A DYNAMIC OPEN-ACCESS RESOURCE FOR ZEBRAFISH RESEARCH

A. Kalueff, E. Kyzar, I. Zapolsky, J. Green, S. Gaikwad, A. Stewart

Department of Pharmacology and Neuroscience Program
Tulane University School of Medicine, New Orleans, LA

Abstract

Zebrafish (*Danio rerio*) are widely used in neuroscience research, where their utility as a model organism is rapidly expanding. Low cost, ease of experimental manipulations and sufficient behavioral complexity make zebrafish a valuable tool for high-throughput studies in biomedicine. To complement the available repositories for zebrafish genetic information, there is a growing need for the collection of zebrafish neurobehavioral and neurological phenotypes. For this, we are establishing the Zebrafish Neurophenome Database (ZND; www.tulane.edu/~znpindex/search) as a new dynamic online open-access data repository for behavioral and related physiological data. ZND, currently focusing on adult zebrafish, combines zebrafish neurophenotypic data with a simple, easily searchable user interface, which allows scientists to view and compare results obtained by other laboratories, using various treatments in different testing paradigms. As a developing community effort, ZND is expected to foster innovative research using zebrafish by federating the strong body of zebrafish neurophenotypic data.

Database Overview

The ZND is designed to consolidate zebrafish information to provide a comprehensive open access database of their behavioral and neurological phenotypes. The database contains details of experimental manipulations and the corresponding responses across all major behavioral domains and tests/paradigms, enabling a better characterization and interpretation of zebrafish phenotypes. ZND also reports negative findings (such as ineffective drug doses or inactive stressors), giving researchers complete information to make more informed decisions regarding optimal experimental design of their zebrafish studies.

ZND covers various forms of scientific communication including scholarly journal publications, books and book chapters, conference abstracts, patents, doctoral dissertations, theses, project reports, government documents, web-sites, posters, personal communications and unpublished observations. Users can review their uploaded data, verify its accuracy and contact the ZND team to make necessary corrections (Fig. 1). Collectively, this is expected to facilitate the comprehensive and updated coverage of zebrafish neurophenotypic data, making it accessible to researchers in this field.

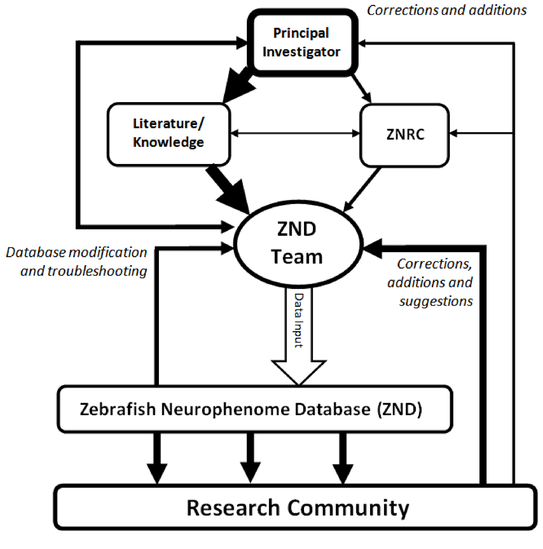
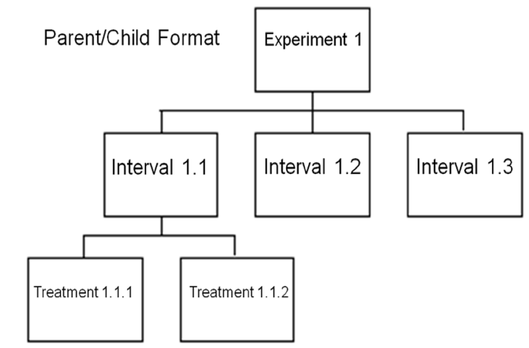


Fig. 1. A diagram summarizing the Zebrafish Neurophenome Database (ZND) development and information flow. This diagram displays the relationships between principal investigators interested in zebrafish research, the Zebrafish Neuroscience Research Consortium (ZNRC), and the ZND framework (see Figs. 2-3 for details).



