ative magnitude differences between the potentials that are compared are not significant because, as the plots indicate, the biasing causes the same relative change in the magnitude of the response to a pure tone, no matter what its absolute size might be.

Another demonstration of contrasting behavior of difference tones at low and high primary intensities under polarization is shown in Fig. 2. Here two pairs of curves are seen for one of the primaries and for the difference tone, at moderate and at high intensities. The relative change in microphonic component is plotted as the function of the magnitude and polarity of the biasing direct current. The functions for the primary at both sound intensities and also for the difference tone at high levels are like those reported (*7, 11*). There is a roughly proportional increase in microphonic with current strength when the scala vestibuli is positive, and similar proportional decrease when the scala vestibuli is negative. In contrast is the curve for the difference tone at the moderate sound level (67 db). The behavior is exactly reversed, positive polarity creates a decrease whereas negative polarity creates an increase in this nonlinear component.

These results indicate that cochlear distortion is at least a two-stage process with signal intensity playing the critical role. At low levels the distortion is primarily a hair-cell phenomenon, and, as we demonstrated (*4*), it is most prominent at the location of the maximum primary microphonic potential. At high intensities a mechanical type of nonlinearity becomes predominant, and the distortion which is generated by this nonlinearity is manifested by components which are probably distributed within the cochlea by traveling waves.

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10. A similar lack of exact repeatability was noted by T. Konishi and T. Yasuno [*J. Acoust. Soc. Amer.* **35**, 1448 (1963)] in their investigation on the effect of polarization upon the summating potential. This similarity is not surprising, because the summating potential is presumably the d-c distortion component in the microphonic potential. The repeatability of results on the effects of polarization on pure tones is excellent; it is the distortion components, irrespective of frequency, that show labile responses.
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Speech: Relation of Nonfluency to Information Value

Abstract. *In spontaneous speech and oral reading of stutterers, likelihood of nonfluency occurring on any word is not related to the amount of information carried by that word. The same is true for spontaneous speech of normal speakers. Previous contrary findings can be accounted for by the relationship between information value and word length.*

It has been suggested that stuttering is essentially similar to nonfluency in normal speech, and that a key factor underlying both is the information value of the word (*1*). Thus, the greater the amount of information transmitted by a word, the greater is said to be the probability that it will be uttered nonfluently. Information value is defined in terms of the probability of correctly guessing a word from those words preceding it: the more judges who correctly guess it, the less information it carries. Since most of the research reviewed has been performed on the oral reading of stutterers, I set out to confirm the nonfluency–information relationship in the spontaneous speech of stutterers, and also in the reading and the spontaneous speech of normal speakers (*2*). Since simple pauses are not counted as nonfluencies in the present work, it cannot be compared directly with Goldman-Eisler's work (*3*) demonstrating a relationship between hesitancy and information within normal speech. The importance of word length as a linguistic variable [see, for example, (*4*)] is taken into account, and also the relationship (*5*) of nonfluency incidence to sentence position and to initial sound of the word.

To examine the reading of stutterers, Quarrington's data (*6*) on 24 subjects reading a 95-word passage were analyzed. Stuttering had been defined by clinical judgments of two experienced listeners. Stuttering and information were significantly correlated (.32); but when the effect of word length was held constant, the partial correlation became nonsignificant (.16). Stuttering and word length were also correlated significantly (.43); with information held constant, the partial correlation remained significant (.36).

Next, the spontaneous speech of eight stutterers was recorded and transcribed. Subjects were asked to talk for 5 minutes about a job which they had held in the past. Nonfluencies were designated (here and in the following studies) according to the criteria of Johnson *et al.* (*7*). Thus, a word was marked as nonfluent if it was associated with one of the following categories: interjections, part-word repetitions, word repetitions, phrase repetitions, and prolonged sounds. A single judge was employed, and adequate reliability was demonstrated through independent judging of five of the passages after 1 month. The four variables, word length (short, medium, long), initial sound (vowel, consonant), fluency (fluent, nonfluent), and sentence position (initial, medial, final), allow 36 cells or categories of words; four words were selected per cell from the transcripts. Information value of each of these 144 words was determined by having 195 undergraduates attempt to guess them from the preceding context; the negatives of the logarithms of the number of correct guesses per word were used as the measure of the information transmitted by each word. Two three-way analyses of variance were performed, each with information as the dependent variable. In the first, the factors were nonfluency, sentence position, and word length; in the second, nonfluency, initial sound, and word length. In each analysis, the only significant relationship was between information and word length (respectively: $F = 19.59$, d.f. $= 2/126$, $P < .001$; $F = 19.93$, d.f. $= 2/132$, $P < .001$).

