

*Science Is Lovable—
Volume 2 of
Explaining Mysteries
of Living (Expanded)*

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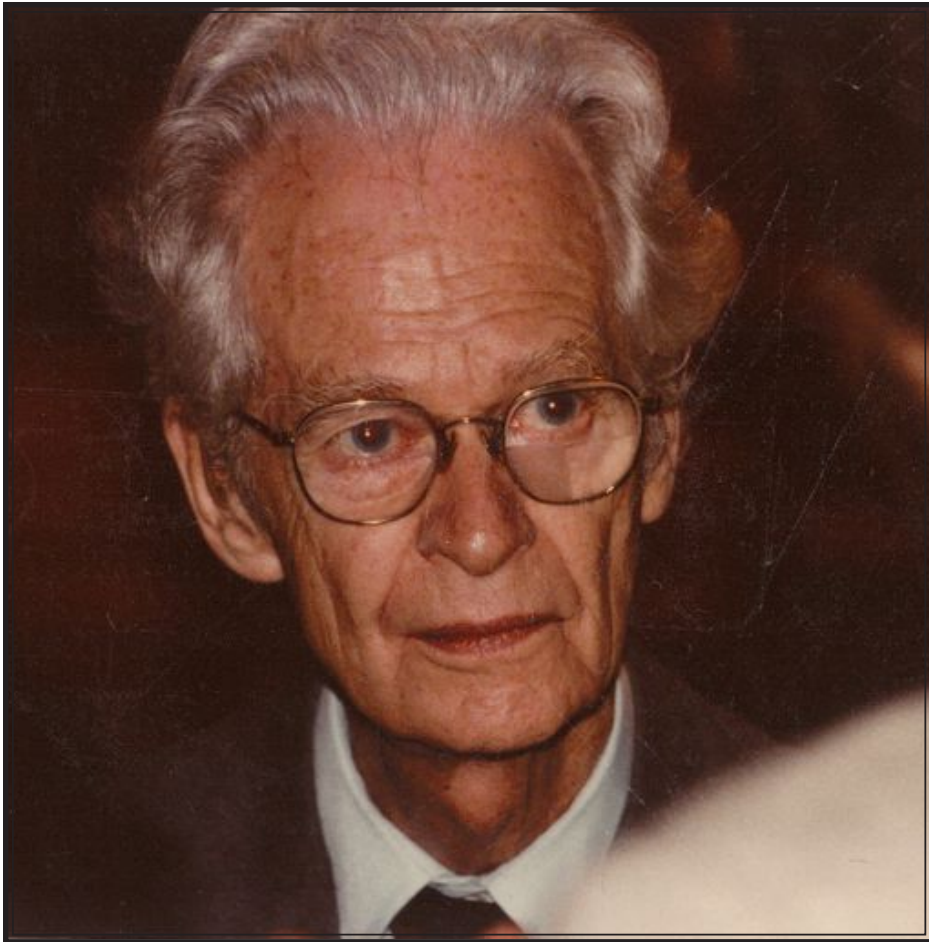


Photo by Stephen F. Ledoux

Burrhus Frederic Skinner

(1904–1990)

Conversing at a convention in 1982

The products of the contingencies of his life established behaviorology.

*Science Is Lovable—
Volume 2 of
Explaining Mysteries
of Living (Expanded)*

Stephen F. Ledoux

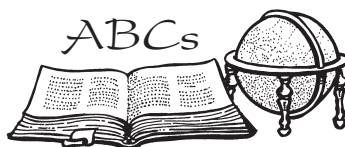
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Science Is Lovable—Volume 2 of Explaining Mysteries of Living (Expanded)

Stephen F. Ledoux, Ph.D.

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This book provides information regarding the subject matter covered with the understanding that the author and publisher are not providing *any* professional services; if problem behaviors occur, and expert assistance is desired or required, contact a competent applied behaviorologist or BCBA (Board Certified Behavior Analyst). The publisher and author hereby exclude all liability to the extent permitted by law for any errors or omissions in this book and for any loss, damage, or expense (whether direct or indirect) suffered by a third party relying on any information contained in this book.☺

Books by Stephen F. Ledoux

Study Questions for Paul De Kruif's Microbe Hunters (1972).

Grandpa Fred's Baby Tender, or Why and How We Built Our Aircrabs
with co-author Carl Cheney (1987; a free download at www.behaviorology.org).

The Panda and Monkey King Christmas—A Family's Year in China
with first author Nelly Case (1997).

Eight other books of *Study Questions* for various texts, one with two co-authors
(1999–2015; see BOOKS at www.behaviorology.org).

Behaviorology Majors Make a Difference
with 11 student authors (2013; a reassembly of a 1977/1979 book).

Running Out of Time—Introducing Behaviorology to Help Solve Global Problems
(2014; a textbook for majors and graduate students).*

An Introduction to Verbal Behavior—Second Edition
with first author Norman Peterson (2014; a verbal-behavior workbook).

Origins and Components of Behaviorology—Third Edition
(2015; a book of readings).*

Beautiful Sights and Sensations—Small Collections of Native American and Other Arts
(2016; this book includes not only a scientifically grounded definition of art,
but also a discussion of the Chinese signature seals that appear at the end of
some parts of the author's works, including this one—see the *Introduction*).

What Causes Human Behavior—Stars, Selves, or Contingencies?
(2017; a general-audience primer).*

Science Works on Human Behavior
(2018; a book of readings).*

Catalog of Select Art Photographs by Stephen F. Ledoux (2019).

*Explaining Mysteries of Living (Expanded)**
(2021; this first volume contains 72 newspaper columns covering basic topics
in the natural science of behavior, plus color graphics and supporting papers).

Science Is Lovable—Volume 2 of Explaining Mysteries of Living (Expanded)
(2021; this second volume contains 72 more newspaper columns covering
deeper topics in behaviorology, plus color graphics and supporting papers).📖

* The Appendices contain the *Table of Contents* for these titles to aid finding details about topics mentioned in the 72 newspaper columns. All of these books, and more, have full descriptions on www.behaviorology.org (and can be obtained, “Print-On-Demand,” from www.lulu.com by clicking the magnifying glass and entering the author's name).

On Typography & Related Resources

Part I of this book is set left, in the Times New Roman typeface collection, because the 72 pieces in Part I originally appeared as newspaper columns, and this is a common typeface for newspapers. The rest of this book is set justified, in the Adobe Garamond, Adobe Garamond Expert, and Tekton collections of typefaces.

In addition, a valuable basis for the typographic standards of this work deserves acknowledgment. As much as possible, this book follows the practices described in two highly recommended volumes by Ms. Robin Williams (both of which Peachpit Press, in Berkeley, CA, USA, publishes). One is the 1990 edition of *The Mac is Not a Typewriter*. The other is the 1996 edition of *Beyond the Mac is Not a Typewriter*.

For example, on page 16 of the 1990 book, Williams specifies practices regarding the placement of punctuation used with quotation marks, an area in which some ambiguity has existed with respect to what is “proper.” In addition the present book follows the advice in these books about avoiding “widows” (which is the name for leaving less than two words on the last line of a paragraph) and “orphans” (which is the name either for leaving the first line of a paragraph alone at the bottom of a page, or for leaving the last line of a paragraph alone at the top of the next page).

Also, since some confusing alternatives remain regarding the use of hyphens and dashes, this book would simply limit hyphens to separating the parts of words that break at a line end, although this book never breaks words at line ends, because good software (e.g., Adobe InDesign5) makes that old, hard to read practice unnecessary. (Too many publishers think that this—hyphenless lines, especially with “justified” lines, like on this page—is impossible without producing “rivers of white,” but the book you hold in your hands, and all of the books described in the appendices of this book, among others, which are justified throughout, prove otherwise.)

Beyond hyphens, “en dashes” most commonly separate the whole words of compound adjectives, and “em dashes” most commonly set off multiple-word—a compound adjective with an en dash—phrases or clauses (as with these examples). These easy-reading characteristics developed across humanity’s centuries of successful printing-press practices. Be aware, however, that ebook formatting, while it has its own benefits, typically destroys most of these easy-reading characteristics.

