

OPERANT PRINCIPLES EVERYWHERE

INTERDISCIPLINARY BEHAVIOR ANALYSIS AND THE FUTURE OF OUR FIELD

Susan M. Schneider
University of the Pacific

John B. Watson



Ethology/"Instincts"

Operant principles

Physiology

Emotion

Classical conditioning

Cognition

- & more

Nature *and* Nurture

The Systems Approach

"The kind of science that I believe is most likely to promote an eventual integration with the physiological, biochemical, and pharmacological sciences is not very close to what is going on today in either psychology or psychiatry"



Wikimedia Commons, self-made by user: Silly rabbit

- B. F. Skinner (1959)

- as quoted in Morris, E. K., Lazo, J. F., & Smith, N. G. (2004). Whether, when, and why Skinner published on biological participation in behavior. *The Behavior Analyst*, 27, 153-169.



John B. Watson & "a dozen healthy infants"

"Was Watson right? We believe that the answer is a resounding 'Yes' . . . We believe that the confirmation of Watson's claim is a plain everyday fact . . ." (p. 48)

-Eytan Avital & Eva Jablonka. (2000).

*Animal Traditions: Behavioural
Inheritance in Evolution.*

Cambridge: Cambridge Univ. Press.



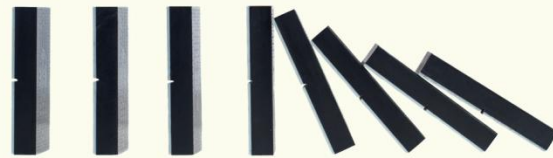
Operant Learning and the Cambrian Explosion



New forms of complex life!

Ginsberg, S., & Jablonka, E. (2010). The evolution of associative learning: A factor in the Cambrian explosion. *Journal of Theoretical Biology*, 266, 11-20.

The Science of Consequences



**HOW THEY
AFFECT GENES, CHANGE THE BRAIN,
AND IMPACT OUR WORLD**

SUSAN M. SCHNEIDER

Outline

Part One

Nature *and* Nurture:

The Biological Context for Operant Behavior

Part Two

Applications and Higher-Order Skills

Part One

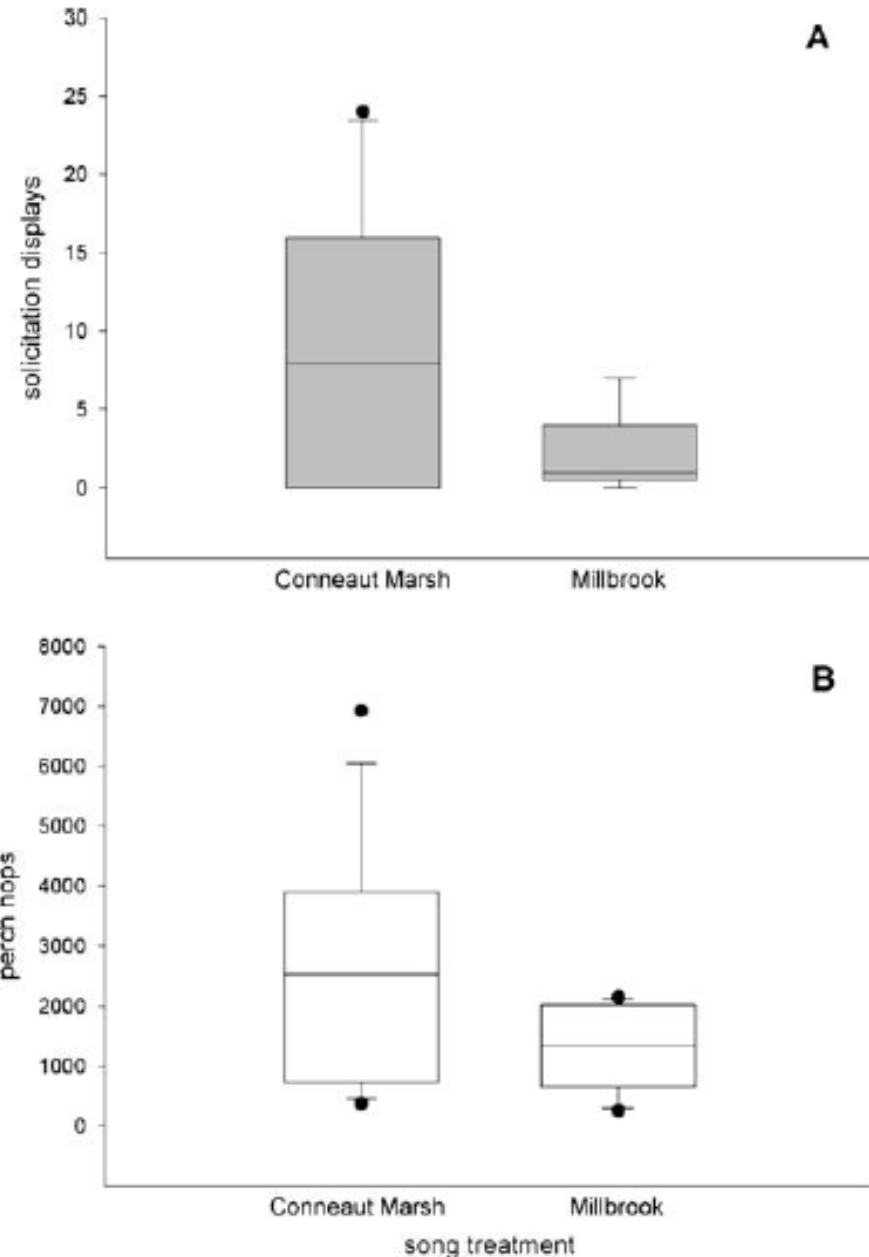
Nature *and* Nurture:

The Biological Context for Operant Behavior

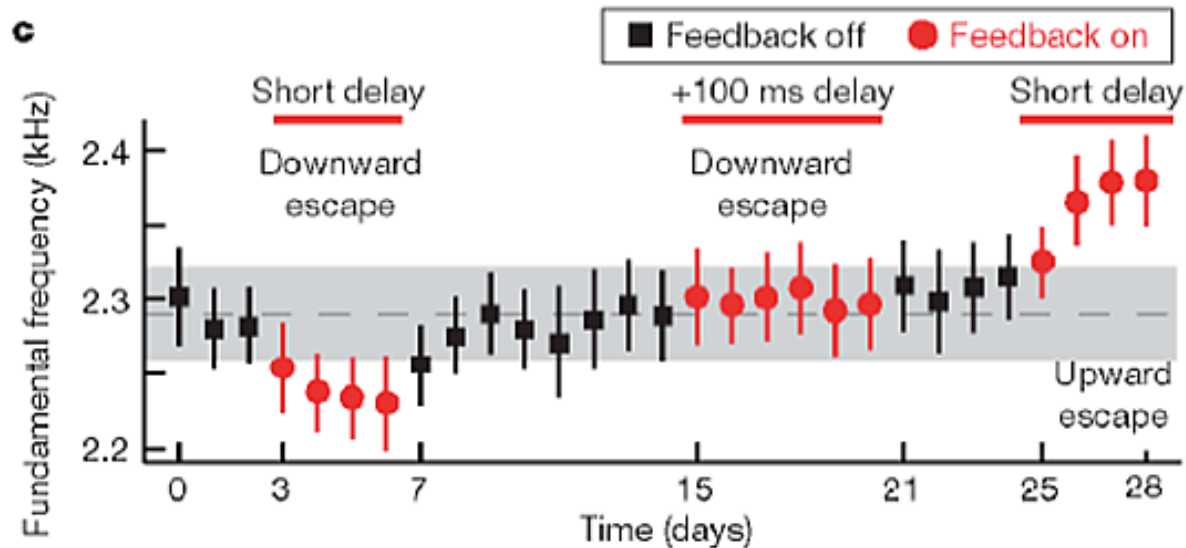
Consequences and "Instincts" -in Swamp Sparrows



Anderson , R. C. (2009). Operant conditioning and copulation solicitation display assays reveal a stable preference for local song by female swamp sparrows *Melospiza georgiana*. *Behavioral Ecology and Sociobiology*, 64, 215-223.
Song: Todd Wilson, xeno-canto 43420, cc2.5 license.



"Differential Reinforcement" within Songbird Song



Tumer, E. C., & Brainard, M. S. (2007). Performance variability enables adaptive plasticity of 'crystallized' adult birdsong. *Nature*, 450, 1240-1244.

