



The Training Technology Firehose: How to stay on the Cutting Edge in an Era of Rapid Innovation

Gregory A. Goodwin, Ph.D.

Simulation and Training Technology Center

Natick Soldier Research Development and Engineering Center

U.S. Army Mad Scientist Conference

George Washington University

August 2018

We live in an era in which mobile computing, the internet of things, data networks, analytics, AI, are evolving at a rapid pace.

Herring (2015) The Truly Personal Computer. *The Economist*

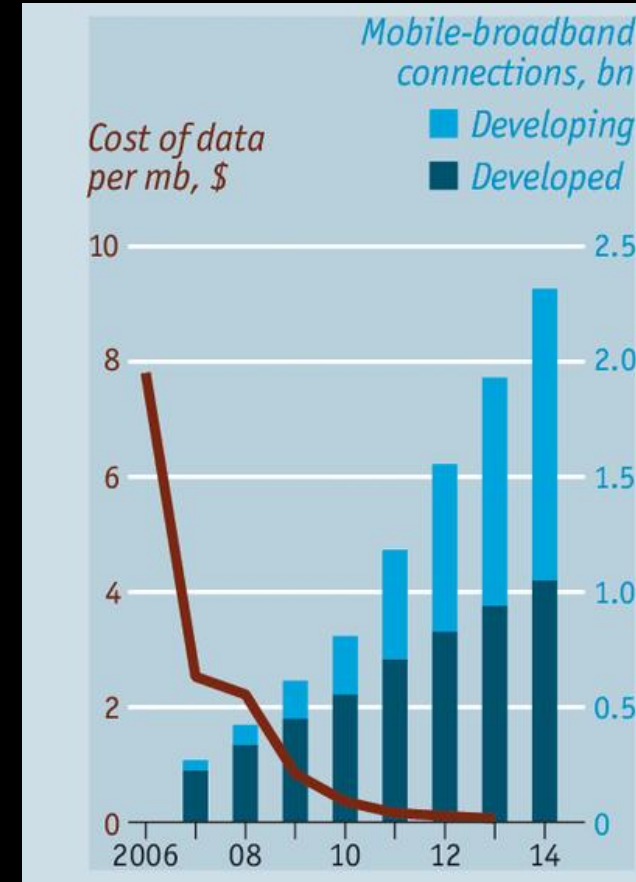


“From 2009 to 2013 the mobile industry invested \$1.8 trillion on improving infrastructure around the world.”

Herring (2015) The Truly Personal Computer. *The Economist*



In that same time,
download speeds
increased by a factor of
12K and data costs
dropped from \$8/mb to
about \$.02/mb.

