

The Intracranial Injection of Drugs in Goldfish. II: Preliminary Report on Behavior of Serotonin as a Potential Hallucinogen When Injected Intracranially and Intraabdominally.†

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The pioneering and critical research of Szara¹ on the effect of tryptamines on behavior has led us to explore more carefully than hitherto the reaction of goldfish and Siamese fighting fish to members of the tryptamine family. The subsequent papers of this series will outline Szara's work in more detail. It is the purpose of this communication to show that serotonin, although excluded by the blood brain barrier from man's brain*, which regulates its own serotonin metabolism and distribution, nevertheless acts on goldfish not only like LSD and Psilocybin, but also like many of the tryptamine hallucinogens. Serotonin, therefore, now joins the ranks of the potential hallucinogens in man. It should merit the view that disturbance in brain serotonin metabolism should be considered a possible part of the processes of the development of the schizophrenic disturbances. For the reader interested in the relationship of serotonin antigen-antibody reactions and anaphylaxis, the first paper of this series should be consulted.²

Table I indicates nine experiments, each experiment on ten fish (suitable controls were part of the experiments) showing the typical surfacing reaction of goldfish hitherto observed only with LSD and its congeners and derivatives, certain tryptamines, and the benzilates. Controls with creatinin were negative. Increasing the concentration of intracranially injected serotonin under our conditions did not materially affect the percentage of fish surfacing. Between 1965 and the present time, serotonin has maintained its importance and is believed to be a neuromodulator in mammals. May I quote Fuller's summary:³

"Drugs with improved potency and specificity are becoming available for the pharmacologic manipulation of serotonin neurons in the brain. Both enhancement and impairment of serotonergic function can now be achieved by drugs acting through different mechanisms. Drugs of this sort are not only valuable tools for exploring functional roles of serotonin neurons but they have real or potential value in the treatment of diseases like mental depression, obesity, myoclonus or other movement disorders, pain, hypertension and endocrine dysfunction."

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* When given intravenously.

TABLE I

Ten goldfish injected intracranially with .01/ml of 5 mg/ml serotonin creatanin sulfate (equivalent to 22 micrograms serotonin). Nine experiments. N = 90. Number of fish surfacing at different times

Time: Min.	Exp. No.:									Average % fish surfacing
	1	2	3	4	5	6	7	8	9	
10	3	4	7	4	2	3	5	3	6	41
20	3	4	7	4	4	4	6	5	6	48
30	4	4	7	4	5	5	5	5	5	49
40	5	2	4	4	3	6	4	4	4	40
50	4	1	4	3	3	4	2	5	3	32
60	5	1	4	4	5	3	4	4	1	34

Controls are not presented in this report but pertinent data may be found in reference (2).

Summary

Serotonin, when injected intracranially and intraabdominally into goldfish, produces the surfacing reaction typical of hallucinogenic compounds active in man. It is suggested that serotonin disorders in the brain in man might be connected with the schizophrenias.

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Bibliography

1. See for example: SZARA, S. Dimethyl tryptamine. Its metabolism in man; the relation of its psychotic effect to the serotonin metabolism, *Experientia* 12:441, 1956.
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