

## Lack of effect of specific sodium hunger on learned aversions to sodium and sucrose

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Frumkin (1975) reported that sodium-deficient rats fail to learn taste aversions to NaCl. However, those rats were sodium-deficient at the time of testing as well as at the time of training; any learned aversion could have been masked by a strong sodium hunger. Rats were made temporarily sodium-hungry by injections of Formalin or aldosterone. They were then poisoned after drinking both an NaCl and a sucrose solution. Several days later they were tested for learned aversions. Rats trained under the influence of aldosterone did not differ from controls. Rats trained under the influence of Formalin acquired slightly weaker aversions to both NaCl and sucrose. Thus there is no evidence that sodium deficiency alters the associability of NaCl with poison.

Rats which are poisoned after ingesting some substance acquire an aversion to the taste of that substance (Garcia, Ervin, & Koelling, 1966; Garcia & Koelling, 1966; Rozin & Kalat, 1971). If a rat drinks more than one solution prior to poisoning, it may acquire a stronger aversion to one solution than to the other (Kalat & Rozin, 1970). One determinant of the salience of various tastes in this situation is their novelty; rats which drink two solutions prior to poisoning acquire a stronger aversion to the more novel solution (Kalat, 1974; Revusky & Bedarf, 1967).

Frumkin (1975) has recently proposed an additional determinant of how associable a taste is with poison. He reported that sodium-deficient rats learned much weaker aversions than normal rats if the taste of NaCl was paired with poison. Similarly, calcium-deficient rats learned weaker than normal aversions if calcium was paired with poison. Such results suggest a possible predisposition of rats to avoid associating a taste with poison while they have a specific hunger for that taste.

However, another, less interesting, interpretation is possible. Frumkin produced sodium deficiency and calcium deficiency by removal of the adrenal and parathyroid glands, respectively. Because these removals are permanent, the rats were sodium- or calcium-deficient at the time of testing as well as the time of training. It is certainly possible that these rats had learned aversions to sodium or calcium, but that the specific hungers for these minerals overrode the aversions (see Cullen, 1969; Rozin & Kalat, 1971; Stricker & Wilson, 1970). For analogy, if an experi-

menter paired breathing with shock and the animals failed to stop breathing, it would not be proper to conclude that they had failed to learn.

In order to test the effect of sodium hunger on the associability of sodium with poison, it would be best to produce a temporary sodium hunger which could be present at the time of training but absent during the test. In Experiment 1, we produced temporary sodium deficiency by injections of Formalin. In Experiment 2, we produced sodium hunger without sodium deficiency by injections of aldosterone.

The experiments were designed to minimize one other possible problem in the interpretation of results. Suppose that sodium-deficient rats learned either a stronger or a weaker aversion to NaCl than the normal rats. A possible interpretation would be that the poison was either more aversive or less aversive, respectively, to the sodium-deficient rats. (The latter possibility is not totally implausible. It could be that when a rat is already ill, a further increase in illness might be less significant to the rat than if the rat had previously been healthy.) To avoid this problem, we poisoned sodium-hungry rats after they drank both a sucrose solution and an NaCl solution. We could conclude that sodium hunger altered the associability of NaCl only if the sodium-hungry rats showed either a stronger or weaker NaCl aversion than the controls, *without* showing a correspondingly stronger or weaker aversion to sucrose.

### EXPERIMENT 1

#### Method

The subjects were 40 adult female rats, mean weight 285 g, which had been born and reared in the authors' laboratory. The ancestry was mixed, consisting mostly of Sprague-Dawley albino; however, pigmented rats were used preferentially for breeding.