You can address correspondence regarding this book to the author (at ledoux@canton.edu). For more information, visit www.behaviorology.org where you can find all the back issues of the journal of TIBI (The International Behaviorology Institute). Previously named *Behaviorology Today* (ISSN 1536-6669), TIBI renamed it *Journal of Behaviorology* (ISSN 2331-0774) in 2013. This journal became fully peer reviewed as of January 2012 under the older name. You can also find full descriptions of most of the author’s books, and behaviorology books by others, on this website. ☺

Table of Contents

✂ *Books by Stephen F. Ledoux ... v*

✂ *On Typography & Related Resources ... vi*

✂ *About this “expanded” Edition ... xiii*

PARTS I–IX: The Second Set of “Exploring Mysteries of Living” Newspaper Columns ... 3

✂ *Notes Regarding All the Columns ... 4*

✂ *Introduction (Traditionally called the Preface) ... 5*

PART I: Examples, Styles, Behaviorisms, and the Questions of Values, Rights, Ethics, and Morals ... 9

1 [Column 1] *Welcome Back ... 9*
[Why we can and should bother about a natural science of human behavior.]

2 *Example and Style Constraints Support Content ... 14*
[Accepting complexity and agential verbal shortcuts.]

3 *Current Efforts Supersede Past Views ... 17*
[Some details on different types of behaviorism.]

4 *Reinforcers Produce Values ... 20*
[Reinforcers become values.]

5 *Speak Up For Rights ... 25*
[Values lead to rights claims.]

6 *Explore Ethics ... 29*
[Rights require ethics respecting them.]

7 *Power Plays Violate Ethics ... 32*
[Ethics versus power plays by boss-like folks.]

8 *View Morals With Moderation ... 34*
[Morals are ethics that can become dangerously unchangeable abstractions.]

9 *Moderation Avoids Morals Fallout ... 37*
[Some morals have dangerous problems that hurt humanity.]

PART II: The Question of Experimental and Practical Research ... 41

- 10 *Tools and Methods Tackle Behavior Laws ... 41*
[Operant chambers as laboratory tools.]
- 11 *Technology Provides Behavior Laboratory Tools ... 46*
[Operant chambers and cumulative recorders.]
- 12 *Reversal Designs Serve as Laboratory Methods ... 52 / 53*
[ABAB/Reversal designs.]
- 13 *Methodology Addresses Variability and Confidence ... 57*
- 14 *Reversal Designs Help in Applied Settings ... 61*
[ABAB/Reversal designs.]
- 15 *A Reversal Design Deals With the Brat–Syndrome ... 66 / 67*
[An applied–setting research example.]
- 16 *Multiple–Baseline Designs Help in Applied Settings ... 72*
- 17 *A Multiple–Baseline Design Deals With the Brat–Syndrome ... 78 / 79*
[An applied–setting research example.]
- 18 *Past Researchers Required Single–File Responses ... 85*
[Response–succession procedures.]
- 19 *Research Explores Simultaneous–Response ... 90 / 91*
[A complex human–behavior research experiment develops the
Multiple Selector–Source Procedure.]

PART III: The Question of Language as Verbal Behavior ... 97

- 20 *People Speak, Sign, and Write So Much ... 97*
[Language is verbal behavior.]
- 21 *Humans, Language, and Verbal–Behavior Analysis Arose Slowly ... 102*
- 22 *Languages Dance with Verbal Communities ... 106*
- 23 *Verbal Behavior Shows Scientific Characteristics ... 110*
[Function over structure, no new principles, and sense modes.]
- 24 *Speakers, Listeners, and Audiences Have Different Functions ... 113*
- 25 *Responses, Products, and Controls Differ ... 117*
[Responses and response products, and thematic and formal controls.]

- 26 *Some Fancy VB Stuff Made Easy* ... 120
[Point-to-point correspondence and formal similarity.]
- 27 *Verbal Mands Get Stuff* ... 124 / 125
- 28 *Tacts Name Stuff That Intraverbals Relate* ... 129
- 29 *Verbal Codics Code Stuff* ... 133
[Textuals, taking dictation, reading, and intraverbal reading of Chinese characters.]
- 30 *Verbal Duplics Duplicate Stuff* ... 138
[Echoics, copy texts, and mimetics.]
- 31 *Same Words Equal Different Repertoires* ... 141
- 32 *Science Improves Teaching Non-Native Languages* ... 145
- 33 *Make Learning Languages Easier and Fun* ... 148
- 34 *Fun Language Corrections and Game Rooms Help* ... 151
- 35 *Language Dining Tables and Dorms Help* ... 155
- PART IV: The Question of Consciousness ... 159**
- 36 *Science Clarifies and Reuses Old Labels* ... 159
[For example, “consciousness.”]
- 37 *Many Parameters Enrich the Consciousness Topic* ... 163
[For example, physiology deals with *how*... and behaviorology deals with *why*....]
- 38 *Humans Misunderstood Consciousness for Millennia* ... 167
[Ancient and modern pre-scientific notions about consciousness.]
- 39 *A Scientific View Considers Animal Consciousness* ... 170
- 40 *Covert Stimuli and Responses Provide Reasonable Access* ... 174
[The “publics of one” and traditional and additional sense modes.]
- 41 *Behavior-Behavior Relations Enhance Interpretation of Consciousness Responses* ... 177
- 42 *Covert Reflex Behaviors Often Precede Covert Operant Behaviors* ... 180

- 43 *Sensations of Self Awareness Satisfy* ... 184
[Plus the status of the past, the future, and memories.]
- 44 *Consciousness Combines Neural Functions and Behavior Chaining* ... 188
- 45 *Behaviors of Consciousness Sequence Into Steps* ... 191
- 46 *Consciousness Behaviors Comprise Single-Channel Processes* ... 195
- 47 *Some Safety on the Road Comes From Consciousness Responses* ... 198
- 48 *Scientifically Understanding Consciousness Benefits From Practice* ... 202
- PART V: The Questions of Life, Personhood, and Death Plus the Law of Cumulative Complexity ... 207**
- 49 *Life, Personhood, and Death Interrelate* ... 207
- 50 *The Law of Cumulative Complexity Counters Old and New Misunderstandings* ... 212 / 213
- 51 *Science Gives Meaning to Life and Living* ... 217
- 52 *Life and Living Extend Nature to Personhood* ... 221
- 53 *Science Gives Meaning to Life* ... 225
- 54 *Science Studies Death and Dignified Dying* ... 229
[Plus the overpopulation problem and some non-coercive, humane solutions.]
- 55 *Science Recognizes Three Kinds of Death* ... 233
[Social, person, and body.]
- 56 *The Body Can Get Confused With the Person* ... 237
- 57 *Science Supports Dignified Dying* ... 240
- PART VI: The Question of Reality ... 245**
- 58 *The Nature of Reality Surprises People* ... 245
- 59 *Facing Reality Means Facing the Quite Unexpected* ... 249

- 60 *The Robotic Perspective Applies to Robots Too ...* 253
- 61 *Reality Can Go Unestablished or Established or Misestablished ...* 257
- 62 *Considering Ordinary Examples Enhances Understanding Reality ...* 260
- 63 *Considering Daily Downers Enhances Understanding Reality ...* 264

PART VII: The Question of Robotics ... 269

- 64 *Robots Wonderfully Complicate Things for Humans ...* 269
- 65 *Robots Can Be Complicated Life Forms Too ...* 272
- 66 *Robot Life Topics Reflect Human Concerns ...* 276
- 67 *Give Robots At Least What Humans Have ...* 280
[Includes a review of some respondent and operant contingencies that also apply to robots.]
- 68 *Many Topics Remain Important to Both Humans and Robots ...* 284
[These include emotions and feelings, energy sources, reproduction, pre-installed experience, planned diversity, and humor.]

