Reduced Binocular Depth Inversion as an Indicator of Cannabis-Induced Censorship Impairment

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EMRICH, H. M., M. M. WEBER, A. WENDL, J. ZIHL, L. VON MEYER AND W. HANISCH. *Reduced binocular depth inversion as an indicator of cannabis-induced censorship impairment.* PHARMACOL BIOCHEM BEHAV **40**(3) 689–690, 1991.—Measurements of binocular depth inversion using a stereoscopic slide projection with polarized light were performed in healthy volunteers before and after cannabis intake. Since binocular depth inversion represents an illusion occurring in the perception of semantically meaningful objects projected in a 3-D inverted fashion, the hypothesis can be tested that cannabis-induced "psychedelic states" represent a condition in which the human CNS is unable to correct implausible perceptual hypotheses. The data demonstrate a strong cannabis-induced impairment of binocular depth inversion.

Cannabis   Visual perception

BINOCULAR depth inversion (3,8) is an illusion which occurs in stereoscopic slide projections when semantically meaningful visual informations are displayed to the right eye instead of the left and vice versa: under these conditions the visual data would give rise to the irrational experience of a "reverse perspective world," which, however, if the object has semantic relevance, is corrected by the human CNS, producing the illusion of the accustomed view of the object, e.g., a normal human face, house, etc. An impressive example of depth inversion is the illusion of a human face mask in the "Haunted Mansion" at Disneyland in California which appears to rotate and follow the visitor when he walks by. This is due to the fact that the object in reality is an inside-out (hollow) relief mask of a human face which is observed from different points of view, and the illusionary reconstruction of a normal face appears to follow the visitor (8). The basic features of the interpretation of ambiguity of monocular depth-cues ("shadowing") have recently been presented by Ramachandran (6).

"Psychedelic states," as has already been demonstrated by Aldous Huxley (4), on the other hand, may be described as states of an internal neuronal dialogue, characterized by an impairment of the capacity to correct implausible hypotheses in the "betting process" between different types of "perceptual hypotheses" (3) in their interaction with sensory data sets [cf.(1)]. If this assumption is correct, an impairment of binocular depth inversion in cannabis-induced states may be predicted.

METHOD

The presented hypothesis has been tested in 7 healthy subjects during a cannabis-induced psychedelic state, using the following technique: six different stereoscopic slides are displayed by a device with two slide-projectors using cross-oriented linearly polarized light, and glasses with corresponding polarization filters for the probands. Stereopsis is tested using the TNO test for stereoscopic vision (Laméris, Utrecht) and has to amount to at least 60 seconds of arc in each subject. Binocular depth inversion was induced by exchanging the filters from the right eye to the left and vice versa. The probands describe their visual experience during the inverted projection by the following procedure: score 1 is constituted from the data from four slides (house upside-down; teddy mask; garden chair upside-down; human face upside-down). The fact that 3 slides are projected in an upside-down orientation is due to the observation (7) that this facilitates inhibition of binocular depth inversion. An operationalized description of three criteria within every slide is given which characterizes the binocular depth perception of special parts of the object (i.e., description of depth perception of, e.g., nose, eyes, cheeks, roof, etc.: Does the object have a convex or a concave shape? Is it oriented towards the observer or away from him? Is the impression stable or oscillating between the two possible configurations?). A maximal score of 2 points is reached in every slide if the three criteria are fulfilled within 30 seconds (exposure time). A similar procedure is used to constitute score 2 (two slides: brush wood, flowers), in which semantically less relevant objects are visualized, i.e., is their appearance also plausible in the reversed perspective? In score 1 a maximum of 8 points (= 100%) can be attained while in score 2 a maximum of 4 points (= 100%) can be attained. The "semantic pressure" exerted by an object depends upon its familiarity in daily life and its exchangeability of inverted and noninverted configurations (e.g., leaves of flowers, etc.).
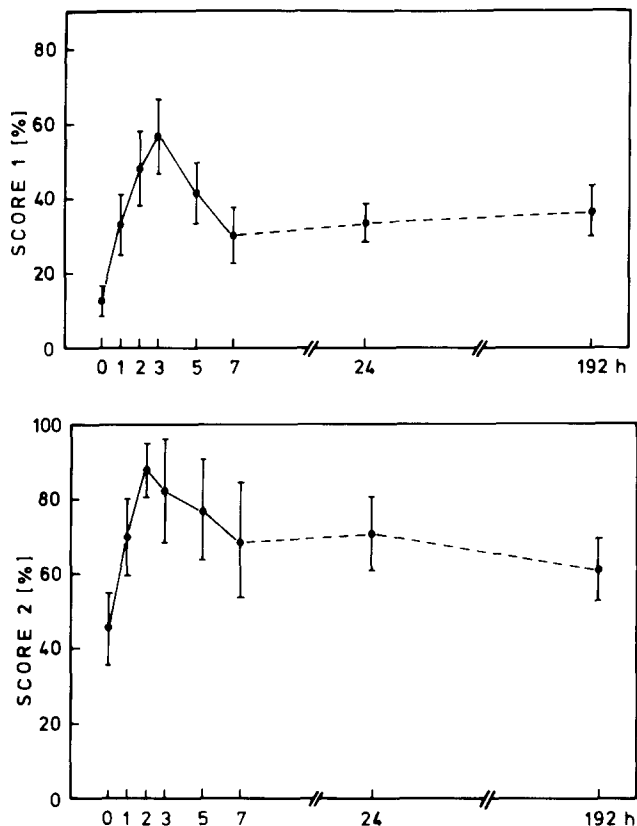
FIG. 1. Binocular depth inversion inhibition scores as a function of time in 7 healthy volunteers taking cannabis at t=0. Bars: SEM. Score 1: Inhibition of binocular depth inversion of semantically relevant objects; Score 2: inhibition of binocular depth inversion of semantically less relevant objects (% of maximal scores).