Consequences and Instincts

Imprinting

1960s

Sir Patrick Bateson & Ellie Reese



gina pina at <http://flickr.com/photos1406748@N00/4381185218>

Consequences and Instincts

Imprinting

How flexible is a chick's preference for its own species' imprinting call?



Bobwhite chick



Bobwhite father

Consequences and Instincts

Imprinting Call Preference

Condition

Bobwhite Japanese NoPref

Normal	28****	4	8
5-min Japanese Quail call --contingent	13	12	12
5-min Japanese Quail call --noncontingent	18**	8	5



Harshaw, C., Tourgeman, I. P., & Lickliter, R. (2008). Stimulus contingency and the malleability of species-typical auditory preferences in Northern bobwhite (*Colinus virginianus*) hatchlings. *Developmental Psychobiology*, 50, 460-472.

IT'S A SYSTEM: Genes & Neurotransmitters+

Rhesus monkeys raised by (unrelated) mothers or by each other (peers)

Serotonin transporter gene 5-HTT, short & long forms

Short gene form - problematic for peer-reared
- *beneficial* for mother-reared

Impulsivity and aggression - "subject to major modification by specific early experiences . . ."

(Suomi, 2003)

Suomi, S. J. (2003). Gene-environment interactions and the neurobiology of social conflict. *Annals of the New York Academy of Sciences*, 1008, 132-139.

Aiwok, Rhesus Macaque with two babies in Shimla Himachal Pradesh near the Jakhu temple.

Turning on Genes

Operant learning activates a
synaptogenesis gene

Stress reduces mRNA activity in
interleukin 2 receptor (immune
system response)

Exercise activates *pgc1-alpha* gene
(metabolism adjustment)

Epigenetics: A New Frontier

Chromatin marks - like DNA methylation
(Also other epigenetic mechanisms)

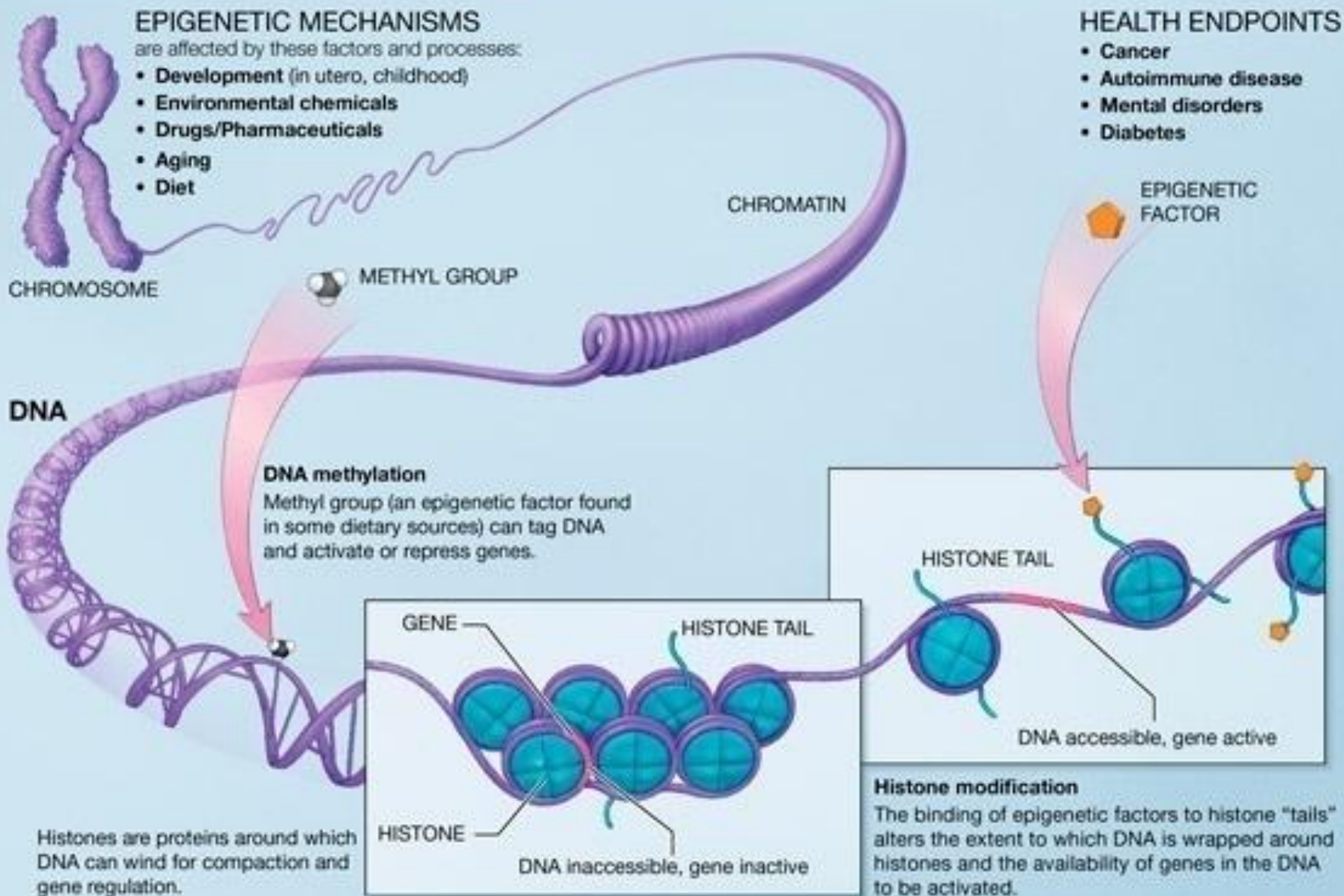
Affected by behavior & environment,
reversible,
--and sometimes inheritable!