PART VIII: The Question of Evolutions ... 289

- 69 *Three Types of Evolution Explain More ...* 289
[Biological evolution from natural selection, repertoire evolution from behavioral selection, and cultural evolution from group-practices selection (also called cultural selection).]
- 70 *Culturology Helps Study Cultural Evolution ...* 293
[Three disciplines occur on the life-science continuum: biology, behaviorology, and culturology.]

PART IX: The Question of Behaviorology Helping People Solve Global Problems ... 297

- 71 *Jobs Abound for Contingency Engineers But Degree Programs Remain Scarce ...* 297
- 72 *Everyone Can Help Solve Global Problems ...* 301 / 302

PART X: Some Column–Supporting Articles ... 307

- 73 *The Law of Cumulative Complexity
Reduces Old and New Misunderstandings ... 307*
- 74 *An Applied Behaviorology Credential (ABC) for
Interested BCBA's [Board Certified Behavior Analysts] ... 317*
- 75 *Open Letter Addressing Coercive Practices ... 347*

APPENDICES ... 353

[the *Tables of Contents* (TOC) for each of several books
covering topics mentioned in the 72 newspaper columns]

- Appendix 1: The Table of Contents for Running Out of Time—
Introducing Behaviorology to Help Solve Global Problems ... 353*
- Appendix 2: The Table of Contents for What Causes Human Behavior—
Stars, Selves, or Contingencies? ... 356*
- Appendix 3: The Table of Contents for Origins and Components of
Behaviorology—Third Edition ... 359*
- Appendix 4: The Table of Contents for
Science Works on Human Behavior ... 361*
- Appendix 5: The Table of Contents for
Explaining Mysteries of Living (Expanded) ... 363*
- ✂ *A Very Short Bibliography ... 369*
- ✂ *About the Author ... 375* ♡

About this “Expanded” Edition

During the year that followed the publication of the original editions of both the first and second books of newspaper columns, work began on the development of the www.BehaviorInfo.com website, which is to provide open access to the scientific information in the columns presented in these books. As part of these development efforts, various supporting graphics got paired with just over half of the columns.

The design of those graphics aimed at visually improving the information content of the associated columns in their appearance online. A handful of these graphics already appeared with their columns, because they were already directly connected with the column contents. While the rest of the graphics played supplemental roles with their columns, reader/viewer feedback suggested that this role was valuable enough to include these graphics with their columns in the *expanded* edition of these books. (Except where specified otherwise, the author is also the photographer for these graphics.) Like the first book, this second book also now includes additional papers supportive of the column topics.

On an historical note, as the 2020 health crisis developed, the local paper carrying these columns found that its pages were needed for too many other different kinds of crisis-related articles. As a result the paper put these science columns on pause. In their place appeared various article types that provided stress relief (e.g., articles and photos about pets and recipes). This seemed to the editors to be more beneficial during the ongoing health crisis than science articles, even though these science articles address many of the concerns for which people were seeking knowledge and skills so that they could deal more effectively with them, especially during the crisis (e.g., parenting, education, domestic coercion, smoking control)... So the paper ran several newspaper-designed, paid ads—like the one on the next page—so that interested readers could know that alternatives existed for continuing with this series of columns.☺

Los Alamos Daily Post Columnist Stephen F. Ledoux
“Now more than ever, everyone needs to know more about the principles and practices of this science to help solve new problems arising from health crises, as well as other ongoing local and global problems.”



*Explaining
 Mysteries of Living
 & Science is Lovable*



Learn about science discoveries concerning:
 parenting, education, love, ghosts, genes, gambling,
 superstition, bribery, nutrition, ethics, morals,
 consciousness, reality, robotics, musical skills,
 domestic violence, quitting smoking, solving global problems,
 ten commandments of natural science and many more.

NO NEED TO WAIT for the series of 72 columns on
the natural science of behavior to resume. GET THEM ALL!

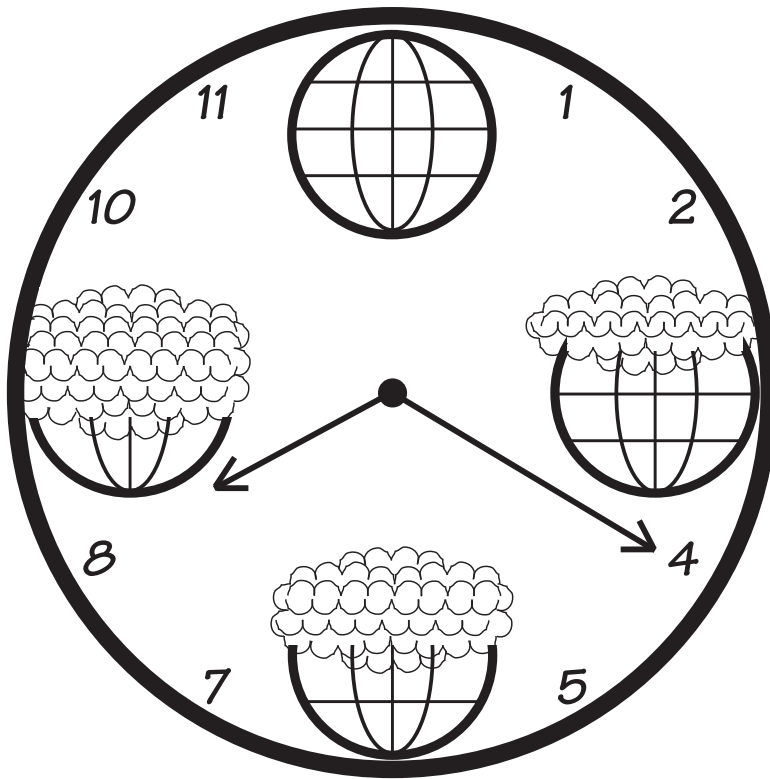
Order both volumes at www.lulu.com

Visit the Books Page at www.behaviorology.org to learn more

Summer 2020 Ad about the Newspaper–Column Books

*Science Is Lovable—
Volume 2 of
Explaining Mysteries
of Living (Expanded)*

Back by popular *necessity*; 72 more newspaper columns cover deeper topics in behaviorology, plus more supporting papers.♣



Running Out of Time

PARTS I–IX

*The Second Set of
“Exploring Mysteries of Living”
Newspaper Columns*

(Each of the 72 columns, in this second set of 72 columns, shares the basic title of “Exploring *More* Mysteries of Living.”)

[Part X—*Some Column–Supporting Articles*—
completes this book’s main content.]

Notes Regarding All the Columns

Each of the columns in this book originally repeated this brief rationale for the whole series of columns, although for columns in this book, this rationale only appears on this page and at the start of the first column of each Part:

“Why these columns? Because human behavior causes global problems, and solving these problems requires changes in human behavior... So *everyone* really benefits from knowing something about the natural science of human behavior that these columns describe. (See the 72 columns in the first set, in the *Explaining Mysteries of Living* book, for the *basics* of the science these columns describe.)”

Plus, as it develops, the www.BehaviorInfo.com website provides readers with occasional video clips of the author answering questions about some of the topics in the columns. (The clips come from a video interview. The MEDIA page on www.behaviorology.org has a full description. The author describes this video as “aurally interesting but visually boring.”) The www.BehaviorInfo.com website may also contain questions and comments from readers and answers and replies by the author.♣

Also note that each of these newspaper columns originally featured a small version of the 2012 photo of the author on the left. The more recent photo, on the right, only became available in early 2020 after the author had already written many of the columns for this second set, so newspapers did not get this photo. For the columns in this book, these photos only appear on this page and in “About the Author” at the back of the book.☺



College January 2012 portrait photo courtesy of SUNY-Canton



January 2020 photo...

Introduction (Traditionally called the *Preface*)

Back by popular necessity! The first newspaper column of the 72 that appear together in the previous volume (i.e., in the book, *Explaining Mysteries of Living*) reminded readers of the general need behind all these columns. Given the role of human behavior in causing global problems, and the need for changes in human behavior to solve global problems, this general need is for *everyone* to know more about the natural science of human behavior. And *now* is better than later, given the shrinking time frame for solving global problems that the problems themselves give us. This need extends beyond that first set of columns. Indeed it provides the main reason for this second set of columns, as the first newspaper column of the second set, in this book, reminds us again.