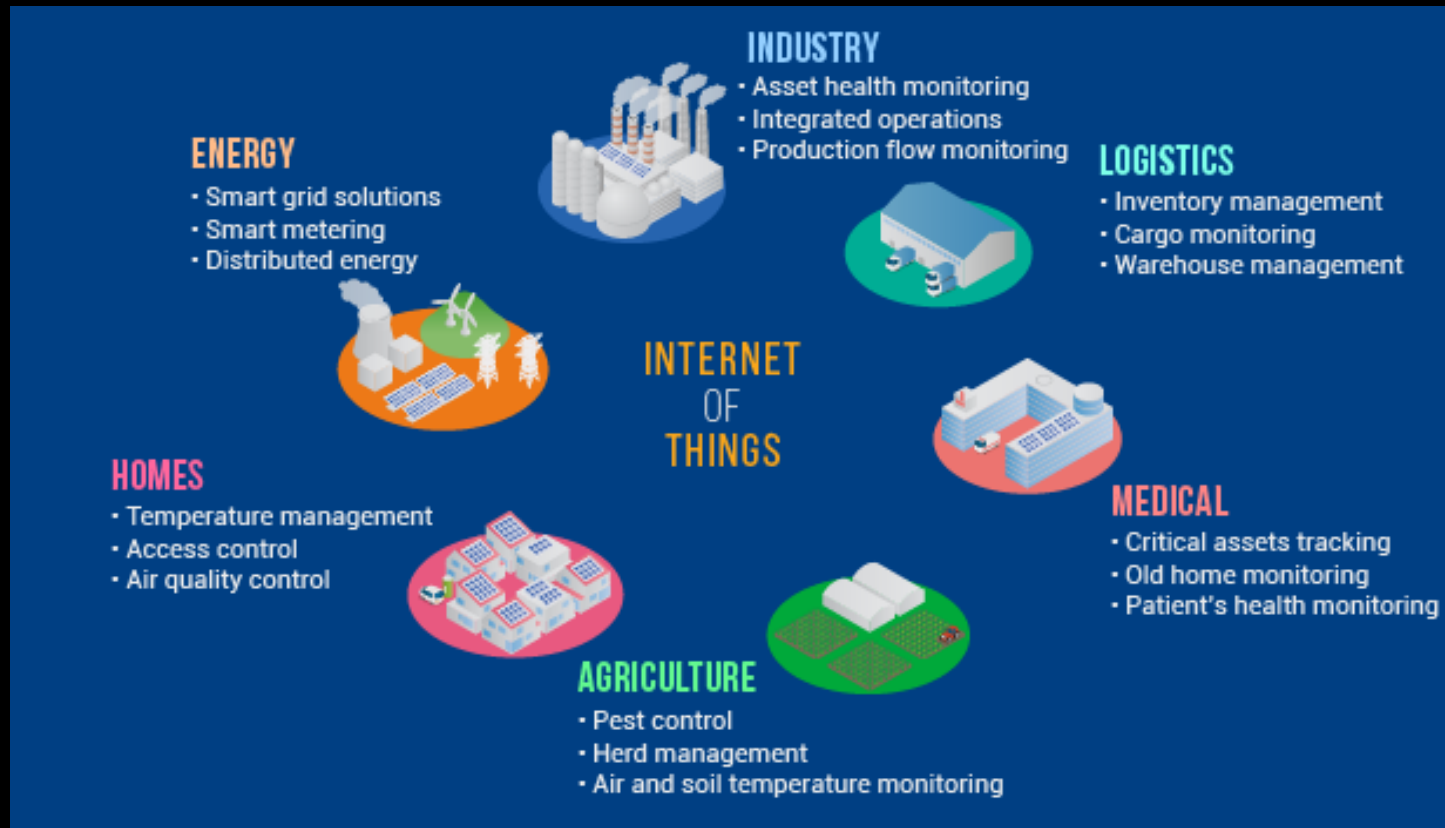


Herring (2015) The Truly Personal Computer. *The Economist*

8.4 billion “Things” are on the internet today, up by more than 30% from just one year ago.



The massive amount of data generated by the IoT will fuel analytics that will continue to revolutionize almost every industry.



How do we stay **cutting edge** with our **training technologies** in an era of such *rapid change*?

Artificial Intelligence

Internet of Things

Edge Computing

Virtual Reality

Big Data

Augmented Reality

Cloud Computing

Virtual Humans

Intelligent Tutoring

Opportunity favors the prepared.

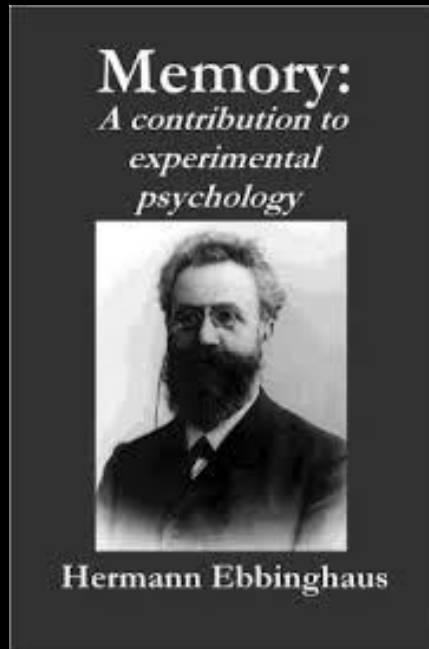
How can we prepare?

- What kinds of technologies could accelerate learning?
- How could technology accelerate learning?
- How do people learn?

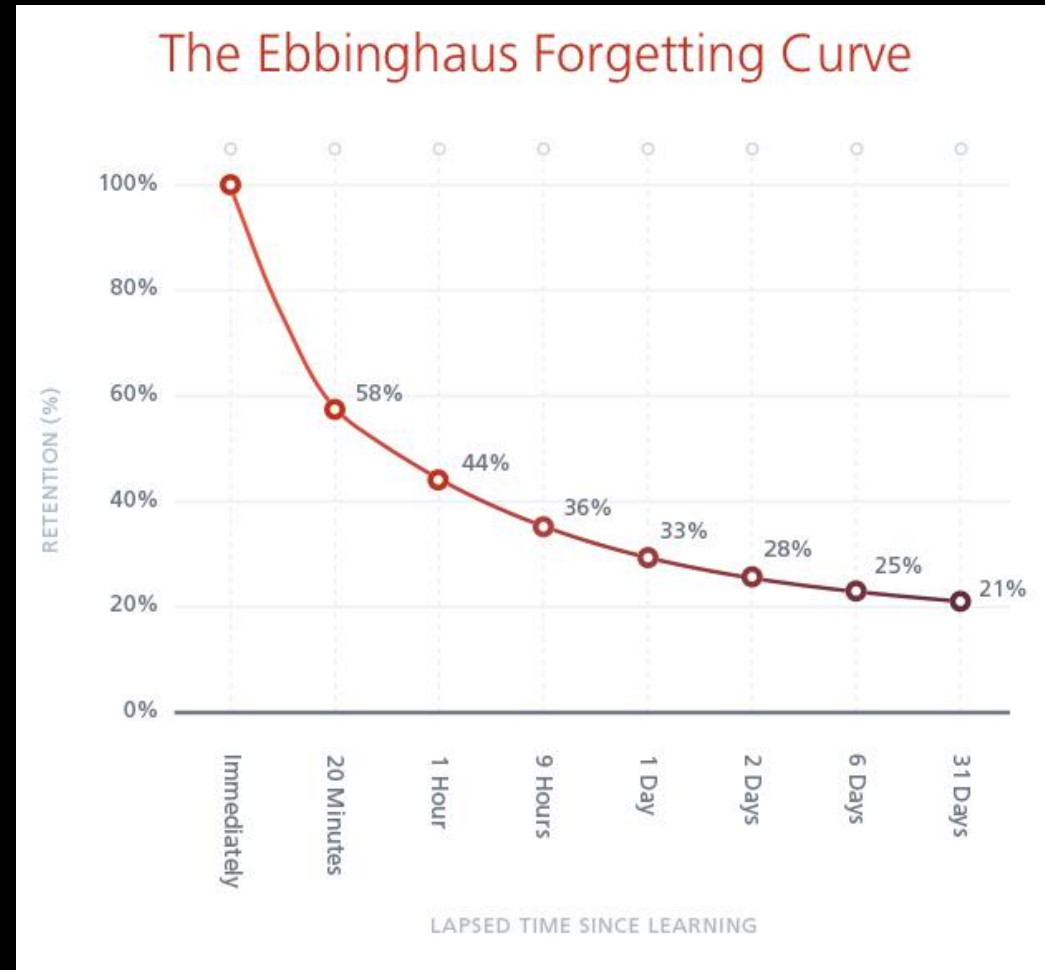
How can we prepare?

