CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kensuke Shimojo

Project Number
J2312

Project Title
Planarians: A New "Shadow Test" on Ultimate Ability of Survival

Abstract

Objectives/Goals
The planarian is known for its nearly almighty ability to fully regenerate its missing body parts. The objective is to find out how the animal can survive during regeneration, without some critical circuits, such as the light sensing system involving eyespots or the ganglia (the primitive neural system). Inspired by the latest findings (of the alternative, UV-based light sensing system), I specifically tested the hypotheses that adaptive behavioral functions (such as avoiding light) are restored much earlier than complete anatomical regeneration, and that the light sensing is switching from the eyespot-ganglia system to the more distributed, (possibly UV-based) system after dissection. To this end, I develop my own behavioral test called "shadow test."

Methods/Materials
Dugesia dorotocephala, or black planarians (up to 20), were dissected in different ways (horizontal or vertical), and raised in petri dishes with spring water. Each body part was put on the lighted side in a half-occluded petri dish, and video-recorded everyday to see if it would show light-avoiding locomotion (Experiment 1). Materials and methods are the same in Experiment 2, except that in the shadow test, an UV light and an UV-filtered, visible-range light sources were employed and compared.

Results
All dissected body parts, even the vertically dissected body part, showed behavioral avoidance of light 4 days after dissection, indicating early restoration of adaptive behavioral functions relative to the time needed for complete anatomical regeneration (Experiment 1). The comparison of UV vs. no-UV light conditions indicates a possibility of early switching after dissection, from the ordinary eyespot-ganglion based system to the UV-based, distributed system (Experiment 2).

Conclusions/Discussion
Different body parts restored adaptive behavior with different delays but long before completion of anatomical regeneration (Experiment 1). The results of Experiment 2 suggest that it is possibly owing to the alternative, UV-based light sensing system. These results underscore amazing degrees of redundancy (redundant light sensing systems) and flexibility (switching between them) that this species has acquired through evolution.

Summary Statement
I developed a new "shadow test" to address the ability of the planarians' body-parts to survive without the ordinary light sensing (eyespot-ganglion) system, results of which indicate amazing degree of redundancy and flexibility.

Help Received
I alone chose the topic, and conceived the idea and experimental methods (the "shadow test#, the vertical dissection, etc.). My father (a Caltech professor; cognitive neuroscientist) helped me to refine the hypotheses and the design; my mother (a Caltech experimental psychologist) helped me to conduct