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# Sodium Hunger

**Jay Schulkin**



## **Sodium Hunger:**

*Calcium Hunger* Jay Schulkin, 2001 This book brings together the behavioral physiological and neuroendocrine regulation of calcium An understanding of how the brain orchestrates whole body demands for calcium is introduced The approach is one in which behavior in addition to physiology serves bodily maintenance The book links basic and clinical literature surrounding calcium homeostasis as a wide variety of clinical syndromes are tied to calcium metabolism Because calcium is so important during life stages particular to women an emphasis is placed on the relevance of calcium to women's health throughout the book though not exclusively since calcium is fundamental to both sexes *Sodium Hunger* Jay Schulkin, 1991 The hunger for sodium has been used as a model system in which to study how the brain produces motivated behaviour In this account of the field Jay Schulkin draws together information across a range of disciplines and topics ranging from the ecology of salt ingestion to the sodium molecule and the action of various hormones The phenomenon of sodium hunger was discovered by Curt Richter the great American psychobiologist over 50 years ago Its study has been of interest for some time to naturalists psychologists endocrinologists physiologists and neuroscientists This book offers a systematic account of the behaviour of the sodium hungry animal the endocrine and physiological mechanisms that act to maintain sodium balance and then act on the brain to promote the search for and the ingestion of salt Finally the book provides a description of a neural network that orchestrates the behaviour of salt seeking and salt ingestion Graduate students and research workers in psychology physiology and neuroscience will find valuable information in this review *The Neuroendocrine Regulation of Behavior* Jay Schulkin, 1999 In this text Jay Schulkin discusses and emphasizes the important roles of steroids and neuropeptides in the regulation of behavior The guiding principle behind much of the research and insights that are presented in the book is the concept of using certain model animal systems to study how hormones influence the brain The results from these model systems can then be used to generalize the information obtained and apply it to other animals and humans Senior undergraduate and graduate students in neuroscience endocrinology psychology and physiology will find this text a useful guide to the role of hormones in behavior It should be of use to colleagues in the field and medical health care professionals *Neurobiology of Body Fluid Homeostasis* Laurival Antonio De Luca Jr., Jose Vanderlei Menani, Alan Kim Johnson, 2013-10-01 A timely symposium entitled Body Fluid Homeostasis Transduction and Integration was held at Araraquara S o Paulo Brazil in 2011 This meeting was convened as an official satellite of a joint gathering of the International Society for Autonomic Neuroscience ISAN and the American Autonomic Society AAS held in Buzios Rio de Janeiro Broad international participation at this event generated stimulating discussion among the invited speakers leading to the publication of *Neurobiology of Body Fluid Homeostasis Transduction and Integration* Drawn from the proceedings and filled with rich examples of integrative neurobiology and regulatory physiology this volume Provides updated research using human and animal models for the control of bodily fluids thirst and salt appetite Explores neural and endocrine control of

body fluid balance arterial pressure thermoregulation and ingestive behavior Discusses recent developments in molecular genetics cell biology and behavioral plasticity Reviews key aspects of brain serotonin and steroid and peptide control of fluid consumption and arterial pressure The book highlights research conducted by leading scientists on signal transduction and sensory afferent mechanisms molecular genetics perinatal and adult long term influences on regulation central neural integrative circuitry and autonomic neuroendocrine effector systems The findings discussed by the learned contributors are relevant for a basic understanding of disorders such as heat injury hypertension and excess salt intake A unique reference on the neurobiology of body fluid homeostasis this volume is certain to fuel additional research and stimulate further debate on the topic **Advances in the Study of Behavior** ,1976-04-23 Advances in the Study of Behavior **The Hunger for Salt**

Derek A. Denton,1982 Abstract Various aspects of salt ingestion are discussed in an authoritative reference text 27 chapters for clinical nutritionists dietitians health anthropologists and other health professionals Topics include the relevance of sodium Na in body fluids Na deficiency and salt appetite hominoid evolution and historical aspects of salt and specific effects of Na deficiency physiologic effects salt taste and response water depletion rapid systemic correction of Na deficiency and endocrine effects of rapid satiation of salt appetite The discussion of factors which influence salt appetite covers plasma volume change hepatic Na receptors the renin angiotensin system and experimental hypertension and salt appetite during reproduction Clinical studies are cited and theories on the genesis and satiation of salt appetite are reviewed Related topics which are discussed include the stimulating effect of steroids on salt appetite electrical stimulation the appetite for phosphate calcium magnesium and potassium and salt intake and high blood pressure wz **Hormonally Induced**

**Changes to the Mind and Brain** Bozzano G Luisa,2012-12-02 Describing the latest findings in both clinical and laboratory research this volume investigates the behavioral and neural affects of endocrine activity in animals and humans Each chapter discusses the relationship between normal endocrine control of behavior and the pathological consequences that result from endocrine abnormalities The relevance to mental health and basic regulatory homeostatic events are balanced with a basic understanding of how hormones affect behavior and the brain The book is written to appeal to a wide audience of readers from the educated lay person to the seasoned M D and research scientist Chapter topics include the effects of endocrine activity on homeostasis sexual behavior aggression circadian rhythms and affective disorders in addition to discussing steroid abuse adrenal steroid effects on the brain and a detailed investigation on the effects of cholecystokinin and oxytocin