- What kinds of technologies could accelerate learning?
- How could technology accelerate learning?
- How do people learn?

Hermann Ebbinghaus

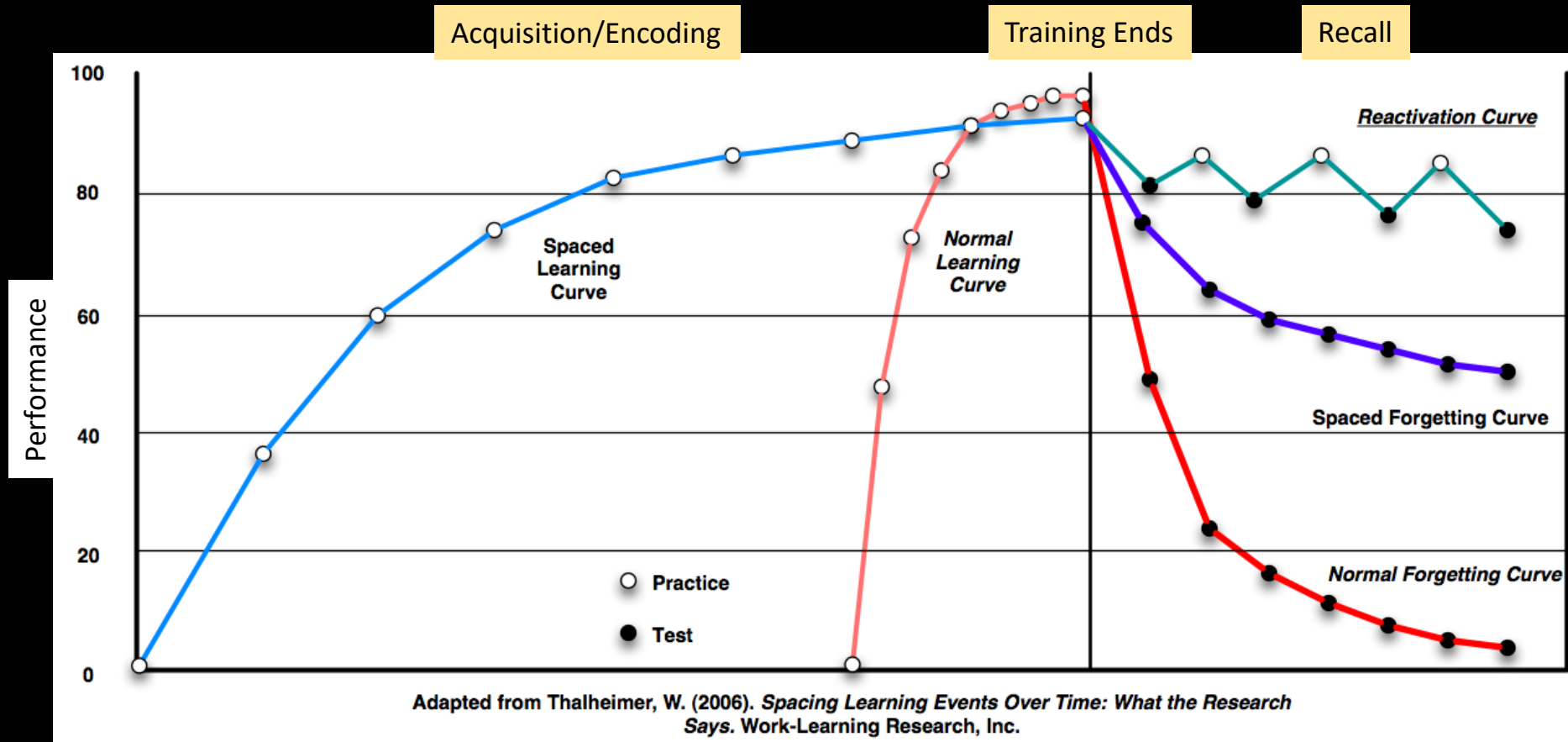


Nonsense Syllables
CYB, WSP, LXR, SNP,
XOP, LIQ, DRW



Hermann Ebbinghaus (ca. 1880)