That first set of columns (which this second set presumes the reader has read) mostly covered the fundamental topics that enable readers to appreciate the deeper topics of the science. Those fundamental topics included a range of the principles, concepts, and practices needed to understand and engineer basic applications of the science to solve individual, local, and global problems. (See Appendix 5 in this book for the list of topics, by column title, in that first set of columns.) Various constraints, however, such as the length and minimal stand-alone status of each of the earlier columns, prevented that first set of columns from covering the longer, more involved, deeper topics in the discipline. These topics, now covered in this second set of columns, concern the extensions, elaborations, implications, and interpretations of the science.

The topics of this second set of columns consider methodology and some initial scientific answers to some of humanity's ancient but as yet inadequately answered questions. Continuing where the first volume left off, these columns cover some research methodology of the science and provide some scientific answers to ancient questions regarding values, rights, ethics, morals, language, consciousness, personhood, life, death, reality, and even the more recent topics of robotics and evolution, while remaining concerned to help humanity deal with individual, local, and global problems.

Furthermore, as implied in the earlier column on "recombination of repertoires," (see column 55 in the *Explaining Mysteries of Living* book) some familiarity with the extensions, elaborations, implications, and interpretations of the science (i.e., its deeper topics) substantially improves one's understanding, appreciation, and application of the science itself. Taking *all* these parts of the science together (i.e., the fundamentals *and* the deeper topics) makes impossible any tendency to see the science as merely a cook-book approach to contingency management or contingency engineering for designing and implementing interventions to solve problems.

People's comprehension of all these topics also provides perhaps the best means to deal with, and even prevent, misuses of this science, because people familiar with the science would be less likely to be susceptible to or fooled

by misuses. Such a subtopic arose in several columns, particularly when the main column topic concerned applications of some principle or concept of the science for which certain variations are *harmful to people's well being*. In many cases these variations were in use (i.e., in misuse) long before, even thousands of years before, the science existed and discovered its principles and concepts (e.g., variations that contingencies induced purveyors of games of chance to apply in ways that induced their victims into more losing behavior).

Continuing the thrust of the earlier volume of newspaper articles, this new volume also complements my previous textbook and general–audience primer as well as my other books of readings. And again, by sharing bits of wisdom from exploring some behavior mysteries of living, this accessible Volume Two serves both new readers and those experienced in the discipline.

After retiring, my interactions with various groups led to several talks, and then to requests for more details, short of book–length treatments. These sets of newspaper columns filled such requests. Subsequent requests for each complete set of columns in a single source led to these books. For people under contingencies to satisfy an interest in why behavior happens, these writings provide some material to fill some of that interest. (Contact the author for steps you might take to see *your* local paper run these sets of columns.)

This book contains the full second set of behavior–related newspaper columns, this time covering deeper topics in the science and its philosophy (i.e., its assumptions). Of course, these newspaper columns are not psychology, because the natural science of behavior, behaviorology, that they discuss is neither a part of, nor any kind of, psychology. No column in this book has previously appeared in any of my books of readings. However, some excerpts from my 2017 general–audience book (i.e., *What Causes Human Behavior—Stars, Selves, or Contingencies?*) and from my 2014 textbook (i.e., *Running Out of Time—Introducing Behaviorology to Help Solve Global Problems*) will seem similar to some columns.

A young behaviorology—only 75 years old when made independent under the behaviorology label in 1987—needed the opportunity to develop as well as to help solve individual, local, and global problems. That contingency–driven separation of the natural science of behavior from its somewhat coincidental shared history with psychology work units (see the article by Fraley & Ledoux, 2015, in the references for details) induced several authors, including me, to commit most, if not all, of their post–1987 writing to expanding the explicit disciplinary literature of behaviorology. As a result a growing disciplinary literature now exists, including the writings in this book.

For full references to many of those works, and to many of the pieces mentioned in these columns, see the short bibliography in this book as well as the much longer bibliography in Ledoux, 2014, in the references. Also, see the five–year indexes of the behaviorology journal that appear online at www.behaviorology.org. That is the website of The International Behaviorology Institute (TIBI).

This book divides the second newspaper–column set into *Parts* (*Part I* through *Part IX*). Each *Part* contains mostly topically related columns. Every column shares the general title “Exploring More Mysteries of Living.”

Each column also has its own specific title. For publication in this book, these columns retain their set-left newspaper-column format, in the Times New Roman typeface family in which they were originally set. (Individual newspapers may have made changes that result in differences between the columns in this book and the versions that they printed.)

After those *Parts* comes *Part X*. This Part contains the column-supporting papers for this ... *Volume 2...* book. The first one provides more details about the Law of Cumulative Complexity, which gets covered more briefly in Column 50 in this book, while the other two articles address broader topics.

Then come the *Appendices*, containing the regular *Table of Contents* of my books that focus on the natural science of behavior. The list of topics in these *Tables of Contents* offers another easy way to find further material for details on any of the many behavior topics that might interest you. (The supporting papers, these appendices, and other parts of the book, like this Introduction, are set justified in the Adobe Garamond and Tekton collections of typefaces.)

Note that in Part II of the previous volume (i.e., in the *Explaining Mysteries of Living* book) half a dozen supportive articles followed the columns. You can find the titles/topics of these articles in Appendix 5 in this book. One of these articles covered the topic of “ten commandments of natural science”; another covered the topic of “culturology,” which is a name for the closely related natural science concerned with the effects of contingencies on the behavior of people in groups, and the resulting group-produced effects that often outlast the life spans of the individuals in the groups (e.g., society’s formal education arrangements and institutions). Hopefully you will find the other topics equally interesting,

Every one of the newspaper columns in this second set starts with that “Exploring More Mysteries of Living” title, because this is what each column does; it explores some mystery of living, of behavior, beyond the columns in the first set. (Each column in the first set carried the title, “Exploring Mysteries of Living,” without the word “more.”) Taken together, however, all the columns *explain* mysteries of living, which gave the first volume of these columns its title.

On the other hand, the title, *Science Is Lovable...*, helps keep that first volume separate from this ... *Volume 2...*, which is the second set of columns. This title comes from various places, in both the first set of columns, and this second set, where the emotional admission appears, “I love science.” These admissions tend to occur in locations covering material of particularly thrilling value or importance for humanity to understand itself better, as an elaboration of the more individual, ancient dictum to “know thyself.” Perhaps this title will help us all better recognize that science satisfies emotionally as well as intellectually, a reality that supports humanity well, especially in the long run. (Also, column 27, in the first set of columns, already provided a scientific discussion of love itself.)

Many other behaviorology books, on a range of topics, receive full descriptions on the BOOKS page both at www.behaviorology.org (which especially changes after the release of each issue of the *Journal of Behaviorology*) and at www.BehaviorInfo.com. You will not regret finding a few moments to peruse these websites.♣

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- Fraley, L. E. & Ledoux, S. F. (2015). Origins, status, and mission of behaviorology. In S. F. Ledoux. *Origins and Components of Behaviorology—Third Edition* (pp. 33–169). Ottawa, Canada: BehaveTech Publishing. This multi–chapter paper also appeared across 2006–2008 in these five parts in *Behaviorology Today*: Chapters 1 & 2: 9 (2), 13–32. Chapter 3: 10 (1), 15–25. Chapter 4: 10 (2), 9–33. Chapter 5: 11 (1), 3–30. Chapters 6 & 7: 11 (2), 3–17. See the JOURNAL page at www.behaviorology.org. (See the Bibliography at the end of this book for more options.)
- Ledoux, S. F. (2014). *Running Out of Time—Introducing Behaviorology to Help Solve Global Problem*. Ottawa, Canada: BehaveTech Publishing. Now available “Print–On–Demand” at www.lulu.com (click the magnifying glass and enter the author’s name).☺

Stephen F. Ledoux
Los Alamos NM USA
2020 November 23





PART I

*Examples, Styles, Behaviorisms,
and the Questions of
Values, Rights, Ethics, and Morals*

**[Column 1] Exploring More Mysteries of Living:
Welcome Back**

by **Stephen F. Ledoux**

A Los Alamos member of **The International Behaviorology Institute**

Welcome to more columns scientifically exploring some of the mysteries of life and living, especially the behavior-related mysteries. Welcome to “more” columns, because this new set of columns follows an earlier set that was titled simply “Exploring Mysteries of Living.”

