
Preface

The future. It is not simply movement through time from year to year... It is day to day, moment to moment. As moments progress and our future unfolds, we grow, we change, we adapt, and we learn; we know more from one moment to the next. **How do we know more tomorrow than we do today?** Knowing more tomorrow requires the capability to learn and form memories, in turn bestowing upon us this glorious lifetime of knowing who we are. Our ability to remember moments gives us our sense of self. Indeed, isn't it true that our memories make us who we are? Learning and novel memory formation allow us to update our world and permit adaptability. This means we can gain and revise knowledge and skills; strangers become familiar friends, new facts become learned information, and skill sets for things we enjoy, such as cooking, playing musical instruments, and effectively using new apps on our iPhone, become acquired. Learning and remembering, from an evolutionary perspective, allow animals to survive in a world ripe with evolving situations and environments.

Scientific knowledge of learning and remembering, including what happens in the brain during these processes, has great breadth and depth. The field has a rich, diverse, and sometimes unexpected, history. Of note, while scientists have made considerable discoveries thus far, there is still much left to discover about learning and memory processes. Questions regarding the search for the memory trace, or the engram as famously discussed by Karl Lashley in the 1950s, have persisted through the decades. As reflected in this book, this research area is not losing steam. In fact, like many scientific domains, the more we learn, the more novel questions materialize and become ripe for answering. We have had illuminating and exciting breakthroughs in the field in the last few decades, and we are surely on the cusp of more. As a scientist studying learning and memory, I anxiously await tomorrow to see what discoveries ever-changing technology and new experiments unearth! All discoveries have a history; they have a science, and a scientist, behind them. Amidst the brilliant foundations of discovery that have been laid out before us by learning and memory scientists is the insight that these experimentalists taught us, not only about the science of learning and remembering, but also about what powerful intellect and generous amounts of creativity could bestow to the scientific world. When peering into a great scientific finding through a looking glass, it is clear that the gem that is research discovery is composed of many facets via the scientist; it is forged from intellectual prowess and brilliant curiosity, but also from creative energy and illuminating insight. Of course, no research is internally flawless. All findings have at least slight inclusions that need to be interpreted in the context of all facets of the research discovery gem. Doing great science takes the courage to think outside of the box when necessary, acknowledging the multifaceted nature of accurate interpretation to yield the truth. Intellect, curiosity, creativity, insight, courage: great scientists encompass these traits.

Approximately 4 years ago, when I was in the planning stages of this book, my vision was to respect and lay out the history of learning and memory science, as well as the trajectory taken by the great scientists who made the discoveries. **To do optimal science and look forward to the future, stand on the shoulders of giants and peer backward we must.** It may seem ironic that we must peer backward to look forward, but, indeed, it is true.

Included in the vision for this book was the goal to provide information to help set up the next generations of learning and memory scientists by arming them with the tools necessary to test their own learning and memory questions using rodents and mazes. I believe that the deeply focused, creative, and insightful contributions from the authors have resulted in meeting this goal. I am indebted to them for devoting substantial time and effort in order to share their in-depth knowledge, ideas, and personal experiences with our readers. Gratitude is also extended to series editor Wolfgang Walz for guidance, and Springer editors David Casey and Patrick Marton for providing expert advice, endless cheerleading, and editorial genius.

Learning and memory research includes and spans the invertebrate level, from the simple marine mollusk *Aplysia californica*, to rodents, to nonhuman primates, to humans... We have a lot to talk about! Research in rats and mice has been especially abundant, and this work has pioneered dramatic discoveries by unlocking some of the mysteries of learning and memory. This book delivers a laboratory roadmap of testing cognition in the rodent, providing a manual for scientists wishing to implement this in their laboratories, and for scholars interested in this field. While rodents and mazes are the main center and focus of this book, many aspects in the field of learning and memory are discussed and detailed, spanning from the molecular to the human. Every chapter gives a respective comprehensive review of historical milestones to provide context of past discoveries, new findings, and future studies. Didactic foundations, operational definitions, and theory, as well as practical experimental and apparatus setup, data analysis, and interpretation instructions, are included in Part I (entitled: “*Why? Foundations of rodent learning and memory: milestones, mazes and mechanisms*”) and step-by-step protocols, troubleshooting, and tips are delivered in Part II (entitled: “*How? The mazes: protocols and practice to test rodent cognition*”). The format is straightforward, clean, and direct, and set in a casual tone with personal accounts chronicled by expert scientists throughout.

As discussed in this book, more than six decades ago, Karl Lashley proclaimed a search for the engram. *Has there been a wealth of research that has dramatically increased our understanding of where, and how, in the brain learning and remembering happens? Absolutely, yes! Have we finished our search? Absolutely, no! We must continue our search for the memory trace, using great resolve and ingenuity, taking an interdisciplinary approach that is rooted in sound science to hunt for the truth in nature.* Before you move on in this book to learn a more detailed history of the science of learning and remembering, and the specific protocols used to study rodent memory, I leave you with my favorite quote from Lashley that I first read while sitting on the floor of the dusty periodical section of the University of Connecticut library basement as a first year graduate student. This quote is motivating to me since I, probably not unlike you (as you are indeed reading the Preface of a book about methods of science), am driven to figure things out and will not accept only knowing where the “memory trace is not”...

This series of experiments has yielded a good bit of information about what and where the memory trace is not. It has discovered nothing directly of the real nature of the engram. I sometimes feel, in reviewing the evidence on the localization of the memory trace, that the necessary conclusion is that learning just is not possible. It is difficult to conceive of a mechanism which can satisfy the conditions set for it. Nevertheless, in spite of such evidence against it, learning does sometimes occur.

(page 477, Lashley, 1950)

May you find your own inspiration in the words of whichever scientists rouse you, and as you perform the science that is your passion, unearth your own beauty in scientific discovery and the truth in nature.

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Reference

Lashley (1950) Edited by: RJ Pumphrey. In search of the engram. Society of Experimental Biology Symposium No. 4; Physiological Mechanisms in Animal Behaviour, 454–482.

The Maze Book

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