Spaced vs Compressed Learning



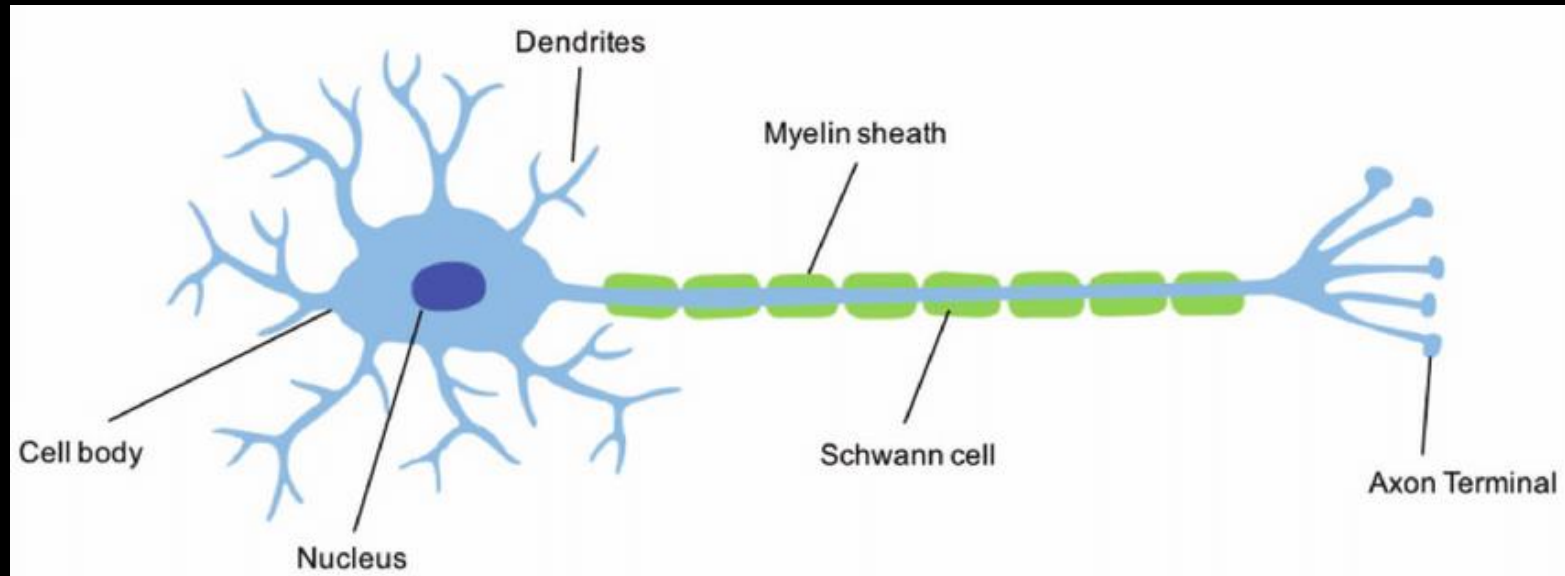
Hermann Ebbinghaus (ca. 1880)

What are Neuronal Changes that Underlie Learning?

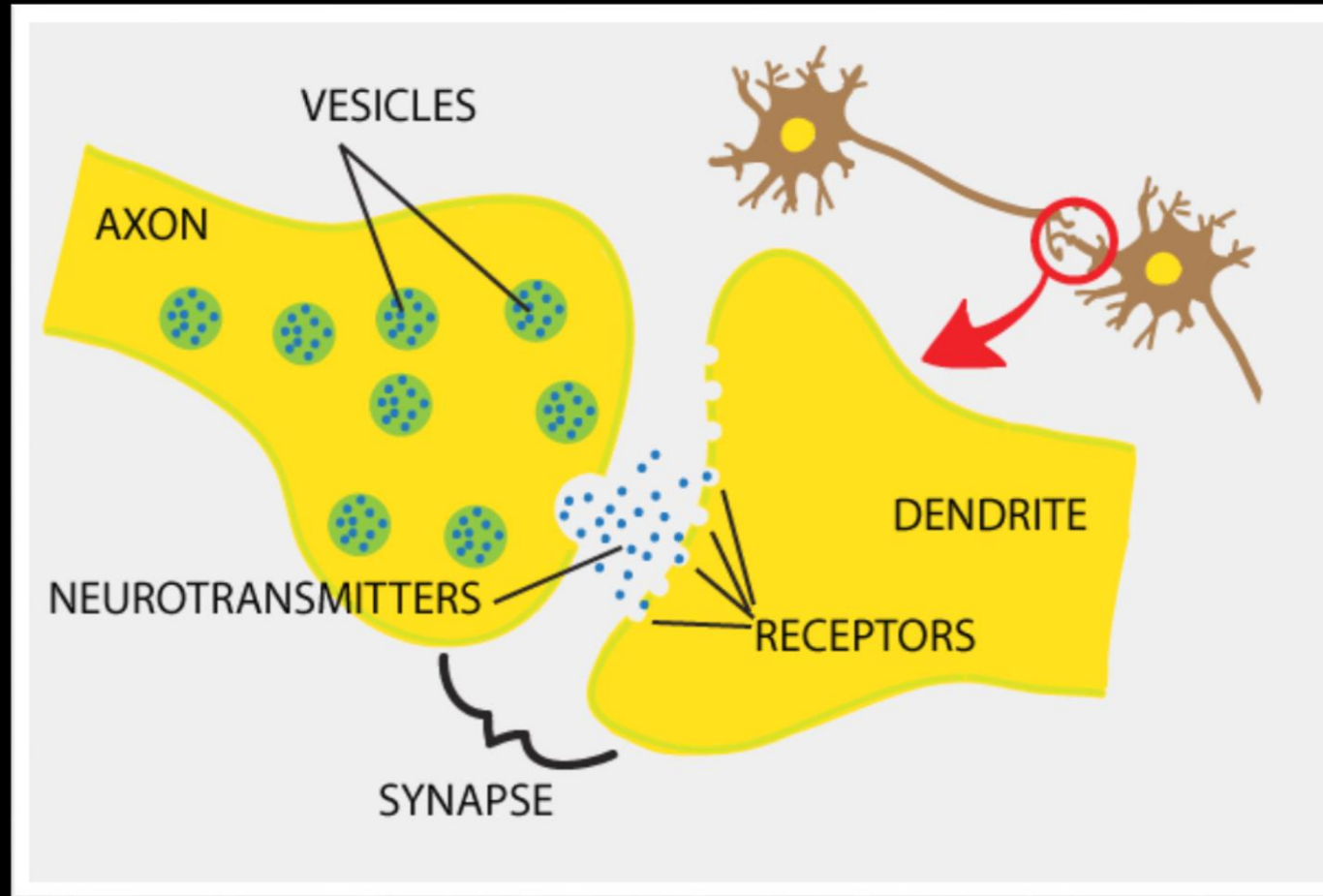
Immediate Changes – temporary, functional