Motivation Roderick Wong,2000-07-03 This book presents an analysis of motivated behaviour from a biological perspective Thirst David J. Ramsay,David Booth,2012-12-06 At one time or another everyone has said I am thirsty Yet what causes this sensation of thirst It is obvious that a certain quantity of fluid must be present for the body to function normally How does a water deficit in the body then influence drinking habits But supposing the physiological need is met what about the psychological need or social need Water is certainly the most necessary fluid then why do we humans often

prefer other beverages even at great cost of effort or money or health The subject of thirst and drinking behavior are uniquely discussed in this book For the first time both the physiological and the psychological aspects of water and beverage consumption are examined in one volume The many recent developments concerning how a lack of water is signalled physiologically and processed neurally to affect drinking behavior are critically surveyed Prospects for understanding the cultural and sensory influences on beverage consumption are mapped out The thirty one chapters by authorities in the field were all mutually reviewed and revised in the light of precirculated comments and round table discussions Together they provide a complete picture of the current state of knowledge on what determines fluid consumption in human beings and animals

*Principles of Hormone/Behavior Relations* Donald W. Pfaff, Robert T Rubin, Jill E. Schneider, Geoff Head, 2018-01-10 *Principles of Hormone Behavior Relations* Second Edition provides an introduction to the underlying principles of endocrine regulation of behavior a newly emerging area of research within neurobiology and endocrinology It addresses the properties of hormone behavior relations including the influence of family background timing issues neuroanatomical features cellular mechanisms and the importance of environmental context and evolution This new edition incorporates critical advances in the field also including increased coverage of hormonal influences on food intake and on the cardiovascular system The addition of entirely new principles provides further coverage of epigenetics and appetite Thoroughly revised and updated this book is an ideal resource for neuroscientists and researchers engaging in this rapidly expanding field of study Provides a unique structure where each chapter addresses a key principle that is illustrated by numerous basic experimental and clinical examples Includes user friendly features such as boxed figures with extended captions and references numerous clinical notes and a comprehensive list of abbreviations Contains numerous illustrations that highlight both the clinical and basic science information

*Angiotensin Vol. II* Thomas Unger, Bernward A. Schölkens, 2012-02-02 Nearly thirty years ago in 1974 the volume on Angiotensin edited by Irvine H Page and F Merlin Bumpus expanded the Handbook of Experimental Pharmacology Even after two decades the multiplicity of its actions appears not to have been fully discovered To call attention to its many functions is one of the purposes of this book This new edition of the volume on Angiotensin attempts to provide an updated account of the knowledge and findings accumulated since the complexity of angiotensin was so accurately recognized

*Taste* Lloyd M. Beidler, 2012-12-06 Taste receptors monitor the quality of all the food ingested They are intimately involved in both food acceptance and rejection The sensation of taste is also important in the regulation of many specific chemicals necessary for maintenance of the body For example disturbance of the adrenal glands results in a change in the intake of salt which is necessary for regulation of the sodium balance Curt Richter s early studies on specific hungers and preference thresholds initiated a large number of studies in this field The relationship between taste and food intake is now well recognized by physiologists psychologists and nutritionists Our current concepts of the neural coding of taste quality and intensity are largely based upon the classical paper by