Behaviorology, a little known but more than 100-year-old, natural science of behavior supplies the informing science. This status of being “little

known” provides one of the main reasons for these columns. Some length and stand-alone constraints led the earlier set to stop after 72 columns, because these constraints seemed too tough for tackling the deeper, more involved topics of the science.

Yet that earlier set only covered the scientific fundamentals that enable readers to appreciate these deeper topics. Those fundamental topics included a range of the principles, concepts, and practices needed to understand the basic applications of the science for solving individual, local, and global problems.

Interested readers of the earlier set, however, have demanded more. So here begins “the rest of the story” (with thanks to Paul Harvey). And it *needs* to be told. So in this second set, the columns are “back by popular *necessity*.” Where those earlier constraints got in the way, this set puts them aside in favor of meeting the interest in these deeper scientific topics.

In this second set of columns those deeper topics concern the methodology, extensions, elaborations, implications, and interpretations of behaviorological science. More specifically, these topics address some of the research methods of this science along with its initial answers to some of humanity’s ancient but as yet inadequately answered questions.

Those long-standing questions concern values, rights, ethics, morals, language, consciousness, personhood, life, death, reality, and even the more recent topics of robotics and evolution. Throughout this effort the columns also remain concerned to help humanity deal with individual, local, and global problems. Such a list offers something for everyone.

Your columnist (whose last name is pronounced “la-due”) holds a Ph.D. in The Experimental Analysis of Behavior. That’s a mouthful, which is one reason for the name change of the natural science of behavior to behaviorology. As in the earlier columns, in these columns the words “science” and “scientist” always mean “natural science” and “natural scientist.”

After growing up in California, several decades of college teaching and research experience led to retirement in 2015 in New Mexico. While some of that experience accrued in Australia and China, most occurred as a professor of behaviorology at the State University of New York at Canton.

Many people have at least some intuitive (that is, not instructed) knowledge about a science of behavior, particularly if they have pets, and train their pets. However, these columns emphasize scientifically discussing human behavior.

As such, these columns tread a thin line between pushy coverage that leaves readers behind, and shallow coverage that leaves readers bored. To keep me treading this line successfully, send your feedback to the Editor (or through the www.BehaviorInfo.com website, which is otherwise seldom mentioned in these columns or in the standardized closing paragraph of each column).

Still, why *should* anyone bother about a science of human behavior? After all, many traditional cultural perspectives say “don’t bother.” These perspectives get conditioned through what we all experience in our seldom questioned childhood upbringing. Conveying pre-scientific, non-scientific, or even anti-scientific notions, these perspectives generally say that the science of behavior does not exist, that it could not exist, even that it should not exist, because it could contradict various traditional cultural views.

So, why bother with a natural science of human behavior? And why bother here and now? One reason concerns the large number of non-scientific books about human behavior on the self-help, new-age, and psychology shelves in bookstores and online lists. These tell us that interest in human behavior runs high.

A smaller number of scientific books about human behavior appears on the science shelves and lists. You will find, however, that most of these books emphasize various engineering applications of the science of behavior. This is no surprise. Society usually needs more engineers than scientists. And the application areas that they cover concern mostly normal human behaviors.

Those application areas cover a wide range. They include parenting, regular and special education, behavioral medicine, green contingency engineering, dignified dying, companion animal training, behavioral safety, business and organizational management, penal rehabilitation, and autism and developmental disabilities interventions, among others.

Those engineering books, however, cover the science itself only minimally, only the principles, concepts, and methods needed to work the applications. Only a small handful of books thoroughly include but go beyond those topics by also covering the extensions, elaborations, implications, and interpretations of the science. These deeper topics constitute the areas of the current columns, with various books mentioned when they are relevant.

Regarding “why bother with a science of human behavior *here and now*,” consider the biggest, baddest, best reason, which involves the solving of global problems and human civilized survival. For decades, ever since Rachel Carson’s 1962 book, *Silent Spring*, and the MIT group’s 1972

book, *Limits to Growth*, traditional natural scientists (like physicists, chemists, and biologists) have noted that human behavior is a major cause of global problems, and that changes in human behavior are required to solve these problems.

So they have repeatedly called for a natural science of human behavior, because its contributions are needed in the team efforts to help humanity solve its problems, and survive. Yet, while many traditional natural scientists have as yet taken too little notice of it, such a science is already over 100 years old.

Today the need is for everyone, including more scientists, to make more effort to become more familiar with this science, and take it into account in their work to solve global, or even individual and local, problems. And knowing more *now* is better than later, given the shrinking time frame for solving global problems that the problems themselves give us. *That is why we should bother with a science of human behavior. That is why we should bother here and now.*

Furthermore, as implied in the column on “recombination of repertoires” (one of the columns in the earlier set; see Column 55 in the *Explaining Mysteries of Living* book listed in the reference) some familiarity with the methods, extensions, elaborations, implications, and interpretations of the science (i.e., its deeper topics) substantially improves one’s understanding, appreciation, and application of the science itself.

Both the fundamentals of the science *and* the deeper topics comprise the parts of the science. Together they make impossible any tendency to see the science as merely a cook–book approach to contingency management or contingency engineering for designing and implementing interventions to solve problems.

People’s comprehension of all those topics also provides perhaps the best means to deal with, and even prevent, misuses of this science, because people familiar with the science would be less likely to be susceptible to or fooled by misuses.

Such a subtopic appears in several previous and current columns. This typically occurs when a column topic concerns applications of some principle or concept of the science for which certain variations are *harmful to people’s well being*.

In many cases those variations were in use (i.e., in misuse) long before, even thousands of years before, the science existed and discovered its principles and concepts. One such example involves variations that contingencies induce purveyors of games of chance to apply in ways that compel their victims into more losing behavior.

You can find the mentioned column 55, and any columns from the first set, on the web pages of the newspapers that ran the set, or in the 2020 book, *Explaining Mysteries of Living*. The first set of columns, in that 2020 book, also provide a vital foundation for the current columns, which presume that readers have read the first set. The BOOKS page at www.behaviorology.org has a full description.

Writing these columns occurs separately from membership in The International Behaviorology Institute (TIBI, at www.behaviorology.org where you can always find more information and resources). The author is not speaking for TIBI, and the author and TIBI need not be in agreement. TIBI welcomes feedback, members, and donations (501.c.3). Write the author through this paper's Editor. This is column 1 of the second set of 72. Copyright © 2020 by Stephen F. Ledoux

[To simplify finding more details, the *Table of Contents* of the referenced book(s) appears in the Appendices at the back of this collection of columns.]

PART V

The Questions of Life, Personhood, and Death

Plus the Law of Cumulative Complexity

[Column 49] Exploring More Mysteries of Living: Life, Personhood, and Death Interrelate

by **Stephen F. Ledoux**

A Los Alamos member of The International Behaviorology Institute

Note: Why these columns? Because human behavior causes global problems, and solving these problems requires changes in human behavior... So *everyone* really benefits from knowing something about the natural science of human behavior that these columns describe. (See the 72 columns of the first set, in the *Explaining Mysteries of Living* book, for the *basics* of the science these columns describe.)

Consider the nature of life, and the nature of living. Previous columns have extended current, although initial, scientifically consistent answers for some of humanity's ancient questions, most recently into the area of consciousness.

Natural science describes *consciousness* basically as the term for the natural chaining of stimulated cascades of neural impulses that comprise the neural behavior-behavior relations (i.e., stimulated behaviors, as real events, evoking further behaviors) that play supplemental functional roles in the contingencies controlling more accessible overt behaviors. A common covert chain of consciousness behaviors includes raw sensation, awareness, recognition, comprehension, observation, and reporting (and then overt reporting).