Long-Term Changes – durable, structural

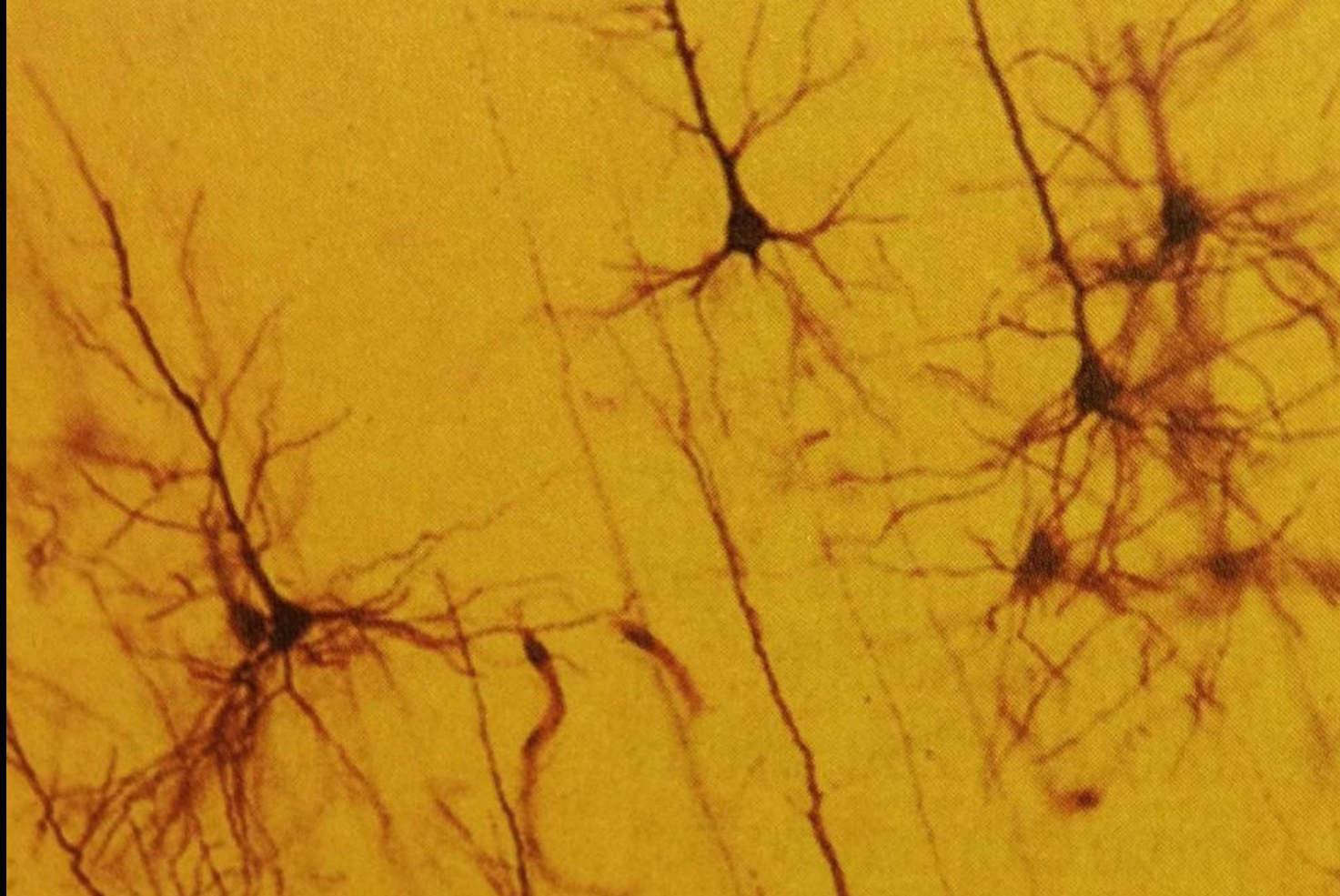
Neuron Structure



Synaptic Structure



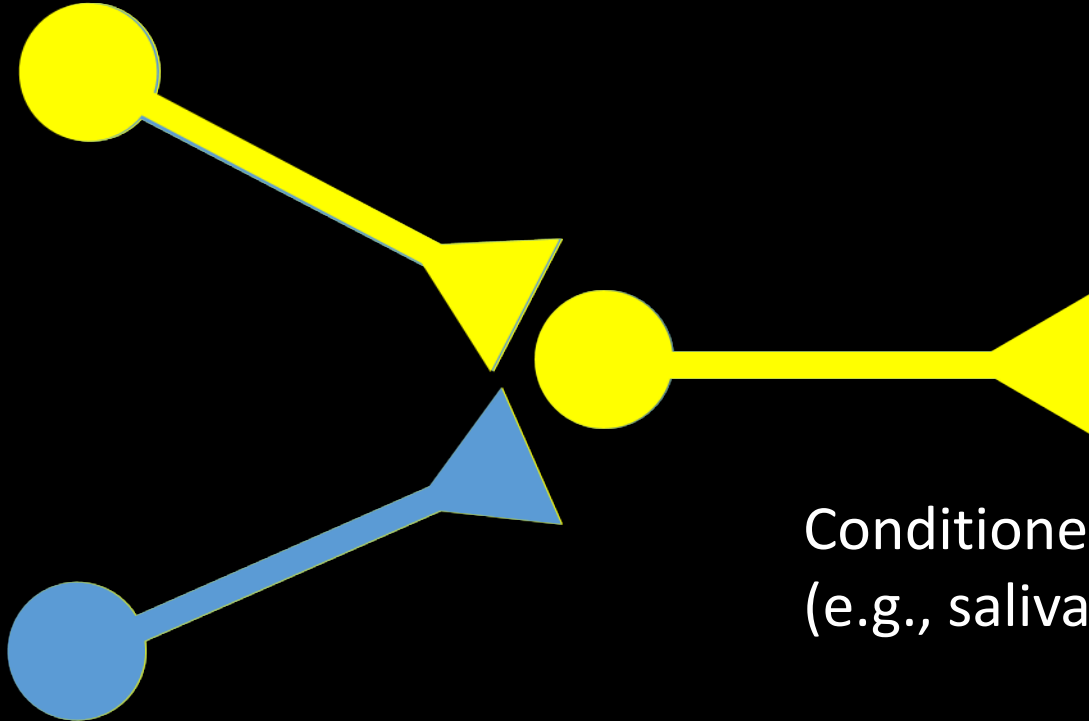
