

Stability of auditory perception of words and pure tones under repetitive stimulation in neutral and suggestibility conditions

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Changes in pitch are perceived by a high proportion of Ss exposed to repetitive pure-tone stimulation. Phantom frequency shifts resemble verbal alternation experienced under repetitive word stimulation (Warren-Gregory effect). Form of instructions and sex of S influence the onset and extent of auditory instability. Frequency of stimulus and subjective set are added to factors basic to the instability of stabilized auditory images.

While seeking an auditory analog of the perceptual failure which occurs under spatial stabilization of retinal patterns, Evans and co-workers at the British National Physical Laboratory (Evans, Longden, Newman & Pay, 1967; Evans, 1967) rediscovered the "verbal alternation" effect first reported by Warren & Gregory (1958). This effect consists in the perceptual distortion of a word presented repetitively to the S at a frequency in excess of one a second. The perceived word may be a fragmentation of the presented word, or a transformation to a different (though often similar) word. Examples of these phenomena are given by Evans et al (1967) and categorized by Warren & Gregory (1958).

In attempting to reveal the factors contributing to instability of the auditory image, Evans & Kitson (1967) varied the "familiarity" and "meaning" of presented words. Following Noble (1953), "familiarity" was defined by the number of occurrences of a selected word in the language, and "meaning" by the associative value of the word. The results showed a tendency toward perceptual change as a function of word familiarity.

The present study was undertaken for the purposes of: (a) comparing the magnitude of the Warren-Gregory effect when instructions to the S suggest the likelihood of the occurrence of verbal alternation (Suggestibility Group) with the magnitude of the effect under neutral instructions (Neutral Group); (b) investigating the relationship between auditory instability under repetitive verbal and pure-tone stimulation; (c) relating auditory perceptual instability to personality factors of extraversion and neuroticism.

METHOD

Pure tones of 1000 cps, duration 0.4 sec, were generated by an audio-frequency oscillator, with 0.4-sec intervals between tones, at a level of 75 dB. Tones were delivered binaurally through 10 ohm impedance stereo-type headphones. The word "kettle" (one of the Evans stimuli) was similarly presented from tape at the rate of 80 per min in the presence of a 65 dB, 500 cps masking tone, which was used to screen out any interstimulus interference from the environment.

Forty-seven adults, 21 male and 26 female, age range 17-46 years (Mdn = 24.8 years) acted as Ss. All Ss were shown to have normal hearing on a standard audiometric test before being accepted for the experiment. Ss were randomly allocated to experimental groups (Suggestibility or Neutral) and to testing sequence (word-first or tone-first). Both word and tone sequences occupied 180 sec, with a break between sequences.

PROCEDURE

After passing the audiometric test, Ss completed the Eysenck Personality Inventory (Eysenck & Eysenck, 1964). The experiment was carried out in a quiet psychophysiological

laboratory. The important part of the instructions was as follows: Suggestibility group Ss were told, "Many people notice that the sound varies in quality," while Neutral group Ss were informed, "This is not to say that a variation will occur."

The Ss' responses were recorded by an event marker. On completion of each part of the experiment, a careful inquiry was conducted on the nature of the signalled changes. The criteria of change adopted were the subjective report of (a) fragmentation or transformation of the word and (b) frequency (pitch) alterations of the tone. Reported changes, such as alterations of duration, interval, or amplitude of the stimulus, failed to meet the criterion. Hereinafter, "change" means criterion type of change. While changes were scorable on subjective report, the experience of such changes could not be identified with confidence from the objective record of the event marker. The following measures are therefore non-specific, referring to any form of experienced change: Time in seconds to onset of first signalled change (T_o); duration of disturbed time in the experimental sequence (ΣT_D); number of changes signalled (N_c).

RESULTS

The number of Ss reporting stimulus change is shown in Fig. 1. Chi-square tests of these frequencies show no significant difference between experimental groups. Order effects (word or tone presented first) similarly produced no difference in report of change.

