

# TSP and Deliberate Practice as Tools for Improved Capability in the Workforce

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# Agenda

## Practice, learning, and neurochemistry

Practice vs. deliberate practice

TSP as deliberate practice

Building capability with TSP / deliberate practice



# What is Practice?

Webster's Revised Unabridged Dictionary (1998): "to perform certain acts frequently or customarily, for instruction, profit, or amusement"

American Heritage Dictionary (2000): "to do repeatedly to acquire or maintain proficiency"

Wordnet (1997): "systematic training by multiple repetitions"



# “Practice Makes Perfect”

Practice improves performance and leads to mastery.



# “Practice, Practice, Practice....”

Mastery is the result of lots and lots of practice; “Gladwell’s 10,000-Hour Rule” says 20 hours of practice per week for 10+ years.



Source: Gladwell, *Outliers*, 2008.



# Truth: All Practice is Not Created Equal

Practice does not make perfect, but it does make permanent.

- Once people achieve acceptable proficiency, performance levels tend to stabilize and remain static.
- Mastery comes from *how* practice is done, not just from *how long*.

Ordinary practice is about *repetition* of numerous skills during set periods of *time*. It usually does not result in mastery-level performance.

Mastery-level performance requires a different kind of practice using *incremental improvements* of sub-skills, resulting in habitual excellence in performance.



# The Neurochemistry of Learning

Neurons (nerve cells) transmit signals to and from the brain.

- Neurons are like wires or cables, insulated with *myelin*.
- Thicker layers of myelin result in faster signal transmission.
- Myelin is built up through action and repetition; it can atrophy from disuse or disease.



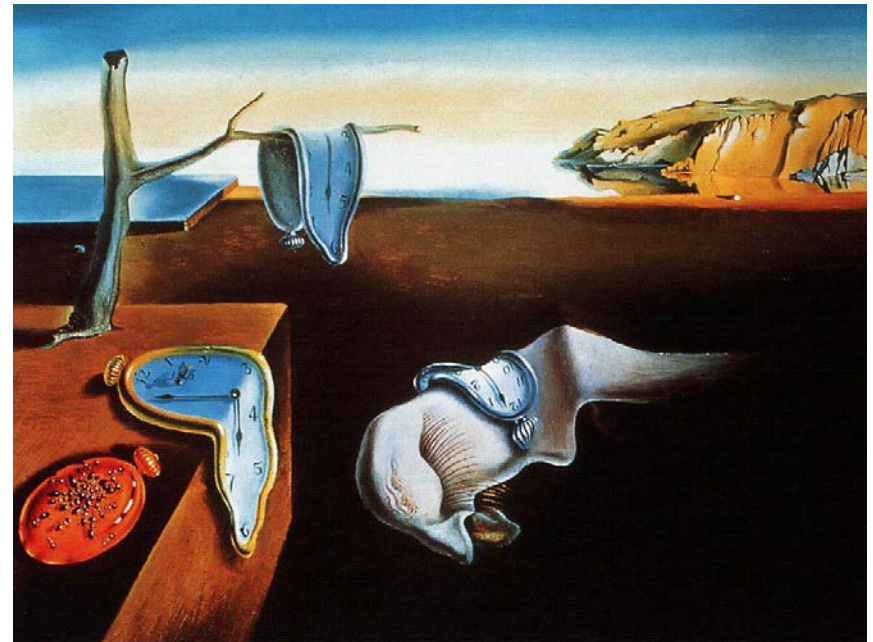
# Hebb's Theory

Persistence or repetition of an activity tends to induce lasting cellular changes that add to stability and synaptic strength between neurons.

*“Neurons that fire together, wire together.”*

New neural pathways form when something new is learned.

Over time, neural pathways become so firmly established that they fire automatically when given the right cue.



*The Persistence of Memory (Salvador Dali, 1931)*





# Paths of Least Resistance

Myelin is the reason that bad habits are so hard to break.

- Myelin does not unwrap (normally); it only wraps.
- Old connections are thicker (stronger) than new connections.
- Established neural pathways are literally the path of least resistance.
- Disused pathways can atrophy, but when triggered, take less time and effort to regain dominance than initially required.

Myelin is the reason that new skills can be so hard to master.

- Repetition is required to form and maintain myelin pathways.
- 50+ repetitions are required to learn new skill at level of “unconscious competence” – meaning 50+ reps of every component of that skill.
- New pathways must be continuously reinforced in order for that pathway to become the dominant pathway: “use it or lose it.”



# Stretch

Research shows that the brain learns best in “stretch” conditions:

- emotions balanced between stress and comfort
- environment with high challenge but low threat

Stress triggers emotional responses in the limbic system, which also controls memory formation and retrieval.

- Negative experiences facilitate the formation of *avoidance* pathways.
- Too much anxiety triggers “fight or flight” and inhibits short term memory.
- Too little anxiety prevents active attention to stimuli.
- Positive or pleasurable experiences facilitate the formation of *stimulus-reward* pathways and stimulate release of dopamine.

