Crayfish on Happy Drugs?

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Fig. 1. Ecstasy pills can act as a releasing agent of serotonin[1]

Serotonin, or 5-HT, is a chemical known to enhance agonistic behavior in crayfish, which can influence aggressive encounters aimed at attaining dominance.

We studied the effect of two competing factors that influence dominance: the addition of serotonin, and resident-intruder status dynamics.

Introduction

- Crayfish are freshwater crustaceans known to exhibit **aggressive** behavior towards others for **control** of resources, like space.
- Crayfish who have already established territorial dominion are more likely to win aggressive encounters against intruding crayfish (Peeke et al.1995).

Hypothesis: Intruders injected with serotonin will exhibit more aggressive behavior compared to those injected with a saline solution, as shown by which demonstrates more dominance in each encounter with a resident.

Fig. 2. Crayfish exhibiting meral spread[2]

Experimental Design:

Matching Up Opponents

Used Principal Component Analysis in matching crayfish opponents to eliminate effect of appearance in determining dominance in order to observe the effect of serotonin alone. n = 24.

Measured variables: chelae length, carapace length, antennae length, abdomen width, color and mass

Interaction

- Resident crayfish isolated for 3-4 days to establish residency in tank
- Intruder was injected with either 100 μL of saline or serotonin solution seconds before interaction
- Encounters were videotaped and allowed to continue for 15 minutes
- Behavior was scored using an ethogram (Table I.) to measure aggression levels

Behavior	Description	Point
Establish dominance	- Flips opponent upside-down - Walks on top of opponent prior to agonistic behavior - Follows a retreating opponent	+3
Attempted flip	Crayfish tries to flip opponent unsuccessfully	+2.5
Approach	Crayfish orients and walks toward a stationary opponent	+2
Interlocked	Chelae of both crayfish are open and interlocked with those of the opponent	+1
Retreat	Reduces aggression and slowly backs away	-1
Flee	Turns away and moves quickly from opponent	-2

Table 1. Ethogram of behaviors observed in aggressive encounters arranged in a point system to determine dominance. With help from Bruski et al. 1987

Results

Is there significant difference in aggressive behavior of the intruder when injected with the serotonin solution?

Solution Used	Saline Solution			Serotonin Solution		
Status	Intruder (I)	Resident (R)	Overall Score (I – R)	Intruder (I)	Resident (R)	Overall Score (I - R)
Trial 1	9	10	-1	8	28.5	-20.5
Trial 2	7.5	18	-10/5	34.5	28	6.5
Trial 3	9	15	-6	23	18	5
Trial 4	8	20	-12	0	2	-2
Trial 5	22	7.5	14.5	24	0	24
Trial 6				10.5	21	-10.5
Average	11.4	14.1	-0.13	16.6	16.2	0.41

Table II. Raw Data Score for Each Crayfish. n = 22*

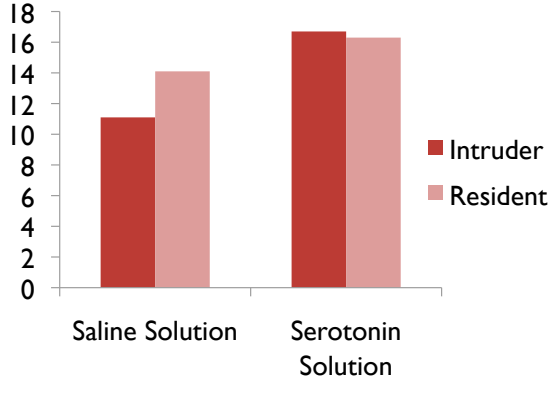

Fig. 3. Average aggression score of Intruder and Resident crayfish for each solution used in a total of 11 encounters

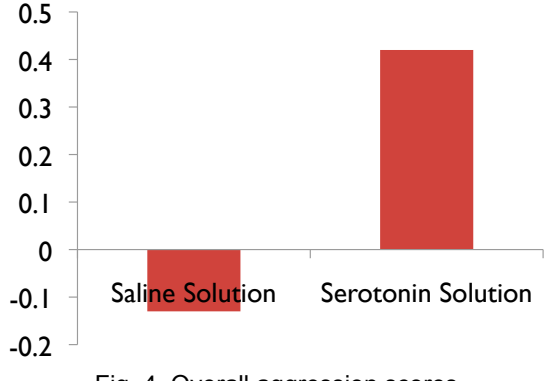

Fig. 4. Overall aggression scores for saline and serotonin solutions

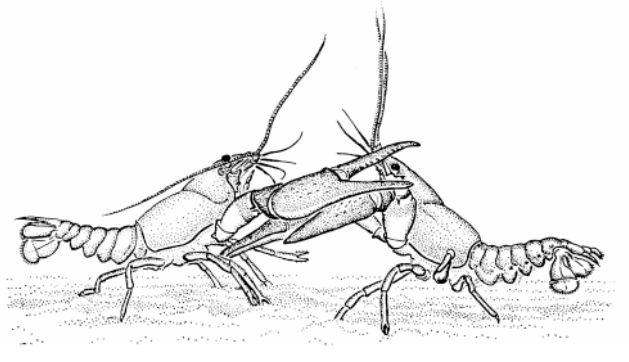

Fig. 5. Crayfish interlocking chelae[3]

*Only 11 of 12 interactions were used in data analysis due to missing footage.

Conclusion

Serotonin did not significantly impact aggressive behavior in experimental groups.

Discussion:

Though our results were not significant, the data trend suggests that a larger sample size would agree with our hypothesis.
Sources of experimental error: Concentration of serotonin not high enough? Incorrect injection method?
Future experiments: See if experimental group is less likely to retreat, instead of taking an overall aggression score. Or use a larger ethogram as in Bruski et al 1987.

More aggressive?	Saline Solution	Serotonin Solution	Row Total
Resident	4	3	7
Intruder	1	3	4
x^2 = 1.17 with df =1	5	6	11

Table III. Chi-Square Test

References:

•C, A. Bruski, D.W. Dunham, (1987) The Importance of Vision in Agonistic Communication of the Crayfish Orconectes rusticus. I: An Analysis of Bout Dynamics. Behavior 103 (1/3): 83-107.

•H.V.S. Peeke, J. Sippel, M.H. Figler (1995) Prior Residence Effects in Shelter Defense in Adult Signal Crayfish (*Pacifastacus Leniusculus* (Dana)): Results In Same- and Mixed-Sex Dyads. Crustaceana. 68 (7): 873-881.

Images:

[1] http://www.steadyhealth.com/4542/Image/ecstasy_pills-2.jpg

[2]http://i.telegraph.co.uk/telegraph/multimedia/archive/01516/crayfish_1516006c.jpg

[3] Bruski et al. 1987

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