Neuron Structure



Golgi Stain of cortical pyramidal cells

Hebb Circuit

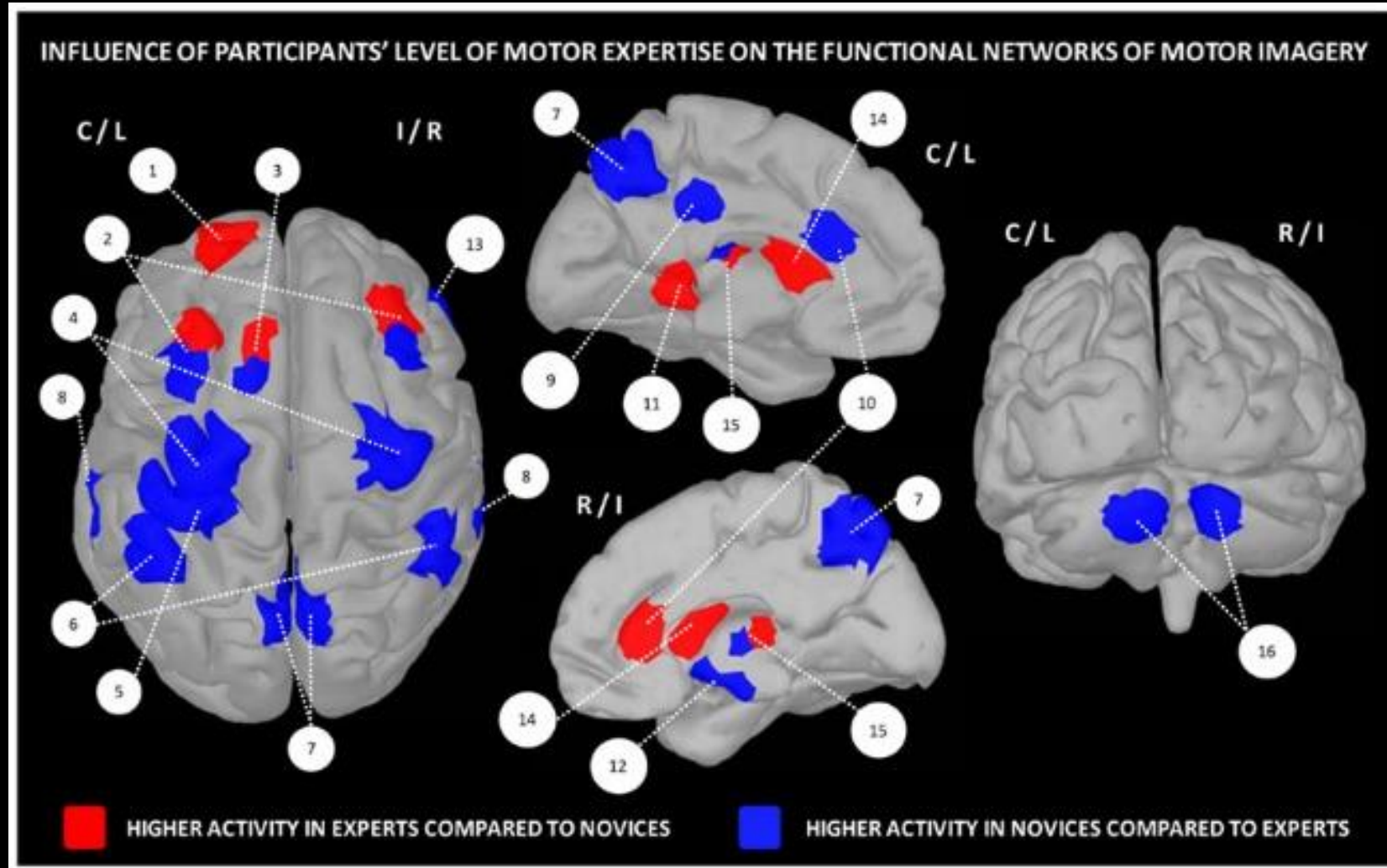
Conditioned Stimulus
(e.g., bell)