No scientific law of nature limits such evoked response chains to humans. Much of the depth, range, and complexity of such chains, however, depends on the presence of verbal repertoires from prior conditioning. Nevertheless, such phenomena reiterate the continuity found across species, a continuity that many research outcomes stress, including Darwin's research outcomes.

This column generalizes that response continuity to the ancient human questions about life across the vast reaches of time. For people, such

questions about life also encompass questions about the phenomena of personhood and death. These topics also invite and demand scientifically consistent answers, which is why subsequent columns address them.

Scientific accounts for each of those topics invariably overlap each other. For example life, and living, inevitably intertwine with personhood. But agentialism can taint each of these topics. *Agentialism*, remember, is the label for reacting superstitiously, due to traditional cultural conditioning, to these topics as though some magical process, entity, or other non-material inner agent inhabits them.

Early and long-enduring, pre-scientific contingencies compelled ultimately unhelpful descriptions of each of those topics: For example *life* referred to animation from the breath of a god, an “outer” agent. *Personhood* referred to a mystical behavior-directing, and so explicitly responsible, inner agent, religious or secular, that inhabited the animated (i.e., alive) body.

And *death*, as a later column discusses, referred to the departure of the entity from the body, leaving it no longer alive. Science sets aside all the pre-scientific, superstitious cultural traditions that imbue such terms with agentialism.

Today, instead, *life* scientifically involves a range of levels of chemical complexity that feature processes involving energy exchanges among simple and complex chemical units that change these units and their surroundings. These processes include evolution and conditioning and even the feedback loops of consciousness and culture.

Personhood is similar. Scientifically, *personhood* involves the whole repertoire of behavior that contingencies induce and that a physiological body, by its nervous system—all products of natural life processes—mediates when environmental energy changes produce behavior.

And *death* is also similar. Scientifically, *death* describes the results when, across several steps, natural processes permanently interrupt the function of behavior mediation and reduce complex chemical units to simpler levels of chemical structures and functions incapable of mediating behavior.

In currently common, non-scientific usage, the term *life* describes the status of living that an untestable inner agent animates, such as a soul, mind, psyche, or self. Supposedly the agent inhabits and animates a lump of matter, *making* it alive. Science must reject this notion due to its agentialism.

Also that notion, that an untestable, magical inner agent animates a lump of matter and so makes it alive, confounds and misleads understanding of the interrelated topics of the alive body, its mediated behavior, life, and personhood. To enable a scientific discussion that clarifies the interrelationships, consider the topics again, separately and without the agentialism.

To start, consider the living body and what we mean by *living*, what we mean by *life*. While we define living and personhood behaviorologically, we define life, the alive body, biologically.

In general scientific terms, *living* refers to the activity, including body-mediated behavioral activity, that results from environmental energies affecting a “lump” of matter. At some point—actually, not a “point”—a lump of matter shares characteristics of enough complexity that these characteristics participate in contingencies that induce us to call the lump of matter alive, to call it an alive body, to call it a life form or, more pertinently, to call it a form of life.

Yet what are these characteristics? What is this *life* to which we refer by saying “form of life?” This determination of life status, and our recognition of it, stem from natural, not magical, functions.

Behaviorologists incorporate and extend the understanding of life and its characteristics as our biology colleagues see them. So for us *life* refers to forms that reside on part of a continuum of chemical complexities that *seamlessly* extends from non-life forms to life forms, *seamless* in that no kind of theological or secular magic enters or breaks the continuum to give a “start” to life.

In a boundaryless area on that continuum, various realities continue to evoke debate about whether or not some forms are alive, or nearly so, or not at all. At what point would they evoke the descriptions *living* or *life*? No such *point* exists, but only a *gray* area.

That whole chemical continuum derives from the circumstances specified in the *Law of Cumulative Complexity*, which states, “the natural physical/chemical interactions of matter and energy sometimes result in more complex structures and functions that endure and naturally interact further, resulting in an accumulating complexity...”

That is quite a mouthful. So the next column digresses to consider it in appropriate detail. Subsequent columns return to our topics of life, personhood, and death.

The BOOKS page of www.behaviorology.org provides a full description of the book that contains the first set of columns, *Explaining Mysteries*

of Living, including where and how to obtain it. In this book one of the papers that supports the first 72 columns is “Ten Commandments of Natural Science.” Commandment V considers the *Law of Cumulative Complexity* in this wider context.

Writing these columns occurs separately from membership in The International Behaviorology Institute (TIBI, at www.behaviorology.org where you can always find more information and resources). The author is not speaking for TIBI, and the author and TIBI need not be in agreement. TIBI welcomes feedback, members, and donations (501.c.3). Write the author through this paper's Editor. This is column 49 of the second set of 72. Copyright © 2020 by Stephen F. Ledoux

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Reader's Notes



Underwater Life on Europa

Stephen F. Ledoux is the photographer for this & most photos accompanying these columns, & his photos have not been photoshopped.

[Column 50] Exploring More Mysteries of Living: The Law of Cumulative Complexity Counters Old and New Misunderstandings

by Stephen F. Ledoux

A Los Alamos member of The International Behaviorology Institute

In discussing the boundaryless biological continuum for life forms that involves non-life and life, the last column pointed to the relevance of the *Law of Cumulative Complexity*. This column digresses to consider this law more closely.

Various realities continue to evoke debate about whether or not some forms are alive, or nearly so, or not at all. At what point would they evoke the descriptions *living* or *life*? No such *point* exists, but only a *gray* area. This chemical continuum derives from the circumstances specified in the *Law of Cumulative Complexity*.

That law states: “*The natural physical/chemical interactions of matter and energy sometimes result in more complex structures and functions that endure and naturally interact further, resulting in an accumulating complexity.*”

Note that this law says “sometimes result,” not “always result.” The products of some interactions fail to endure, and some interactions can reduce complexity. Understanding this law benefits from some careful unpacking of its elements. That is, one benefits from pondering the implications of ... *physical / chemical interactions ... sometimes ... more complex structures ... functions ... endure ... interact further; ... accumulating complexity.*

Then, one finds that this law helps everyone make sense of numerous past, growing, and current complexities, starting with the origin of this universe in which we live. In reviewing the results of all the experimental work on the natural events of, and after, the “big bang,” one traces the complexities that naturally accumulate from the “big bang” events and on through the natural development of stars and galaxies and so many more chemical elements, and so on.

Then in later generations of stars, after the end of many massive stars has provided additional amounts of so many elements, accumulating complexities usually and naturally produced and produce planets. *All of this happens with no need for contributions from magical or mysterious or spontaneous events*, either secular or theological. The Law of Cumulative Complexity helps people grasp the lack of need for magical or mysterious or spontaneous events.

Reviews of what we know—what research has shown us—about the origins of life, show similar outcomes. We should not be surprised that on some—perhaps many or even most—planets, further developments naturally produce an ever expanding and increasingly complex range of different minerals and compounds.

Those minerals and compounds are both organic and inorganic, from a kind of compound or mineral evolution. This evolution likely differs on each planet both due to the varying conditions present on, and developing on, each planet, and due to the varying conditions of each planet's location with respect to its local star.

Robert Hazen, among others, drew attention to such developments a decade or two ago. Hazen's 2005 book, *Genesis: The Scientific Quest for Life's Origins*, and his 2012 book, *The Story of Earth: The First 4.5 Billion Years*, both help clarify some of the details.

Actually, on at least one planet that we know of so far—ours—such naturally produced developments accumulated further mineral and compound complexities that we now call or, more accurately, *tact* (from the previous columns on verbal behavior) as *life*. Indeed, *any* origin of life anywhere—on this planet or others, outside or even inside a laboratory—can be broadly understood in terms of the *Law of Cumulative Complexity*, and again without requiring contributions from magical or mysterious or spontaneous events.