In order to investigate directly the relationship between word length and nonfluency, another sample of 144 words was selected from the original transcripts, stratified according to initial sound, nonfluency, and sentence position. A three-way analysis of variance showed that word length, as the dependent variable, was significantly related to initial sound and to nonfluency (respectively: $F = 34.11$, d.f. $= 1/132$, $P < .001$; $F = 9.75$, d.f. $= 1/132$, $P < .01$). There were no significant interactions in any of the above analyses.

To examine the reading of normal speakers, tape recordings were made of 207 male undergraduates reading Quarrington's 95-word passage, for which word information values were already available. The number of nonfluencies for each word were categorized into 0 to 1, 2 to 4, and 5 or more, and these three groups were matched on word length by discarding words from two of them. Information value was dichotomized at the median for the words utilized. Chi-square analysis showed that nonfluency and information were positively related ($\chi^2 = 9.95$, d.f. $= 2$, $P < .01$). A t-test comparing fluent and nonfluent words showed that long words were uttered nonfluently significantly more often than short words ($t = 2.68$, d.f. $= 93$, $P < .01$).

The spontaneous speech of 35 normal speakers was then recorded and transcribed, the topic this time being the Vietnam war. From the first 300 words of the transcriptions, 45 fluent and 45 nonfluent words were selected, matched for exact sentence position. Information values of these 90 words were determined as above from the guesses of 165 undergraduates. A two-way analysis of variance showed that information, as the dependent variable, was related neither to nonfluency nor to sentence position ($P > .10$ in each case). A t-test between the 45 fluent and the 45 nonfluent words showed that word length was unrelated to nonfluency ($t < 1$). Another t-test between long and short words (dichotomized as close as possible to the median length of the 90 words) showed a positive relationship between word length and information value ($t = 3.37$, d.f. $= 88$, $P < .01$). I should point out that word length was not included in the main analysis of this particular study because the study was conducted before the importance of word length was realized. However, the meaning of the results does not appear to be affected by this omission.

Existence of a nonfluency versus word length (but not a nonfluency versus information) relationship in both the reading and spontaneous speech of stutterers suggests the rather unsurprising formulation that the likelihood of a stutterer stuttering on any given word depends not on how much information it conveys but on how much speech production is required to say the word. The fact that long words are shown to carry more information than short words is also unsurprising, but is another matter entirely. This formulation also applies in part to the reading of normal speakers. However, no such relationship applies to normal spontaneous speech: the most to be demonstrated here is that, like the other situations, longer words carry more information than shorter words. The results also suggest that we should question theories of stuttering which postulate that nonfluencies in stuttering are determined by the same factors as in normal speech.

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Stereoscopic and Resolution Acuity with Various Fields of View

Abstract. *Progressively restricting the field of view—without, however, obstructing the binocular visibility of the targets—does not affect resolution acuity, but stereoacuity is increasingly degraded.*

Although there are many similarities in the behavior of resolution and stereoscopic acuity as a function of physical conditions, recent studies of visual processes under water have revealed a significant difference. In clear water, resolution acuity is at least as good as it is in air (*1*), but stereoacuity suffers a marked deterioration (*2*).

What causes this difference? The most notable characteristic of underwater viewing is, perhaps, that the field of view is generally hazy and relatively undefined, with few clearly visible objects. It begins to approach a "ganzfeld," the psychological term for an unstructured, homogeneous field of view. The distorting effects of the ganzfeld have been pointed out for many visual functions (*3*), but not, apparently, for any form of acuity, no doubt because the presence of a distinct target is, strictly speaking, incompatible with the idea of a ganzfeld.

Acuity, of course, is best in the fovea and deteriorates very rapidly as the target is imaged farther and farther in the periphery. For well-illuminated tar-

Table 1. Resolution acuity in minutes of visual angle with fields of view of different extent.

Observer	Field of view			
	Unrestricted	45°	7.5°	3.8°
SL	0.588 ± .08	0.528 ± .06	0.660 ± .04	0.528 ± .10
JW	.576 ± .05	.408 ± .09	.624 ± .15	.564 ± .02
FD	.624 ± .02	.576 ± .05	.588 ± .04	.624 ± .03
CL	1.026 ± .04	.840 ± .06	.858 ± .06	.726 ± .02
JL	0.774 ± .06	.828 ± .10	.708 ± .07	.858 ± .03
HM	.858 ± .12	.840 ± .06	.840 ± .07	.840 ± .03
AR	.942 ± .09	.960 ± .11	.540 ± .15	.972 ± .07
RE	.726 ± .09	.708 ± .02	.660 ± .04	.756 ± .07
Mean	.764 ± .07	.711 ± .07	.685 ± .08	.734 ± .05