

Behavioral Toxicology

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The new fields of behavioral toxicology and behavioral teratology investigate the outcome of specific toxic exposures in humans and animals on learning, memory, and behavioral characteristics. Three important classes of behavioral neurotoxins are metals, solvents, and pesticides. The clearest data on the deleterious effects of prenatal exposure to toxicants comes from the study of two metals, lead and mercury, and from epidemiological investigations of the effects of alcohol taken during pregnancy. Less complete data are available for two other groups of agents, solvents and pesticides. What we do know about their effects on the fetal brain is convincing enough to make us demand caution in their distribution. —*Environ Health Perspect* 103(Suppl 6):77–79 (1995)

Key words: toxicants, lead poisoning, brain development, synapse, neurotransmitter, neurons, astrocytes.

Behavioral Toxicology

Behavioral toxicology, the study of chemical toxicants and their influence on brain function, is a young field. The notion that a chemical can affect the brain and that the earliest expression of toxicity could be found in altered behavior, thinking, or mood is not new; it was voiced at least 2000 years ago by Dioscorides when he wrote, "Lead makes the mind give way." Despite this early warning, the scientific community has until recently paid little systematic attention to the impact of neurotoxins on behavior. The first textbook on this subject was published in 1975 (1).

Behavioral teratology, the study of the effect on behavior of chemical exposure of the fetus *in utero*, is an even newer discipline. Until recently, the uterus had been visualized as a time capsule with a 9-month lease, sheltering the developing fetus from most adverse influences such as drugs, toxicants, or nutritional deprivation. The thalidomide and Minamata disasters quickly disabused scientists and laymen alike of this false comfort. It is now clear that many chemicals cross the placenta and impinge on the developing brain. Behavioral deficits have been shown for some agents at doses well below those that cause anatomical alterations.

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from the study of two metals, lead and mercury, and from epidemiologic investigations of the effects of alcohol taken during pregnancy. Less complete data are available for two other groups of agents, solvents and pesticides. What we do know about their effects on the fetal brain is convincing enough to demand caution in their distribution.

Lead

Lead has been known to affect workers for millennia, and its hazards to the reproductive process have been known for at least a century. British factory inspectors at the turn of the twentieth century noted that women who were exposed to lead through working in the cottage ceramic industry tended to be barren and that children who were born to those women were often short-lived (2). Childhood lead poisoning was first described in Australia 100 years ago. For 50 years it was believed that if lead did not kill the child, he or she was left with no stigma of the exposure. Careful follow-up of children who had recovered from the disease showed that most had school failure or behavioral problems. For the past 20 years, epidemiologists and child development specialists have been investigating the effects of lead exposure in children with no clinical symptoms. This controversial issue has now been effectively settled. Almost all workers in the field agree that lead at silent doses produces deficits in psychological functions; these include intelligence, perception, attention, language function, and perhaps social adjustment. The recently published report of the National Academy of Sciences provides a thorough summary of this issue (3).

In the late 1970s, attention began to shift to the question of intrauterine exposure to lead. Scanlon (4) measured umbilical-cord blood lead concentrations in new-

borns and showed that infants born to inner city mothers tended to have higher blood lead levels than those born to suburban mothers. The observation that lead crossed the placenta sparked studies of prenatal exposure on infant development. The first study examined a large cohort of births at the Boston Hospital for Women (5). Umbilical-cord bloods were obtained from almost 12,000 births over a 2-year period. Lead was found to be related to minor birth defects in a subsample of 5000 of these infants. A subsample of these subjects that was evenly divided among low exposure ($< 3 \mu\text{g/dl}$), medium exposure ($6\text{--}7 \mu\text{g/dl}$), and high exposure ($> 10 \mu\text{g/dl}$) was followed. Subjects were seen at 6, 12, 24, 37, and 120 months of age. Significant deficits in infant IQ scores were found in children in the high cord blood lead group as late as 24 months of age (6). At 37 and 120 months of age, the effect of umbilical-cord blood was no longer significant, but the effect of the 24-month blood lead level was statistically significant (7). Similar data have subsequently been reported from studies in Cincinnati (8) and Australia (9). It is clear that lead exposure during pregnancy is a behavioral teratogen.

Mercury

Knowledge about the neurotoxicity of mercury dates from the 1950s. In Minamata, Japan, a chemical plant used the waters of Minamata Bay to discharge its wastes. One of the most important discharge products was mercury, mostly in its inorganic form. Aquatic bacteria transformed it to the organic form methylmercury. Because it enters the brain more readily, this form is much more toxic. It was taken up by the local fish and, in the 1950s, residents who ate fish from the bay were found to suffer

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Behavioral Toxicology

Bernard Weiss



Behavioral Toxicology:

Behavioral Toxicology Harold Zenick, 1977 *Behavioral toxicology, an emerging discipline*, 1977 Behavioral Toxicology Bernard Weiss, 2013-03-09 Behavioral toxicology is a young discipline in the United States so young in fact that this is one of its first books Behavioral questions are bound to play a major role in future scientific work and governmental decisions involving the health effects of environmental contaminants and other chemicals This role springs from two key problems that face scientists and public agencies required to set acceptable exposure standards or to determine criteria for the toxicity of therapeutic chemicals How do you evaluate effects that may show up only as subtle functional disturbances And how do you detect toxic effects early enough so that they may still be reversible before they produce major damage The contributions in this book come from a collection of scientists whose interests span a wide variety of problem areas The focus is largely on methodological issues because they represent the most immediate concern of the discipline We expect that this collection of papers will represent a useful source book for behavioral toxicology for some time For the past few years the University of Rochester's Department of Radiation Biology and Biophysics has sponsored a series of international conferences on chemical toxicity partly as a response to concern over the consequences to health of the rich chemical soup in which we live This book is based upon presentations made to the fifth of the series Held in June 1972 it was the first formal meeting devoted to behavioral toxicology in this country Introduction to Neurobehavioral Toxicology Hugh A. Tilson, R.M.A. Jaspers, L.M.W. Kornet, J.M. van Ree, 1998-11-25 Introduction to Neurobehavioral Toxicology Food and Environment examines the effects of chemicals on the central and peripheral nervous system and the subsequent changes in behavior with a focus on the toxicity of food components and behavioral effects of environmental toxicants Topics addressed include acute and chronic effects reversible and *Behavioral toxicology*, 1974 **Behavioral Toxicology** National Institute for Occupational Safety and Health, 1974 *Neurobehavioral Toxicity* Bernard Weiss, 1994-06-30 In establishing how certain chemicals can cause behavioural disorders the process of neurotoxicity risk assessment poses significant challenges to every discipline within neuroscience In this volume leaders from industrial academic and government settings share insights on behavioural measurement in neurotoxicity risk assessment and address the critical scientific issues arising from the expanding role of neurobehavioral toxicology in public policy development The authors set out to provide a comprehensive and authoritative review of current methods in the analysis and interpretation of neurobehavioural toxicology Coverage begins with a discussion of criteria for determining neurotoxic potential The next section examines neurobehavioural evaluations in developmental neurotoxicity Subsequent sections focus on activity and observational data and applications of schedule controlled operant behaviour in toxicity testing The contributors address controversies surrounding the suitability and interpretation of procedures designed for neurotoxicological assessments Some case studies are also included **Behavioral Measures of Neurotoxicity** National Research Council, Division of Behavioral and Social

Sciences and Education, Commission on Behavioral and Social Sciences and Education, U.S. National Committee for the International Union of Psychological Science, 1990-02-01 Exposure to toxic chemicals in the workplace and at home is increasing every day Human behavior can be affected by such exposure and can give important clues that a person or population is in danger If we can understand the mechanisms of these changes we can develop better ways of testing for toxic chemical exposure and most important better prevention programs This volume explores the emerging field of neurobehavioral toxicology and the potential of behavior studies as a noninvasive and economical means for risk assessment and monitoring Pioneers in this field explore its promise for detecting environmental toxins protecting us from exposure and treating those who are exposed

Hayes' Principles and Methods of Toxicology A. Wallace Hayes, Tetyana Kobets, 2023-07-03 Hayes Principles and Methods of Toxicology has long been established as a reliable and informative reference for the concepts methodologies and assessments integral to toxicology The new edition contains updated and new chapters with the addition of new authors while maintaining the same high standards that have made this book a benchmark resource in the field Key Features The comprehensive yet concise coverage of various aspects of fundamental and applied toxicology makes this book a valuable resource for educators students and professionals Questions provided at the end of each chapter allow readers to test their knowledge and understanding of the material covered All chapters have been updated and over 60 new authors have been added to reflect the dynamic nature of toxicological sciences New topics in this edition include Safety Assessment of Cosmetics and Personal Care Products The Importance of the Dose Rate Response Novel Approaches and Alternative Models Epigenetic Toxicology and an Expanded Glossary The volume is divided into 4 major sections addressing fundamental principles of toxicology Section I Principles of Toxicology major classes of established chemical hazards Section II Agents current methods used for the assessment of various endpoints indicative of chemical toxicity Section III Methods as well as toxicology of specific target systems and organs Section IV Organ and System Specific Toxicology This volume will be a valuable tool for the audience that wishes to broaden their understanding of hazards and mechanisms of toxicity and to stay on top of the emerging methods and concepts of the rapidly advancing field of toxicology and risk assessment

Principles and Methods of Toxicology, Fifth Edition A. Wallace Hayes, 2007-09-25 Founded on the paradox that all things are poisons and the difference between poison and remedy is quantity the determination of safe dosage forms the base and focus of modern toxicology In order to make a sound determination there must be a working knowledge of the biologic mechanisms involved and of the methods employed to define these mechanisms While the vastness of the field and the rapid accumulation of data may preclude the possibility of absorbing and retaining more than a fraction of the available information a solid understanding of the underlying principles is essential Extensively revised and updated with four new chapters and an expanded glossary this fifth edition of the classic text Principles and Methods of Toxicology provides comprehensive coverage in a manageable and accessible format New topics include toxicopanomics plant and

animal poisons information resources and non animal testing alternatives Emphasizing the cornerstones of toxicology people differ dose matters and things change the book begins with a review of the history of toxicology and followed by an explanation of basic toxicological principles agents that cause toxicity target organ toxicity and toxicological testing methods including many of the test protocols required to meet regulatory needs worldwide The book examines each method or procedure from the standpoint of technique and interpretation of data and discusses problems and pitfalls that may be associated with each The addition of several new authors allow for a broader and more diverse treatment of the ever changing and expanding field of toxicology Maintaining the high quality information and organizational framework that made the previous editions so successful Principles and Methods of Toxicology Fifth Edition continues to be a valuable resource for the advanced practitioner as well as the new disciple of toxicology

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