Epigenetics: A New Frontier



The Dutch "Hunger Winter"
of World War II



Epigenetics: A New Frontier

The Case of the Stressed-out Moms

Tania Roth's rat foster moms, pup abuse,
& epigenetic changes (e.g., *BDNF*)

Michael Meaney's stress research

- Includes epigenetic changes
- Similar mechanisms in humans



Operant learning & classical conditioning involved

Roth et al. (2009). Lasting epigenetic influence of early-life adversity on the BDNF gene. *Biological Psychiatry*, 65, 760-769.

REALLY SIMPLE ENRICHMENT

Fixed interval schedule
performance in rats:



- * Reversed behavioral & physiological effects of stress (restraint, cold, new environment)
- * Reversed some effects of lead exposure

Cory-Slechta, D. A., Virgolini, M. B., Rossi-George, A., Weston, D., & Thiruchelvam, M. (2009). Experimental manipulations blunt time-induced changes in brain monoamine levels and completely reverse stress, but not Pb+/-stress-related modifications to these trajectories. *Behavioural Brain Research*, 205, 76-87.

Consequences and Neuroplasticity

Merzenich & the Owl Monkeys

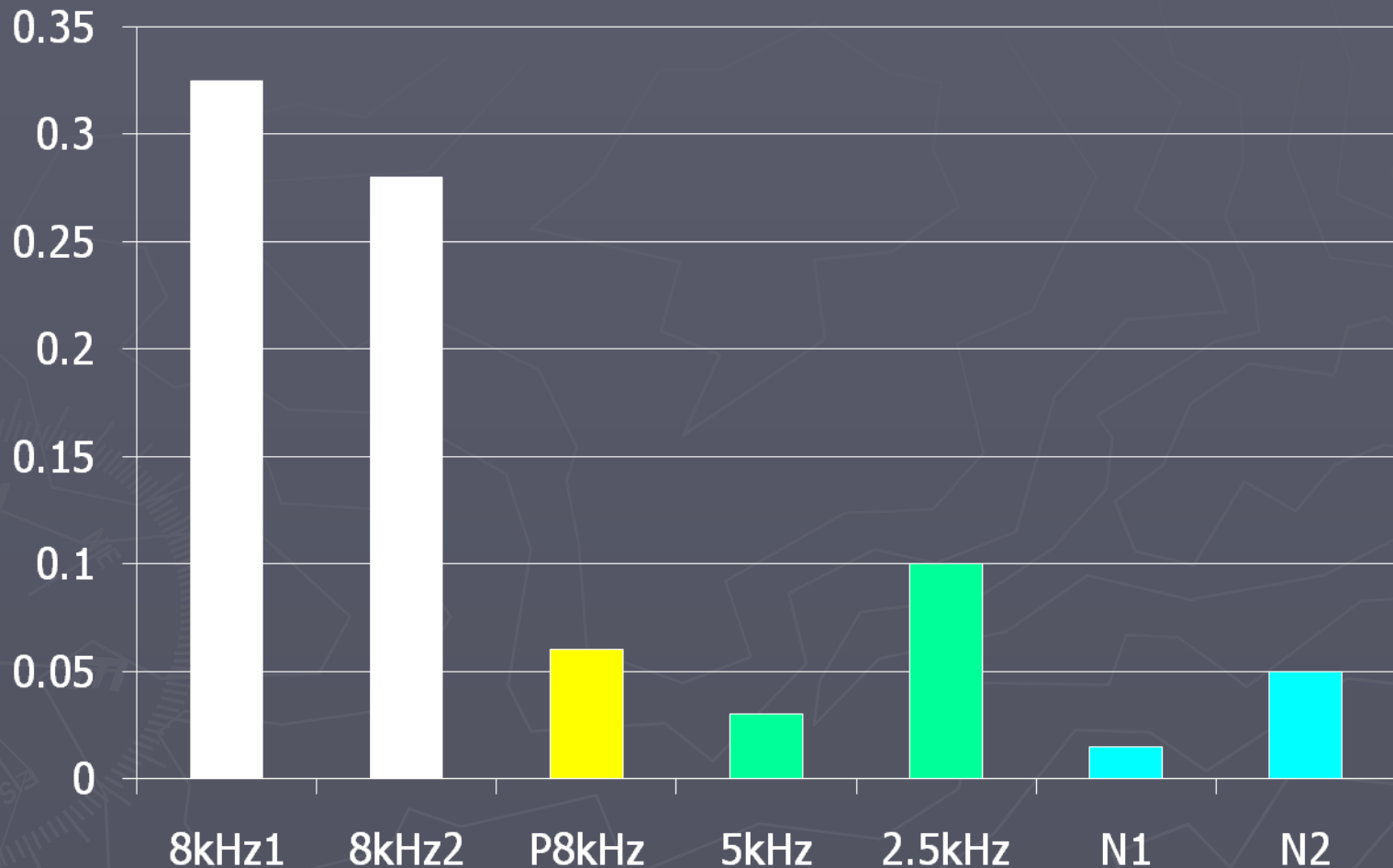
- ▶ All monkeys heard sounds at different frequencies.
- ▶ Some monkeys were reinforced for learning to discriminate a change in sound frequency.
- ▶ Others had their fingers tapped, and learned to discriminate a change in tapping pattern.

Result: Brain cortex expanded only after operant learning.

Consequences and Neuroplasticity

Flexibility in the Auditory Cortex

Cortical Area (mm²)