Analyses of variance revealed significant effects on two of the objective measures, ΣT_D for tone, and T_o for word. Mean duration of disturbance (ΣT_D) on pure-tone stimulation was 47.9 sec and 24.8 sec for the Suggestibility and Neutral groups, respectively. The difference between these means is significant ($F = 5.02$, $df = 1/39$, $p < .05$). For time of onset of word change (T_o), two of the main effects, experimental treatment and sex, are significant ($F = 6.64$, and $F = 7.21$, respectively, $df = 1/35$, $p < .05$). Mean T_o (word) was 17.3 sec for the Suggestibility group and 35.7 for the Neutral group, and 35.7 sec and 20.7 sec for males and females, respectively.

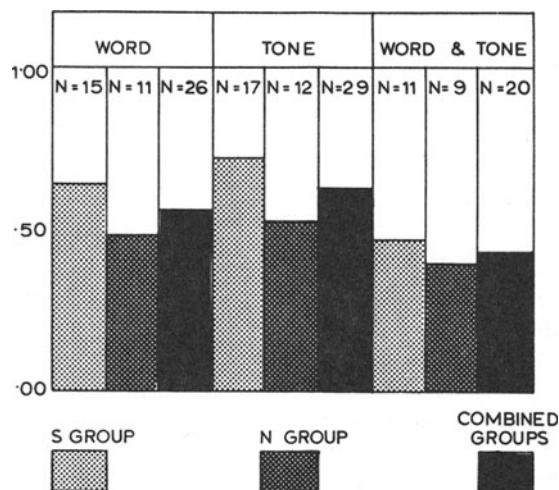


Fig. 1. Number and per cent of Ss reporting criterion change in word, tone, and both word and tone.

The relationship between auditory instability for word and tone was tested by computing tetrachoric correlations for frequencies of reported change. Only the correlation for the Neutral group ($r_t = +0.78$) approaches significance.

Biserial coefficients were calculated to check on the relationship between reported change in word and tone, and the personality variables of extraversion and neuroticism. The coefficients, though positive, fell short of significance.

DISCUSSION

The results show that the Warren-Gregory effect can be induced in a high proportion of Ss, using stimuli of moderate intensity (confirming Warren, 1961), in relatively short experimental sequences. The Ss experienced a variety of word fragmentations, and transformations. The following "phantom" words were reported: careful, cattle, cattaw, cackle, chattle, gettle, kartel, keckle, kethling, krettle, tettle. These may be added to the list of Evans et al (1967). Increased variety of response in the presence of masking noise was reported by Warren & Gregory (1958). The use of the masking tone may have had the same effect in the present study, though no explanation can be offered at the present stage for such facilitation, if indeed it occurs.

It is evident that the nature of instructions given to Ss may affect the findings. The present study has shown that nonspecific responses, such as time of onset (T_o) and duration of disturbance (ΣT_d), are influenced by the degree of suggestion given to the S. In the Suggestibility group, on the second trial, 10 Ss changed category of response (from experience of instability to nonexperience, or vice versa) compared with five Ss in the Neutral group. An explanation of the effect of instructions in motivational terms seems plausible. A differential sex response has been shown on the ΣT_d measure. On the other hand, order of presentation was shown not to affect outcome in the present study.

The personality measures, selected for their possible value in additional studies of auditory instability, seem to have no predictive value, singly, for change in either tone or word.

Experimentation to date has shown: (a) the importance of rate of presentation of word stimuli (Warren, 1961); (b) the facilitative effect of masking noise (Warren & Gregory, 1958, and present study); (c) the influence of word familiarity

(Evans & Kitson, 1967); (d) the influence of instructional and sex variables (present study). Phantom frequency change was selected as the criterion in the pure-tone experiments on the basis of preliminary trials. Results confirm that frequency shift is one of the physical parameters of auditory instability. In a current study, by the senior author, auditory instability is being investigated in relation to nervous system reactivity. The Ss in this study are given a difference-limen reference for frequency change before the experimental sequence begins.

With regard to technique, in earlier studies, the S has been required to tap with a pencil to indicate experience of change (Warren, 1961), or to make a written report during the ongoing sequence (Evans & Kitson, 1967). A less interfering method of indicating change was used in the present study in conjunction with postexperimental inquiry. Under conditions where the S is instructed precisely on the type of change to signal, this method should be satisfactory, and is recommended for use in future studies.

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NOTE

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