Conditioned Response
(e.g., salivation)

Unconditioned Stimulus
(e.g., food powder)

The Expert Brain is More Efficient



Learning Trade Space

Time

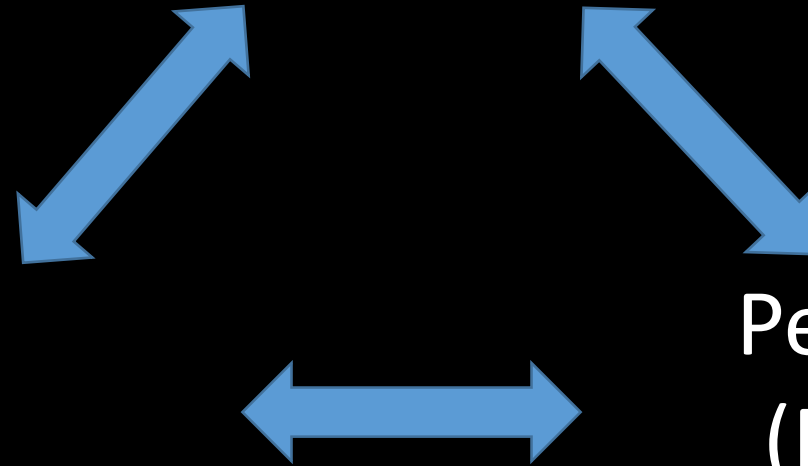
- Initial training duration
- Retraining duration

Cost

- Facilities
- Personnel
- Devices

Performance (Readiness)

- Skill Level
- Decay Resistance



How Could Technology Accelerate Learning?

- Eliminate the need for learning
 - Automation/AI
- Facilitate Acquisition
 - Intelligent training systems
- Facilitate Recall
 - Provide cueing, prompting
- Support training process:
 - Tools to automate planning, preparation, execution and assessment
- WHAT ARE THE RISKS/TRADEOFFS?