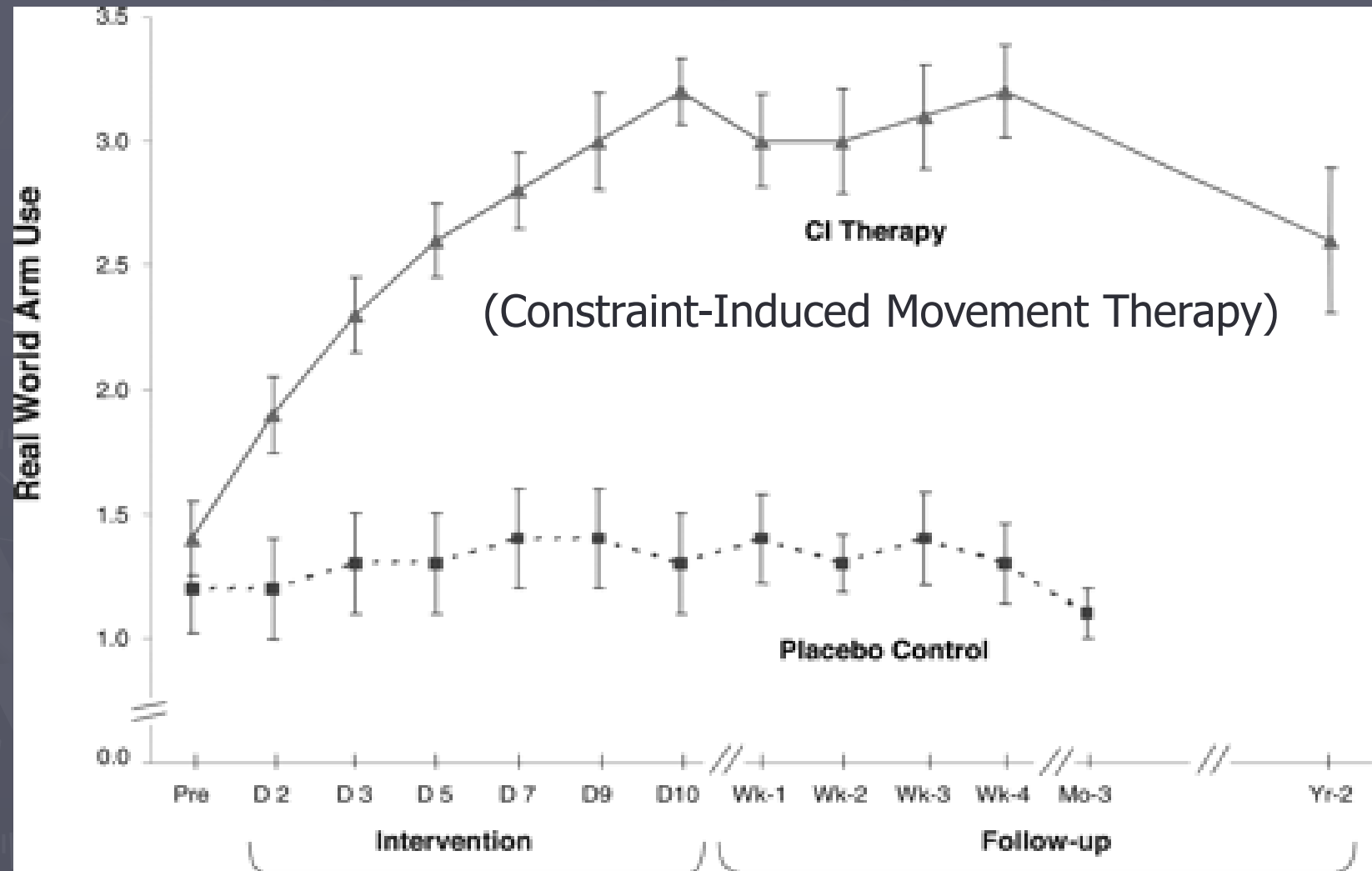
Recanzone, G. H., Schreiner, C. E., & Merzenich, M. M. (1993). Plasticity in the frequency representation of primary auditory cortex following discrimination training in adult owl monkeys. *Journal of Neuroscience*, 13, 87-103.

Part Two

Applications and Higher-Order Skills



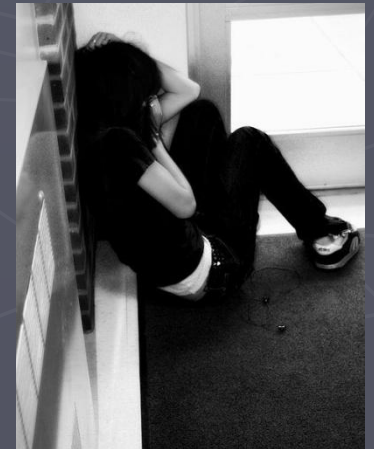
Applied Behavior Analysis for Stroke Victims



Taub, E. et al. (2006). A placebo-controlled trial of Constraint-Induced Movement Therapy for upper extremity after stroke. *Stroke*, 37, 1045-1049.

Applied Interdisciplinary Successes

- ▶ Joint attention in autism
- ▶ Speech language pathology
- ▶ Behavioral pharmacology
- ▶ Cognitive behavioral therapy
- ▶ Positive Behavior Support/
Response to Intervention/
KIPP schools



Methodology Notes

Institute of Education Sciences

"What Works Clearinghouse"

Accepts single-case experimental designs now

Guyatt et al. (2000). Users' guides to the medical literature: XXV. Evidence-based medicine: Principles for applying the users' guides to patient care. *Journal of the American Medical Association*, 284, 1290–1296.

