SYNCHRONY OF VISUAL PERCEPTION INDUCED BY VOICE VIBRATION

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Abstract: Under special conditions, the voice can be used to drive the visual preceptual system in synchrony with the voice's fundamental frequency. The phenomenon has been demonstrated on a number of moving objects and has been calibrated at frequencies ranging from 60 to 324 Hz. Implications for fatigue in machine operators, altered mental states, and a commercial application are discussed.

The yogis of India intone syllables which evoke distinct sensations, feelings, and images. These syllables are called 'mantras' and are used in their ritual chants[1]. The yogis ascribe unique properties to these mantras such as endowing the chanter with 'cosmic consciousness', awakening of the 'subtle body', and the acquisition of conscious control over autonomic processes[2]. Although much of yogic practice is empirical, the literature often appears to be obscure, or at best metaphorical to the Western mind, especially when it begins describing subjective phenomenology[3]. The present study arose out of an attempt to obtain direct experience of this subjective phenomenology, and describes an optical cadencing or gating effect which was experienced while phonating 'aum', 'zhzhzhzh', or 'mmmmmmmm'.

According to various yogic texts it is important to meditate on the mantra so as to heighten one's perception of the body vibrations which accompany it[4]. The procedure followed intitially in this study was that prescribed by Ma Yoga-shakti Saraswati, called *Ahamasmi-Yoga*[5]. By experimentation, a shortcut procedure or opening exercise was found for achieving the same effect and the associated visual phenomenon. This will be described in the procedures section of this paper.

The neurophysiological literature on epilepsy contains references to induction of seizures by sound6 and by flickered light[7]. These references give nothing on cadencing of the visual system. The literature on visual inhibition during voluntary eye movements (saccades) contains more information. Volkmann, *et al.* suggest that this inhibition is probably mediated in the thalamus, specifically in the lateral geniculate bodies[8]. Ditchburn triggered a slightly supraliminal strobe light with subtle eye movements of which the subject is usually unaware (microsaccades), and the subjects were unable to perceive the

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light because of the associated elevation of visual thresholds[8]. Thus, the saccadic inhibitor, or visual damping mechanism, tends to shut down all visual perceptions at once. It appears that it is this mechanism for synchronous shut-down which is made reactive to vocal cadencing by the opening exercise. The phenomenon does not seem to be related to translational or rotational displacements of the eyeball because direction of translation or rotation of the target does not alter the perceptual phenomenon. It is also unlikely that it is being mediated by positional or vibratory (proprioceptive) cues fed back to the brain from the eye muscles[10], or from the retinas (cf. procedures), but it may be due to direct action upon the central nervous system in the manner suggested by Volkmann for saccadic inhibition.

Equipment: A Trav-ler Radio Corporation Model TS-382D/U Audio Oscillator provided the acoustic calibration. A General Electric RP 2345 stereo phonograph was fitted with an Allied Radio Shack 4-speed Phono Strobe Disc for the visual frequency calibration. The strobe disc thus provided a photo-mechanical calibration for the optical gating effect. Matching the vocal pitch which froze the markings on a particular band of the strobe disc with the output of the TS-382D/U, the.voice's fundamental frequency could be calibrated. The RP 2345 was operated at 16-2/3, 33-1/3, 45, and 78 rpm. The frequencies with which the markings of the four bands of the strobe disc passed any given point were fixed functions of the above rotational velocities and thus yielded some irregular appearing numbers. These, and the readings from the TS-382D/U were rounded off to the nearest whole number. The accuracy of the TS-382D/U was ±1 per cent at 440 Hz. Illumination of the disc was by battery operated flashlight in a darkened room—*not* by 60 Hz powered incandescent or by fluorescent illumination.

A Uher 4000 Report L tape recorder was fitted with a b. c. transducer from a Zenith 538 audiometer. This was used as a substitute for the voice. The same vocal pitches which produced the strobing effect by live voice were recorded and were played back while the b. c. unit was held to the labial aspects of the upper first incisors.