Stretch conditions help to create a state of “relaxed-alertness.”



# Relaxed-alertness

Relaxed-alertness is the optimal condition for learning and practicing.

- A safe environment for practicing skills enables the brain to thoroughly process and better retain new information.
- Practicing in a realistic environment facilitates memory retrieval.
- Interesting challenges spark and/or reinforce myelin-building.
- Keeping challenge at an attainable level helps to create positive feelings about learning by stimulating dopamine release.
  - aids motivation (signals when a stimulus is worth working hard for)
  - reinforces stimulus-reward pathways; increases desire for repetition
- Perception of “hardness” impedes myelin formation and strengthens avoidance pathways.



# Lessons from the Neurochemistry of Learning

Learners should focus on performing a skill the right way, from the first time it is done, because....

- Where neural pathways are concerned, learning things right is easier than learning them over.
- Doing the right thing becomes the path of least resistance.

...Old habits are hard to break

- With enough repetitions, behaviors become habits.
- Habits are behaviors that always result in a specific outcome, given a specific cue which activates the neural pathway of least resistance.
- Under stress, the brain almost always uses the path of least resistance.

*We are what we repeatedly do. Excellence, then, is not an act, but a habit.*  
-Aristotle



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# Deliberate Practice is not “Just” Practice

Practice is “doing something over and over again till you get it right.”

Deliberate practice is a process that uses activities which are

- focused on one specific performance element
- designed specifically to stretch current ability
- repeated for several hours a day, every day, *ad infinitum*
- coached and/or objectively self-assessed
- assessed using specific and immediate feedback
- performed mindfully and in-the-moment
- mentally demanding such that practice can be sustained for a couple of hours at a time
- not intrinsically enjoyable due to emphasis on problem areas, not practicing skills that are already done well

Source: Ericsson et. al., 1993



# How Deliberate Practice Changes the Brain

Elements of deliberate practice both promote and strengthen “correct” neural pathway formation.

- Focus on one specific performance element allows mastery of sub-skills.
- Immediate and specific feedback inhibits reinforcement of “wrong” neural pathways.
- Repeated correct practice enables correct performance when unconscious competence has been achieved.
- Metacognition (mindful performance) strengthens pathways and promotes formation of motor-cognitive links.

Elements of deliberate practice stimulate release of dopamine.

- Setting and reaching specific, challenging stretch goals
- Measuring performance improvement (self-actualization)



# How Deliberate Practice Improves Capability

Continuous performance improvement (vs. performance stabilization) leads to mastery in the domain.

Mastery results in unconscious competent performance of routine tasks, with high-quality or defect-free results.

Automaticity in performing routine tasks allows individuals to

- use their limited cognitive energy to
  - be more creative
  - focus more attention on analytical and problem-solving activities
  - respond to problems or crises in an agile way
- improve their performance under stress

*“Don't practice until you get it right; practice until you can't get it wrong.”*





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# TSP is Deliberate Practice for Software Work -1

Recap: Deliberate practice is a highly repeatable process that

- requires analysis of performance to identify areas of weakness
- is a series of single tasks designed specifically to address individual problems and stretch current abilities through incremental improvements
- occurs in situations that closely approximate, even mirror, actual performance conditions
- provides immediate, measured feedback on performance of practice tasks, usually from a master teacher or coach
- requires intense, focused concentration on the practice task at hand

TSP is a highly repeatable process intended to improve the quality of work processes and work products for teams working on software-related projects.



# TSP is Deliberate Practice for Software Work -2

TSP builds on PSP training, a highly repeatable process that

- uses a series of single tasks designed specifically to address individual problems
- stretches current individual abilities through incremental improvements
- uses programming problems that closely approximate, even mirror, actual performance conditions
- provides immediate, measured feedback on performance of practice tasks from a master teacher
- requires individuals to analyze their performance to identify areas of weakness
- uses tools (checklists, etc.) to address problem areas that are specific to each individual
- requires intense, focused concentration on the practice task at hand
- is generally regarded as hard work, not “fun”



# TSP is Deliberate Practice for Software Work -3

TSP is a highly repeatable process that

- requires teams to set specific, measurable goals
- uses data to objectively measure progress towards goals
- provides immediate feedback on performance (data, coach input)
- identifies problem areas in individual and team performance
- provides solutions to specifically address each problem area
- focuses on completing one task at a time



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# Building Capability with TSP

Organizational use of TSP can and has produced dramatic increases in capability at all levels (project, team, individual).