Recommends single-case experimental designs

Methodology Notes

Randomized Controlled Trials

Addiction

Autism

Depression

Phobia

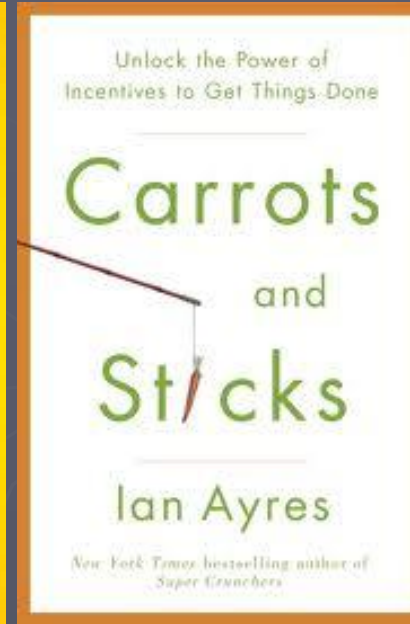
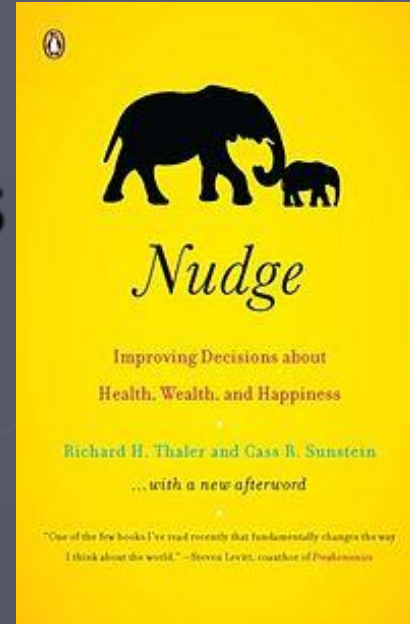
Stroke

Tourette Syndrome

. . . and more

Everyday Applications: Behavioral Economics

- ▶ Delay discounting and self-control
- ▶ Choice
- ▶ Classic economic concepts
- ▶ Marketing



Nudge (Thaler & Sunstein)

Carrots and Sticks (Ayres)

Predictably Irrational (Ariely)

"Incentives are the cornerstone of modern life. And understanding them--or, often, ferreting them out--is the key to solving just about any riddle . . ." (p. 13)

- Steven Levitt and Stephen Dubner, *Freakonomics*

Everyday Applications

Automaticity and Habits

Reflexes vs. automatic behavior

Do operant principles apply in exactly the same way?

Schedules? Discriminative stimuli?



► Applications for self-control

► The Stroop effect

Signal Detection Theory

		Signal present?	
		Yes	No
Response	Yes	Hit	False Alarm
	No	Miss	Correct Rejection

JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR

1978, 29, 331-336

NUMBER 2 (MARCH)