Procedure: The subject relaxes, breathing easily. He takes a deep breath, and in mid-exhalation, begins forcibly phonating 'zhzhzhzh'. The purpose of articulating 'zhzhzhzh' appears to be the elevation of the expiratory pressure which results from that tongue position while at the same time permitting phonation without damage to the vocal folds. While thus phonating, the subject should allow his face to become flushed as if the intrathoracic pressure were acting upon the -vascular bed of the head and neck. As the tissues become responsive, the gating effect begins to take place. With a little practice, almost anyone can experience the phenomenon. There is no change in the continuity of visual awareness except for the suddenly acquired subjective ability to 'freeze' regularly repeating patterns almost as if they were being illuminated by a rapidly flashing

stroboscopic light such as **that** used for timing an automotive engine or for balancing a tire or wheel. It seems to be desirable to execute the opening exercise several times, sweeping the phonatory pitch range, if the subject is to maximize the range of frequencies over which the stroboscopic effect can be experienced.

Illuminating the. strobe disc with a dc light source, the subject phonates 'zhzhzhzh' sweeping his phonatory pitch range until he has frozen each of the calibration bands of the strobe disc at each of its rotational velocities.

The phonatory frequency was determined by matching pitch with the TS-382D/U, and matching visually on a Jetronic Industries 0S-8C/U scope.

A second procedure involved recording the pitches of 'zhzhzhzh' which were identified in the first procedure on the 4000 Report L and playing them back through the subject's head by means of a b. c. transducer applied to the labial aspects of the upper first incisors. The strobe disc was viewed in the same manner as in the first procedure, and with identical results.

Results: The results are displayed in Table 1. The frequency range of the visual gating extended from a vocal fundamental frequency of 60 Hz to 324 Hz. At one visual frequency (46 Hz) the effective vocal frequency was an octave higher. At another (240 Hz) two vocal pitches—one synchronous, and one an octave lower—succeeded in inducing the strobe phenomenon.

TABLE 1. Comparison of vocal pitch and visual stimuli

Frequency of Visual Stimulus	Frequency of Voice*
26	—
46	92+
51	—
60	60
69	70
92	90
120	120
124	124
161	160
215	215
240	240 also 120+
280	280
324	324
562	-

•Pitch-matched to Trav-Ier audio oscillator TS 382D/U.
+Harmonically related to the visual stimulus.

The foregoing results were duplicated by employing the same vocal signals, but recorded on the 4000 Report L. Other locations on the head were tried, and some at the eyeball, **but** none succeeded as well as the teeth for a point of contact.

Discussion: Although the equipment used lacks the nicety which might have been realized with a continuously variable visual stimulus and a dual trace oscilloscope, the measurements confirm the existence of this phenomenon. The phenomenon has been demonstrated on seven out of ten subjects tried. Six of these were adult males and one was a thirteen year-old female. The data given here were taken from the subject who exhibited the greatest vocal frequency range. When exhibited, the phenomenon appeared within five minutes of the beginning of the opening exercise. The thirteen year-old subject required only 30 seconds.

Head vibration, whether vocally induced or imposed by an external source, appears to gate the visual system in such a way that it will behave stroboscopically, at least for the frequencies 60-324 Hz.

This phenomenon can be observed easily outside the laboratory. Several examples are provocative: spinning wheels with spokes, hubcaps embossed with spoke-like ridges, hub-nut configurations of truck wheels, and airplane propellors can be strobed at their normal rotational velocities. The lift rotors of helicopters appear to rotate too slowly for a clear-cut effect.

As yet uninvestigated observation involves television screens. Viewed from a distance of about 100 feet, vocal tones of about 60 Hz induce an illusion of a regularly pulsating dip of the picture along its vertical axis.

If the effect described here is indeed taking place by direct action of audio-frequency vibration upon the central nervous system, then it appears likely that other sensory modes may be affected also. This may be the physiological basis of one of the procedures by which yogis tune into some of their altered mental states. A possible benefit might be the use of audio-vibration for direct intervention in times of .emotional stress, providing a means of instantaneous mood stabilization. A commercial application might be a device for timing reciprocating engines. Closer examination of many industrial accidents may identify vibratory cadencing of the central nervous system rather than muscular fatigue as a special causal factor.

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