- More efficient work, with higher-quality outputs
- Better accuracy in cost and schedule estimates
- More innovative solutions to problems
- Improved ability to react to crisis situations
- Increased awareness of potential problems: allows “pro-active” solutions instead of reactive responses
- Fewer post-ship defects found by customers
- Easier maintainability of products
- Higher morale, lower turnover of employees who use TSP in their work

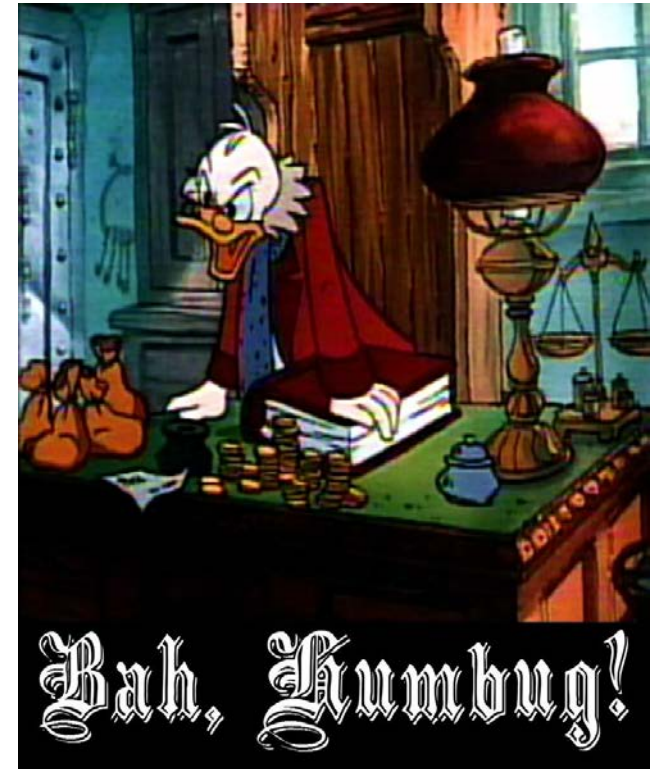
However, organizational adoption of TSP requires in-depth culture changes.



# Deliberate Practice vs. Corporate Culture

Most corporate practices directly contradict the principles of deliberate practice.

- Work process goals = business goals  $\neq$  improvement or learning goals
- Improvement goals focus on corporate needs, not those of individuals or teams.
- People are assigned work they already do well.
- When people get training in new skills, it is often sporadic and superficial.
- Training in new skills fits company needs as much or more than the individual's needs.
- Feedback occurs long after the work is done, and usually focuses on general performance trends, not specific skills.



# The Challenge of Culture Change

Culture change is difficult because

- Organizations and teams are composed of individuals.
- Individuals are neurochemically predisposed to resist change.

Change (at any level) has three important components.

- The desire to modify habits, performance, behaviors for the better
- A deliberate and disciplined plan of action designed to incrementally build new neural pathways that are stronger than existing pathways
- Avoidance or replacement of “bad” cues with cues that trigger the desired behavior





# Culture Changes at the Individual Level

Individuals must be willing to

- honestly assess their abilities and identify areas for improvement
- set specific and measurable goals for personal performance growth
- actively seek objective feedback on progress against personal goals
- regard criticism as input for future improvements, not as a personal attack
- focus as much attention on the process of performing the work on the work itself
- continue to do their work the right way (and use deliberate practice) even – and especially – when the going gets tough

Desired outcome: Enough practice that one can't get it wrong....



# Culture Changes at the Management Level

Managers and executives must

- provide training in PSP, TSP, and/or deliberate practice skills – and the time to practice these skill – for all employees (including themselves)
- expect all employees to implement these skills in their daily work
- ensure that employees have the time and resources needed to do their work the right way from day one of a project
- allow employees to make – and learn from – mistakes
- analyze (vs. punish) failed efforts at innovation or improvement and share lessons learned
- give timely and specific feedback on performance
- provide or facilitate access to meaningful professional enrichment opportunities
- expect and recognize excellent performance as the expected operating procedure
- encourage original thinking and reward successful risk-taking



# Summary -1

Over time, learned behaviors become hard-wired into the brain.

From a neurochemical perspective, excellence in performance is most likely to be realized by focusing on *what* is practiced and *how* the practice is done, rather than on *how long* one practices.

The elements of deliberate practice support mastery of the fundamental components of routine tasks so that they can be automatically and competently performed. (“Practice until you can’t get it wrong.”)

Routine automaticity allows cognitive energy to be channeled towards creative, analytic, or problem-solving tasks. Benefits include

- higher quality work, better products
- shorter cycle time, reduced costs



# Summary -2

In the workplace, deliberate practice enables employees to grow professionally and strive for excellence in their work, and provides a foundation for improving workforce capability at all levels of the organization.

Successfully implementing deliberate practice across organizations requires fundamental changes in the corporate culture.

- Short-term: quality is expensive
- Long-term: quality becomes “free”

Over time, working the right way becomes the path of least resistance.

- All performance (even competent / masterful) always has room to grow.
- Capability improvement is an on-going journey, not a destination.



# Questions?



# Contact Information

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