1. Eliminate or reduce the need for training

Automation – make complex tasks simpler



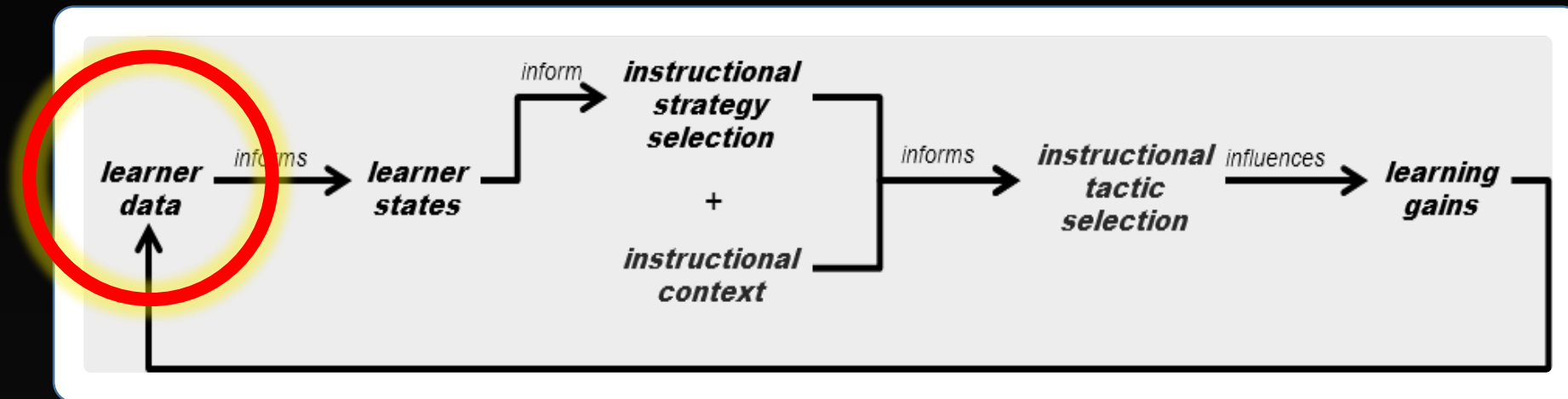
MARKSMANSHIP
SMART RIFLE



AUTONOMOUS
VEHICLES

2. Facilitate Acquisition

Intelligent Tutoring – Adapt training to the needs of the individual or unit



Big Data Analytics
Machine Learning

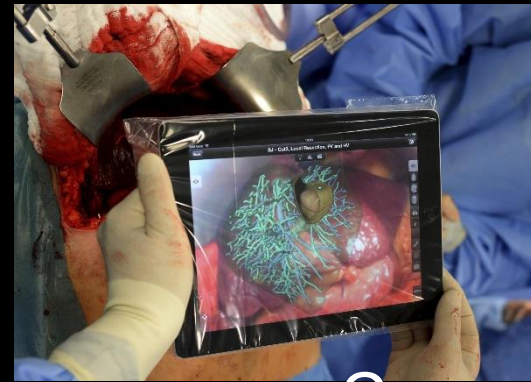
3. Facilitate Acquisition and Recall

Augmented Reality: Cueing, Prompting procedures

Maintenance/Repair



Medical



Operations

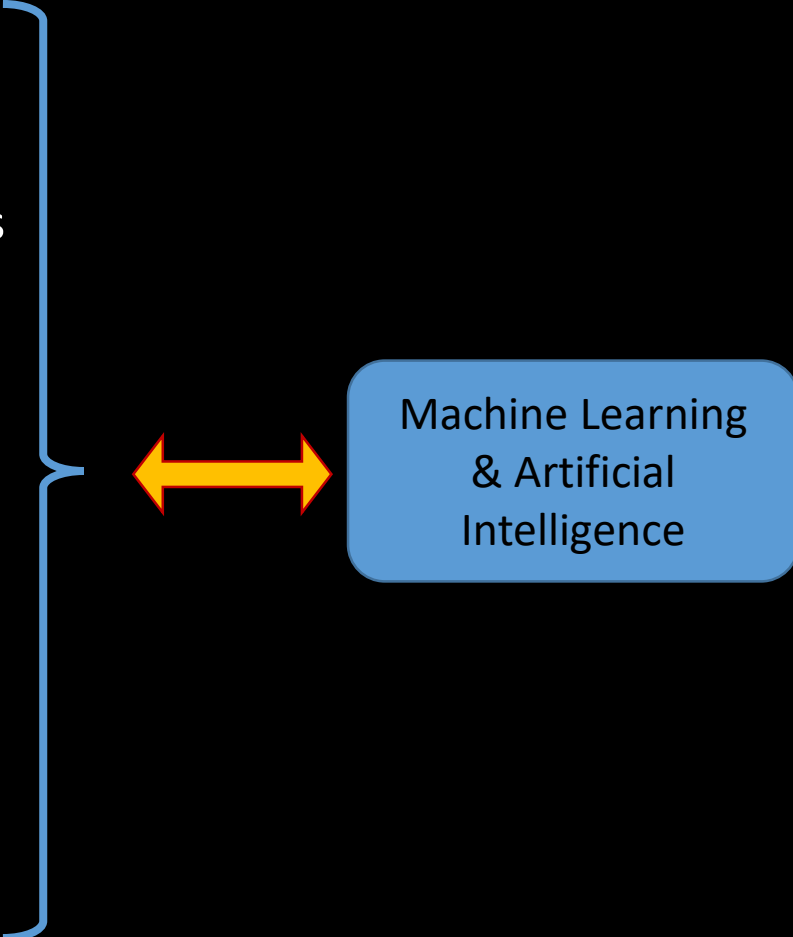
Mission Planning



4. Support Training Enterprise

Automation, Automation, Automation...

- Plan
 - Identify training needs
 - Create training scenarios
 - Identify and create performance metrics
- Prepare
 - Scheduling of resources
 - Validation of scenarios and metrics
- Execute
 - Monitoring of performance
 - Adaptation of scenarios/scripts
- Assess
 - Training status by unit and objective
 - Recommend follow on training



Machine Learning
& Artificial
Intelligence

Risk/Benefit Tradeoffs

- Automation
 - Reduced training cost/need vs. dependence on automation
- Facilitate Encoding
 - More efficient training vs. risk of easy access to individual training records
- Facilitate Recall
 - Reduced need for refresher training vs. dependence on AR/HUDs to provide cueing, prompting
- Support training process:
 - Reduced training overhead costs vs. trust in automated processes and pushing more responsibility to the unit to conduct its own training.

Wrap Up

- How humans learn and develop expertise determines the kinds of outcomes we can expect when we try to accelerate learning
 - *Think Learning Trade Space*
- Four ways to accelerate learning with Technology:
 - Reduce need
 - Facilitate Acquisition
 - Facilitate Recall
 - Automate training support.
- Risks and Benefits are associated with all solutions