the fact that, with the exception of *inflection*, the voice factors are largely acquisitions of the same general nature as scholarship, and are more like it than like intelligence. The situation shown in the table may be summarized by saying that *inflection* consistently yields positive correlations of substantial size with both scholarship and intelligence for all boys and for unknown girls, but that the other voice factors fail to correlate with either scholarship or intelligence very highly.

Let us now turn to the results of the use of multiple correlations in the study. We have found three variables with substantial inter-correlations; namely, *scholarship, intelligence, and inflection*. Our problem is, then, to predict one of these from a combination of the other two, or *vice versa*. By means of multiple correlation we can determine what correlation would result if we were to combine the scores in two variables in the optimum manner and correlate the combined score with the third variable. Results of such computations are shown in Table III both for the entire group and for the unknowns. The result is that in only two of the six multiple correlations is there any appreciable increase because of the combinations. One of these is when scholarship is combined with intelligence and correlated with *inflection* in the case of unknown students, causing a rise from .57 to .64. The other is when intelligence and *inflection* are combined and correlated with scholarship for the whole group, causing a rise from .51 to .60. Neither of these increases is great enough to be statistically reliable, and it appears, therefore, that there is not much advantage in making the combinations.

TABLE III.—SIMPLE AND MULTIPLE CORRELATIONS INVOLVING THE THREE VARIABLES, INFLECTION, SCHOLARSHIP, AND INTELLIGENCE (COEFFICIENTS FOR UNKNOWNNS IN ITALICS)

	Inflection	Scholarship	Intelligence
Inflection alone.....	...	<i>.47</i>	<i>.34</i>
	...	<i>.57</i>	<i>.53</i>
Scholarship alone.....	<i>.47</i>	...	<i>.51</i>
	<i>.57</i>	...	<i>.44</i>
Intelligence alone.....	<i>.34</i>	<i>.51</i>	
	<i>.53</i>	<i>.44</i>	
Intelligence and scholarship combined....	<i>.49</i>		
	<i>.64</i>		
Intelligence and inflection combined.....	...	<i>.60</i>	
	...	<i>.58</i>	
Scholarship and inflection combined.....	...	...	<i>.53</i>
	...	...	<i>.50</i>

Finally, we shall note the results of multiple correlations in which the several voice factors were combined with inflection and correlated with scholarship, in order to see whether the addition of any of these factors would increase the correlation. The results are emphatically negative. For the eight factors, in the order listed in the tables, the results, in the case of all 56 students, were .47, .49, .50, .47, .47, .48, .49, and .48 respectively, while inflection alone gave .47. For the 26 unknown students, inflection alone gave .57, and when the other factors were each combined with inflection the coefficients were .61, .57, .60, .57, .59, .57, and .60 respectively. In other words, there was no significant increase as a result of the combinations. Direct inspection of the simple correlation coefficients reveals that the same thing would result in the case of predicting intelligence from inflection. The scores for inflection alone are therefore as good for predicting scholarship or intelligence as combinations of scores for inflection and the other voice factors.

SUMMARY AND CONCLUSIONS

It has been found that inflection, or the pattern of pitch changes in the voice, is a reasonably good measure of ability.

The correlations between inflection and scholarship are approximately the same as those between intelligence tests and scholarship.

Inflection correlates with scholarship slightly better than it does with intelligence tests.

The correlation of inflection with intelligence and with scholarship is higher in the case of unknown students than in the case of students known to the judge. The difference is due in part to the difficulty of judging inflection in familiar voices.

The various voice factors are positively correlated one with the other, and also positively correlated with scholarship; but inflection is the only one of the voice factors which has any important correlation with intelligence.

The three factors, scholarship, intelligence, and inflection, are about equally intercorrelated, and any one of the three is about as safe a basis for predicting another as any two combined.

There is little or no advantage to be gained by combining measures or other voice factors with inflection, since correlations with intelligence or scholarship are not raised appreciably as a result.