RESULTS

Seven healthy volunteers (supervised physicians, aged 34.6±8.3 years, instructed about the declaration of Helsinki,

having signed an ethical protocol), in a controlled self-experiment, took 222–373 mg of cannabis resin (3.0–4.0 mg/kg body weight, leading to maximal plasma-THC values between 1.6 and 14.8 ng/ml) and were tested regarding their binocular depth inversion at time 0–192 hours after intake of the drug. The intensity of the subjective cannabis effects (derealization, etc., documented on the LSD scale) was moderate and correlated with the findings in the inversion test as well as with plasma-THC values. The test results are depicted in Fig. 1. Mean score 1, reflecting the reduction of binocular depth inversion of semantically relevant objects (house, human face, teddy-mask, garden chair) rises from $12.5 \pm 11.4\%$ to a maximal average value of $56.6 \pm 10.0\%$ ($p<0.02$, Wilcoxon-test, 2-tailed) within three hours after cannabis intake and is reversed again to $36.5 \pm 15.2\%$ after 8 days (192 hours). Score 2, reflecting the reduction of binocular depth inversion of semantically less relevant objects (flowers, etc.), starts at a higher average value of $45.4 \pm 25.3\%$ and reaches a maximum at 2 hours after cannabis intake of $87.5 \pm 19.1\%$ ($p<0.03$, Wilcoxon-test, 2-tailed). Interestingly, after 8 days (192 hours), score 1 is significantly higher ($p<0.05$, Wilcoxon test, 2-tailed) than the initial value. This may be attributed to a "learning effect" due to the drug-induced experience of inhibition of binocular depth inversion. The finding that the initial scores 1 in Fig. 1 are significantly lower than the initial scores 2 ($p<0.02$, Wilcoxon-test, 2-tailed), confirms the assumption that binocular depth inversion is stronger in semantically relevant objects than in semantically less relevant objects.

DISCUSSION

The results strongly support the view that psychedelic states are due to a disorganisation of the interaction between generation of perceptual hypotheses and sensory data. Apparently, an illusion-producing adaptive correcting system is deficient under these conditions, a finding which has been described also in patients with schizophrenic psychoses (1,5).

Recent neuropsychological concepts point to the view that hippocampal structures serve as "comparator-systems" (2) in which actual sensory data interact with already acquired data sets in memory ("world-models"). It appears plausible that these systems may serve as "censor" systems, and the fact that these structures contain high densities of cannabinoid receptors is in line with the (plausible) explanation that cannabinoids exert their psychotropic effects by censorship impairment.

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