PFAFFMANN in 1941 Many subsequent single nerve fiber studies have added to our understanding In recent years Zotterman and Diamant have successfully recorded from the human taste nerves as they pass through the middle ear This allowed them to study the relationships between the response of taste receptors and the resultant taste sensation No similar feat has yet been accomplished with the visual and auditory systems Nephrology in your pocket Egils Veverbrants, Aivars Petersons, 2013-09-15 Textbook on kidney diseases for medical students residents and practitioners *Bodily Sensibility* Jay Schulkin, 2004-04-08 Although we usually identify our abilities to reason to adapt to situations and to solve problems with the mind recent research has shown that we should not in fact detach these abilities from the body This work provides an integrative framework for understanding how these abilities are affected by visceral reactions Schulkin presents provocative neuroscientific research demonstrating that thought is not on one side and bodily sensibility on the other from a biological point of view they are integrated Schulkin further argues that this integration has important implications for judgements about art and music moral sensibilities attraction and revulsion and our perpetual inclination to explain ourselves and our surroundings **Biological and Behavioral Aspects of Salt Intake** Morley Kare, 2012-12-02 Biological and Behavioral Aspects of Salt Intake presents the developmental social and anthropological aspects of salt intake This book explores the existing knowledge of those factors that influence man's appetite for salt Organized into five parts encompassing 28 chapters this book starts with an overview of the pathological and physiological importance attached to levels of salt intake in health and in disease This text then examines the scientific information concerning the nature of man's appetite for salt and the variations of that appetite as an expression of biological needs behavioral patterns differing environmental conditions and normal or disturbed physiology Other chapters examine the plasma renin activity urinary sodium excretion and taste responses of hypertensive and normotensive individuals The final chapter explores the relations between taste intake preference and hypertension This book is a valuable resource for nutritionists food scientists and researchers interested in the planning of nutritional programs in public health or therapeutic regimens **A Perspective on Opioid Addiction** Jay Schulkin, Bryce Huebner, 2025-09-30 Today the opioid crisis often feels intractable This book offers a wider perspective on its underlying causes examining the biological psychological and social aspects of addiction and the interactions among them Jay Schulkin a behavioral neuroscientist and Bryce Huebner a philosopher explore the complexities of opioid addiction through a distinctive combination of neuroscientific knowledge and pragmatist thought They detail the biological and neurological processes that shape and sustain addiction showing why opiates power to ease pain makes us vulnerable to abusing them The book discusses the relationship between addiction and depression the dilemmas of pain management and the meaning of recovery Schulkin and Huebner underscore the stigma that marginalizes people who struggle with addiction and the social factors that shape access to treatment and care calling for a focus on harm reduction They consider questions of individual and social accountability reflecting on choice autonomy and freedom Interdisciplinary and wide ranging this

book brings deep learning empathy and insight to understanding the experience of addiction

**Encyclopedia of Neuroscience, Volume 1** Larry R. Squire, 2009-06-12 The Encyclopedia of the Neuroscience explores all areas of the discipline in its focused entries on a wide variety of topics in neurology neurosurgery psychiatry and other related areas of neuroscience Each article is written by an expert in that specific domain and peer reviewed by the advisory board before acceptance into the encyclopedia Each article contains a glossary introduction a reference section and cross references to other related encyclopedia articles Written at a level suitable for university undergraduates the breadth and depth of coverage will appeal beyond undergraduates to professionals and academics in related fields

**Mental Health Research Institute Staff Publications** University of Michigan. Mental Health Research Institute, 1974

**Reducing Salt in Foods** Cindy Beeren, Kathy Groves, Pretima M. Titoria, 2019-06-18 Reducing Salt in Foods Second Edition presents updated strategies for reducing salt intake The book contains comprehensive information on a wide range of topics including the key health issues driving efforts to reduce salt government action regarding salt reduction and the implications of salt labeling Consumer perceptions of salt and views on salt reduction in different countries are also discussed as are taste processing and preservation functions of salt and salt reduction strategies Final sections discuss salt reduction in particular food groups including meat and poultry seafood bread snack foods dairy products and canned foods each one including a case study This updated edition also includes a new section on the future of salt reduction the development of new ingredients to replace salt salt reduction in catering and how to teach new generations to adjust salt levels from an early age Completely revised and updated with an overview of the latest developments in salt reduction Presents guidelines to help with reducing salt in specific product groups Presents a new section on the future of salt reduction development of new ingredients to replace salt salt reduction in catering and how to teach new generations to adjust salt levels from an early age Contains new chapters on preservation issues taste issues and processing issues when reducing salt in food along with case studies that illustrate salt reduction

**Appetite and Food Intake** Ruth Harris, Ruth B.S. Harris, Richard D. Mattes, 2008-02-21 A complex interplay of social economic psychological nutritional and physiological forces influence ingestive behavior and demand an integrated research approach to advance understanding of healthful food choices and those that contribute to health disorders including obesity related chronic diseases Taking a multifaceted approach Appe

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web complete the changes in concentrations for each of the following reactions baso 4 s ba 2 a q so 4 2 a q x ag 2 so 4 s 2 ag a q so 2 4 a q x al oh 3 s al 3 a q 3 oh a q x pb oh cl s pb 2 a q oh a q cl a q x

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web purpose identify the ions present in various aqueous solutions systematically combine solutions and identify the reactions that form precipitates and gases write a balanced molecular equation complete ionic equation and net

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