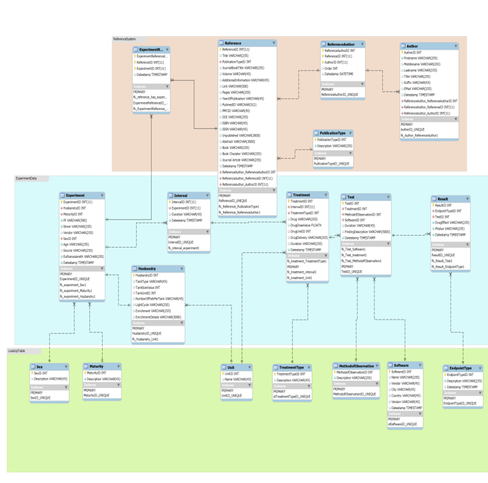


Fig. 2. Current modular organization of the Zebrafish Neurophenome Database. The figures above show the general schema underlying the database. The ZND is organized in a parent/child format, which separate database schemes for experimental intervals, treatments, tests and results. While this view is not available to database users, it illustrates the detailed nature of data structure within the ZND.

Organization and Structure

LSD NTT5

Primary Investigator: Kalueff
Strain: wild type sourced from
Fish: 20-30 count of sex Both of age 5-7 months in a 40L Hometank
Light cycle: 12:12
Enrichment: none, -
Euthanasia: Tricaine

Interval ID	Duration
101	20 min

Treatment ID	Drug	Dosage	Duration	Delivery
107	LSD	250 µg/L	20 min	Immersion

Test ID	Method	Software	Duration	Finding
108	Both	Ethovision XT	6 min	NTT - anxiolysis

Result ID	Endpoint Type	Drug Effect	PValue
367	Latency to enter top	Decreased	<0.001
368	Transitions to top	Increased	<0.001
369	Time in top	Increased	<0.001
370	Average Entry Duration	Increased	<0.001
371	Freezing bouts	Decreased	<0.01
372	Freezing duration	Decreased	<0.01
373	Unaffected endpoints	Distance traveled, average velocity	NS
374	Cortisol levels	Increased	=0.05-0.1

Fig. 3. Diagram data output of the Zebrafish Neurophenome Database (ZND). This data is based on a published study by the Kalueff laboratory testing lysergic acid diethylamide (LSD) in the novel tank diving test. In addition to providing experimental/methodological details, overview of positive findings (observed phenotypes) and their statistical significance, also note the mention of *unaffected* endpoints (negative findings) in ZND, collectively providing a comprehensive summary of zebrafish phenotypic data.

Conclusion

In summary, ZND is expected to enhance zebrafish neurophenotyping by providing scientists with an open-access comprehensive resource of relevant data generated in this species. This innovative, dynamic database offers a timely tool for researchers studying zebrafish behavior and neurobiology. Continuing the current trends of data sharing, it increases visibility of zebrafish research and encourages collaboration between established and new laboratories worldwide. With the growing international network of laboratories involved in zebrafish research, ZNRC and other members of the zebrafish research community will also continue to provide necessary expert support to ZND, further increasing the participation of established and newer groups in sharing their zebrafish data through ZND. Providing the researchers with effective new resource for data-mining and analysis, ZND shows how compact *specialized* neurobiological databases not only address specific biomedical problems, but can also advance our understanding of complex biological phenomena.

Acknowledgement

This project was supported by Tulane University, Tulane Medical School Intramural and Pilot funds, LA Board of Regents P-Fund and NIDA R03 SOAR (DA030900-02) grants, as well as by the Tulane University Innovative Learning Center (expertise of Budd Hirons and Paul St-Pierre is much appreciated). Help of Xiang Chen and colleagues from Tulane University's Innovative Learning Center is also greatly appreciated.