As complexity accumulates, continuing developmental interactions of living matter and energy produced and produces the natural (but not necessarily repeatable) evolution of life's physiology and forms, and behavior-related processes and functions. The broad availability of the natural science of biology has enabled the general population to gain some relatively widespread understanding and appreciation of the evolution of life's physiology and forms.

However, at only about 100 years old, the relative youth of the natural science of behaviorology has contributed to the general population having relatively little exposure to, and thus little understanding and appreciation of, life's behavior-related processes and functions. Yet all these life functions and processes occur through the developments of natural interactions of energy traces with various sensory and motor forms of neural physiology, and these interactions, in all their complexity, produce behavior, in all its complexity.

On this planet Earth, examples of this *Law of Cumulative Complexity* include the vast range of DNA-based life forms available for study. And on some other planets, perhaps the complexities of life originate and accumulate on some other chemical basis.

In the local Earth case, the intricacies of global problems and solutions, and the joys and sorrows of life in the interconnected web of existence of which we are a part, all contribute to producing behavior. Along with these the interrelations and interactions of energy exchanges, between internal and external environmental events and the body, as described by physiology and behaviorology, produce all behavior, including all human behavior, all without needing contributions from magical or mysterious or spontaneous events.

That knowledge helps people deal effectively not only with behavior but also with the place of humans in the universe, and with the place of the natural science of behavior, behaviorology, among the rest of the natural sciences. *All of these phenomena are cumulatively complex; all are entirely natural.*

No one can ever say for sure what else will naturally develop in the future. This *Law of Cumulative Complexity*, however, *fundamentally* describes—but not with details or formulas—all these developments. While many details still await scientific elaboration, this law operates always and only as a sequence of purely natural–event interactions spreading out repeatedly as multiple, additional, purely natural, usually increasingly complex, outcomes.

With enough time the operation of this law builds the accumulation of the complexities visible with many diverse phenomena, in many areas, disciplines, applied fields, sciences, arts and engineering activities, all again with no contribution from magical or mysterious or spontaneous events. Reviewing the extent and diverse variety of such applicable phenomena both induces the “law” status of cumulative complexity, and adds to our confidence about it.

That generality must leave us wondering what interesting and curious adjustments will occur when these scientific realities get regularly applied to broad areas within all those disciplines and fields by their practitioners. What will become of the contents of various disciplines when, for example, these scientific realities get regularly applied to broad areas in, for example, literature, history, politics, or art?

Having now considered the *Law of Cumulative Complexity* in a little detail, the next column returns to the discussion of whether or not some chemical forms, some chemical combinations and processes, are alive, or nearly so, or not at all. At what point would they evoke the descriptions *living or life*? No such *point* exists, but only a *gray* area...

In the book that contains the first set of columns, *Explaining Mysteries of Living*, one of the papers that supports the columns is “Ten Commandments of Natural Science.” Commandment V considers the

Law of Cumulative Complexity in this wider context. The BOOKS page of www.behaviorology.org provides a full description of this book. [Also, first column supporting article in this volume 2, featuring a title very similar to the title of this column, has even more details.]

Writing these columns occurs separately from membership in The International Behaviorology Institute (TIBI, at www.behaviorology.org where you can always find more information and resources). The author is not speaking for TIBI, and the author and TIBI need not be in agreement. TIBI welcomes feedback, members, and donations (501.c.3). Write the author through this paper's Editor. This is column 50 of the second set of 72. Copyright © 2020 by Stephen F. Ledoux

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PART IX

The Question of Behaviorology Helping People Solve Global Problems

[Column 71] Exploring More Mysteries of Living: Jobs Abound for Contingency Engineers But Degree Programs Remain Scarce

by **Stephen F. Ledoux**

A Los Alamos member of The International Behaviorology Institute

Note: Why these columns? Because human behavior causes global problems, and solving these problems requires changes in human behavior... So *everyone* really benefits from knowing something about the natural science of human behavior that these columns describe. (See the 72 columns of the first set, in the *Explaining Mysteries of Living* book, for the *basics* of the science these columns describe.)

This and the next column turn from details *about* the natural science of behavior to considering what seems at present to be one of the most important areas, or perhaps *the* most important area, for *applying* the science of what we know about human behavior. This is the area concerning the behavior components of understanding and solving global problems.

In a couple of columns, however, we cannot and will not cover how to apply this science in that arena. Our interest now concerns preparing for that task, because the world still lacks adequate human resources fully trained in behaviorology, at all academic–performance levels, to contribute fully to solutions for those problems through research and teaching and interventions.

Many major businesses offer jobs, under various names, for “sustainability staff and managers.” Holders of a four–year bachelor’s degree in sustainability, one that includes a major in the natural science of behaviorology along with basic familiarity with all the other foundation natural sciences (i.e., physics, chemistry, and biology) would make exceptionally capable staff.

But most universities and colleges still pour their resources into agential psychology majors for dealing with understanding behavior. Very few so

far offer behaviorology majors. Given the importance of solving global problems to humanity's civilized survival, this might strike you as a poor use of your tax or tuition dollars. If so, speak up! Behaviorology bachelor's degree programs might not replace psychology programs, but higher education should at least offer them.

For managers of sustainability staff, after earning the kind of bachelor's degree described for staff, a master's degree would make an appropriate academic program. If the program stressed applied behaviorology, it would make exceptionally capable managers.

Again, however, most universities and colleges still pour their resources into agential psychology master's degree programs for dealing with behavior concerns. Too few so far offer behaviorology master's degree programs. Given the importance of solving global problems to humanity's civilized survival, this too might strike you as a poor use of your tax or tuition dollars. Behaviorology master's degree programs might not replace psychology programs, but higher education should at least offer them. So speak up!

Of course, you need professors to provide the behaviorology courses for the academic programs for sustainability staff and managers. For all these professors, doctoral degrees in behaviorology would make the appropriate academic program.

Yet again, most universities and colleges still pour their resources into agential psychology doctoral degree programs. Far too few so far offer behaviorology doctoral degree programs. Given the importance of solving global problems to humanity's civilized survival, this again might strike you as a poor use of your tax or tuition dollars. Behaviorology doctoral degree programs might not replace psychology programs, but higher education should offer them. Again, speak up!

Applying behaviorology as part of the science–team efforts to solve global problems remains of such significance that, of the first set of 72 columns, the last *nine* columns addressed various aspects of this topic in substantial detail. So this and the next column—the last columns of the *second* set of 72 columns—provide just a review of some of the concerns that benefit humanity through your consideration and, hopefully, action, regarding solving global problems.

Some of the main topics that those last nine (of that first set of 72 columns) covered concerned (a) interdisciplinary developments, (b) dangers from unbalanced educational playing fields, (c) contributions to and from fellow natural scientists, and (d) aspects of establishing behavior–related academic science programs. Of course, the presumption is that you already have read,

or will read, those earlier columns. Given the action recommendations contained in them, revisiting them could lead to giving substantial help to supporting science in general, and behaviorology in particular, in addressing the behavior components of solving humanity's individual, local, and global problems.

In this second set of 72 behavior-related columns, after touching on the research methods behind behaviorology's discoveries and developments, we briefly toured several topics needing and benefiting from interpretative scientific answers to many of humanity's ancient, and a couple more recent, questions. These answers derived from extensions of behaviorology. The topics we covered included verbal behavior, the reinforcers-values-rights-ethics-morals series, consciousness, life, personhood, death, reality, robotics, and evolutions. We addressed all these topics in light of the concepts, principles, methods, and practices of behaviorology.

Before that, in the first set of 72 behavior-related columns, our topics had included the value of a scientific philosophy of science, and the ubiquity of the emotional and intellectual behavior related to the continuously operating processes of respondent and operant conditioning. We also covered reinforcement schedules, the stimulus controls of evocation and generalization, direct stimulus control, direct-acting contingencies and rule-governed behavior, and a range of intervention practices grounded in these lawful relations (e.g., differential reinforcement, shaping, chaining, fading, extinction, and clicker training).