THE RELATION BETWEEN THE GENERALIZED MATCHING LAW AND SIGNAL-DETECTION THEORY

M. C. DAVISON¹ AND R. D. TUSTIN

UNIVERSITY OF AUCKLAND, NEW ZEALAND

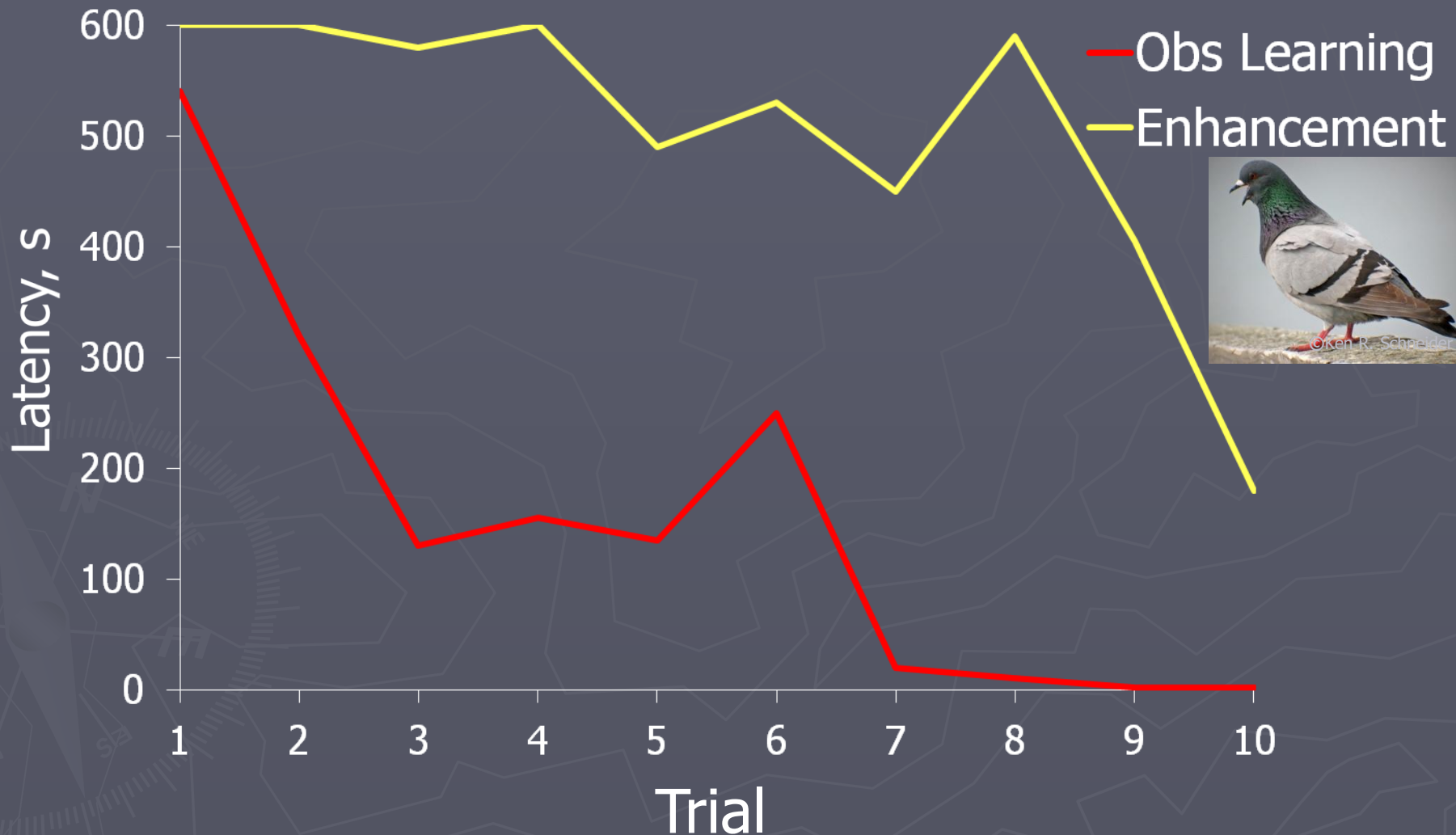
The generalized matching law can be applied to a signal-detection matrix to give two equations. The first relates responding in the presence of the stimulus to the reinforcements for the responses, and the second relates responding in the absence of the stimulus to the reinforcements for the responses. Evidence for stimulus discrimination is given by biases that are opposite in sign in the two equations. As the logarithmic ratio and z proportion transformations are similar, the combination of the absolute values of the two logarithmic biases gives a measure equivalent to the signal-detection measures d' and η . The two equations can also be combined to eliminate the biases caused by the signalling stimuli and to produce a generalized matching-law statement relating overall performance to the obtained reinforcements.

Key words: generalized matching law, signal-detection theory, sensitivity, response bias

Learning Through Observing Others



Piercing a Paper Cover for Food



Palameta, B., & Lefebvre, L. (1985). The social transmission of a food-finding technique in pigeons: What is learned? *Animal Behaviour*, 33, 892-896.

Learning Irregular Verbs

Researchers show:

Children *learn* grammar.

First, "I ran."

Second, "I runned."

Third, "I ran."

Grammar "frames" generalize.



Maratsos, M. (1983). Some current issues in the study of the acquisition of grammar. In P. H. Mussen (Ed.), *Handbook of child psychology* (Vol. 3, pp. 707-786). New York: Wiley.

Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition*, 74, 209-253.

"The Mainstream"

Functional Linguists on Chomsky

"Universal Grammar is dead."

- Michael Tomasello (Max Planck Institute, Functional Linguistics)

"It's crazy to say it's dead. It was never alive."

- Ted Gibson (MIT, Cognitive Science)

Quoted in the March 20, 2012 issue of the *Chronicle of Higher Education*, chronicle.com/article/Researchers-Findings-in-the/131260/

CONCLUSION

The Delights of Interdisciplinary Digging

Learning *about* related fields

Learning *from* each other

Working with each other

A vibrant rainbow arches across a dark, cloudy sky. The rainbow's colors are bright and distinct, contrasting sharply with the deep blue and grey tones of the clouds. The text is overlaid on the image in a white, sans-serif font with a subtle drop shadow.

Operants are everywhere
--so our science is everywhere!