All of those topics from both sets of columns become, in far more depth and detail, the core of educational programs designed specifically to enable students at all academic levels to address effective applications to helping solve global problems. We can call this academic area *green contingency engineering*, an area particularly relevant to many pressing issues including the humane reduction of population levels and the building of sustainable lifestyles.

Perhaps the culture could currently derive the most benefits by first expanding behaviorology into this educational area, from which graduates could then extend it into other needed practical areas. Consider a degree in *Green Behavior and Engineering* (or *Behaviorology and Green Engineering*) that includes basic coverage of the full roundtable of foundation natural science and engineering disciplines (e.g., physics, chemistry, biology, behaviorology) so that graduates can contribute to any and every area of solutions for global problems. We are sitting on the brink of a breakthrough to substantive successes in solving global problems by building a more complete science and engineering team—a team with members from all the natural sciences—to address these concerns.

The BOOKS page at www.behaviorology.org provides a full description of the book that contains the first set of 72 columns, *Explaining Mysteries of Living*. This page also provides full descriptions of many other books containing greater detail about behaviorology than these columns could cover, such as the *Running Out of Time—Introducing Behaviorology to Help Solve Global Problems* book, and the less comprehensive but easier to read *What Causes Human Behavior—Stars, Selves, or Contingencies?* book, a general–audience primer.

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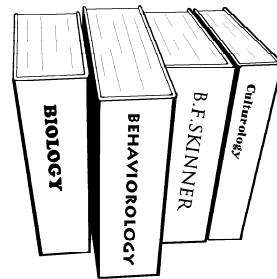
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Help Get These Involved

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Courageous & Bold
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of college *Natural–Science* units to
implement Doctoral, Master,
& Bachelor programs in
the *natural science of*
human behavior,
Behaviorology,



emphasizing basic experimental research
& culturally relevant applications to
understand human nature better
& to make a better world for
individuals & humanity



Contact Board Members of TIBI (*The International
Behaviorology Institute*) at www.behaviorology.org



[Column 72] **Exploring More Mysteries of Living: Everyone Can Help Solve Global Problems**

by **Stephen F. Ledoux**

A Los Alamos member of The International Behaviorology Institute

The topics of the last several columns convince us of our readiness to apply, as a culture, the behaviorological technologies that we can derive from the principles and concepts of the natural science of behavior (covered in earlier columns) to the widest range of humanity's concerns. How can we make this happen?

Basically, the next step involves you and me and other readers supporting, perhaps even agitating for (Dare I say "campaigning for"?) establishing more university behaviorology programs and departments. We all require these to meet growing needs. (See the WANTED poster before this column, and show it to those people who are in positions to help.)

Then, an increasing proportion of our world population can soon operate with an expanded, behaviorologically informed repertoire as a component of their general science education. This would lead to more traditional natural science in the education of behaviorologists, and to more behaviorology—and less superstition—not only in the education of the general population but also for traditional natural scientists.

Why is that important? Recall that our columns have supported an interdisciplinary approach to the engineering of solutions for global and local problems. This approach is not only valuable but necessary, because humanity is running out of time to solve these problems before their implications overwhelm us, forcing us to experience their worst effects.

To design and implement solutions effectively requires *all* the relevant natural sciences to coordinate their efforts. And these sciences include not only the traditional ones focused on energy, matter, and life forms (e.g., the sciences surrounding physics, chemistry, and biology) but also the science focused on life functions (i.e., behaviorology). Given the acknowledged, substantial behavior components of global problems and their solutions, humanity needs all of these natural sciences working together, with reasonable familiarity with each other, if the solutions are to occur in a timely fashion.

Cultural survival puts that interdisciplinary cooperation at the forefront of efforts to solve global problems. Examples of concerns on which traditional natural scientists and behaviorologists work together, or even on which just *behaviorologically informed* traditional natural scientists work, include humanely reducing overpopulation (the necessary foundation for solving *many* global problems), establishing sustainable lifestyles, keeping the air and water clean, and preserving habitats and resources and species diversity, to name but a few.

Beyond helping solve local and global problems, behaviorology makes other contributions to the capabilities of traditional natural scientists. Once they become basically familiar with behaviorology, they become more able to remain naturalistic in dealing with subject matters at the edge of, and beyond, their particular specializations. Thus they can avoid slipping into the compromising use of common, culturally conditioned, superstitious agential accounts.

Furthermore, knowing some behaviorology helps them add supportive details to accounts within their specializations (for example, how various natural sciences each help account for phenomena that we tend to see as limited to humans, such as language, and ethics). Also, behaviorology provides the students of natural scientists with a natural–science alternative to the non–natural disciplines that most of these students study when covering subject matters related to behavior, including scientific behavior.

Even if people—especially those whom we call scientists, because they have a thoroughly conditioned repertoire in one or another natural science—have only a minimal conditioned repertoire in behaviorology, they would still be more likely to produce, or consider as viable, solutions to global problems that at least intuitively, or better, through design, take behaviorological realities into account. As a result the behavior-related components of global-problem solutions could develop as reasonable behaviorological interventions with an increased likelihood of success, thereby supporting the other physical, chemical, and biological solution components.

Humanity could thus reduce or entirely avoid the alternative of continuing to stumble along with intuitive or coincidental successes from attempting solutions that stem from *only* traditional natural sciences, or from superstitious cultural lore. This would be a major benefit even if it only meant avoiding the failure of coercive solutions (see columns 45–49 in the first set of columns regarding the fallout from coercion and aversiveness). Instead, solutions would involve designing interventions that included new or enhanced reinforcing contingencies for behaviors consistent with overall, improving environmental health.

Those contingencies should involve the long-term best interests of most people, and would help generate and stabilize the behaviors required to maintain environmental health. Indeed, as many more people gain more extensive behaviorological repertoires, and begin to apply them to global problem solutions, so much more is possible and will, I think (and we all hope) get done.

And so we approach the end of this second set of columns and our current journey together, a journey that introduced behaviorology to you out of concern for our planetary home, a journey about this natural science of *why* human behavior happens, a natural science to help solve global problems in a timely manner. Virtually every column included some wonderful reality about human behavior that relates to solving the behavioral components of individual and local problems as well.

Of course, that may have left you wondering why I never spelled out *exactly* how to apply behaviorology to solve all those problems. Why did the columns only introduce the principles, concepts, methods, practices, extensions, implications, and interpretations of this natural science? The reasons are several; here are two of them. (a) The topic of how, thoroughly, to apply behaviorology, to cover its share of the efforts to solve global problems, requires many books. And (b) since a proper treatment of this topic extends well beyond my own expertise, and likely beyond the expertise of any single professional, it would best come from a team of authors, a team from all the basic natural sciences—including many new, fully trained behaviorologists—working to solve these problems.

Possibly you will be a member of such a team. After all, whenever contingencies have compelled behaviorologists to address particular past problems, successful interventions have followed. Problems whose solutions need broader teams of behaviorologists and other natural scientists should similarly see successes.

In any case our current global problems, with their behavior components, loom in our collective face. If contingencies compel enough of us to participate in the production and implementation of solutions, then we can together prevent humanity, and life on this planet, from running out of time.

Here near the end of 144 columns, I hope why science is lovable has become clear for you. It helps humanity in so many ways, and you can too. Thank you for allowing me to serve as your guide during this “journey through the columns.” May the future hold more wonderful journeys for all, perhaps even to the stars.

The BOOKS page on www.behaviorology.org provides a full description of the book that contains the first set of 72 columns, *Explaining Mysteries of Living*. This page also provides full descriptions of many other books containing greater detail about behaviorology than these columns could cover, as well as the book that contains the *second* set of 72 columns, *Science Is Lovable—Volume 2 of Explaining Mysteries of Living*, including where and how to obtain it.

Some of those book descriptions, and many other resources, also appear on the pages of www.BehaviorInfo.com. Some of these columns appeared first on this website, which may also feature columns from other natural–scientist–of–behavior authors.

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[To simplify finding more details, the *Table of Contents* of the referenced book(s) appears in the Appendices at the back of this collection of columns.]