

CNS AROUSAL AND PERFORMANCE

The relationships among performance factors and the implications of traumatic brain injury.

LN Matheson, PhD (2011)

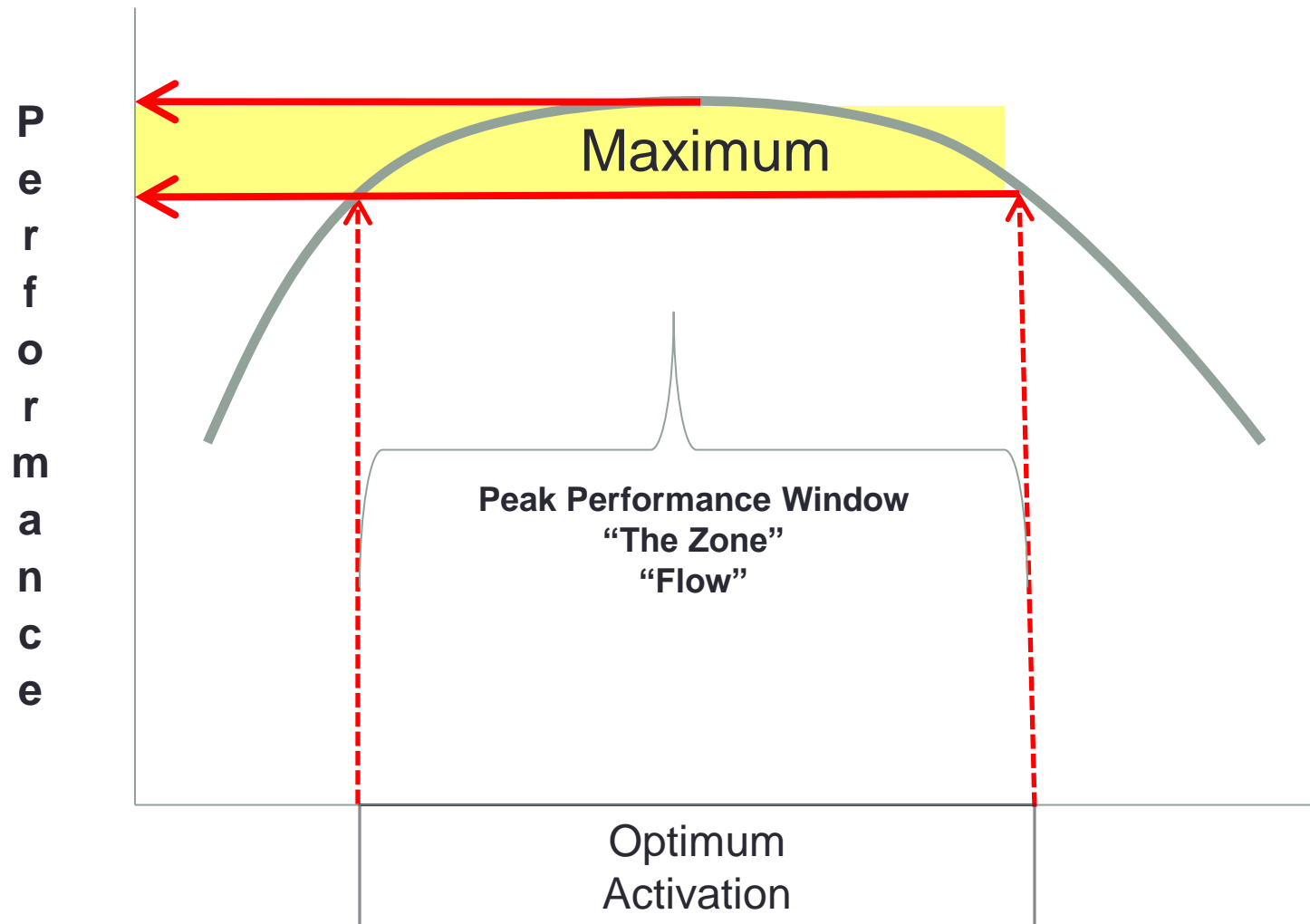
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Yerkes–Dodson Law¹

- In complex tasks, performance is affected by arousal, with low arousal and high arousal producing lower levels of performance than moderate arousal.
- The process is illustrated graphically as a curvilinear, inverted U-shaped curve that increases to a maximum as arousal increases, and then decreases with higher levels of arousal (activation).

¹ Yerkes RM, Dodson JD (1908). "The relation of strength of stimulus to rapidity of habit-formation". *Journal of Comparative Neurology and Psychology* 18: 459–482.

Arousal / Activation - Performance Curve



Inverted-U: Arousal & Job Performance

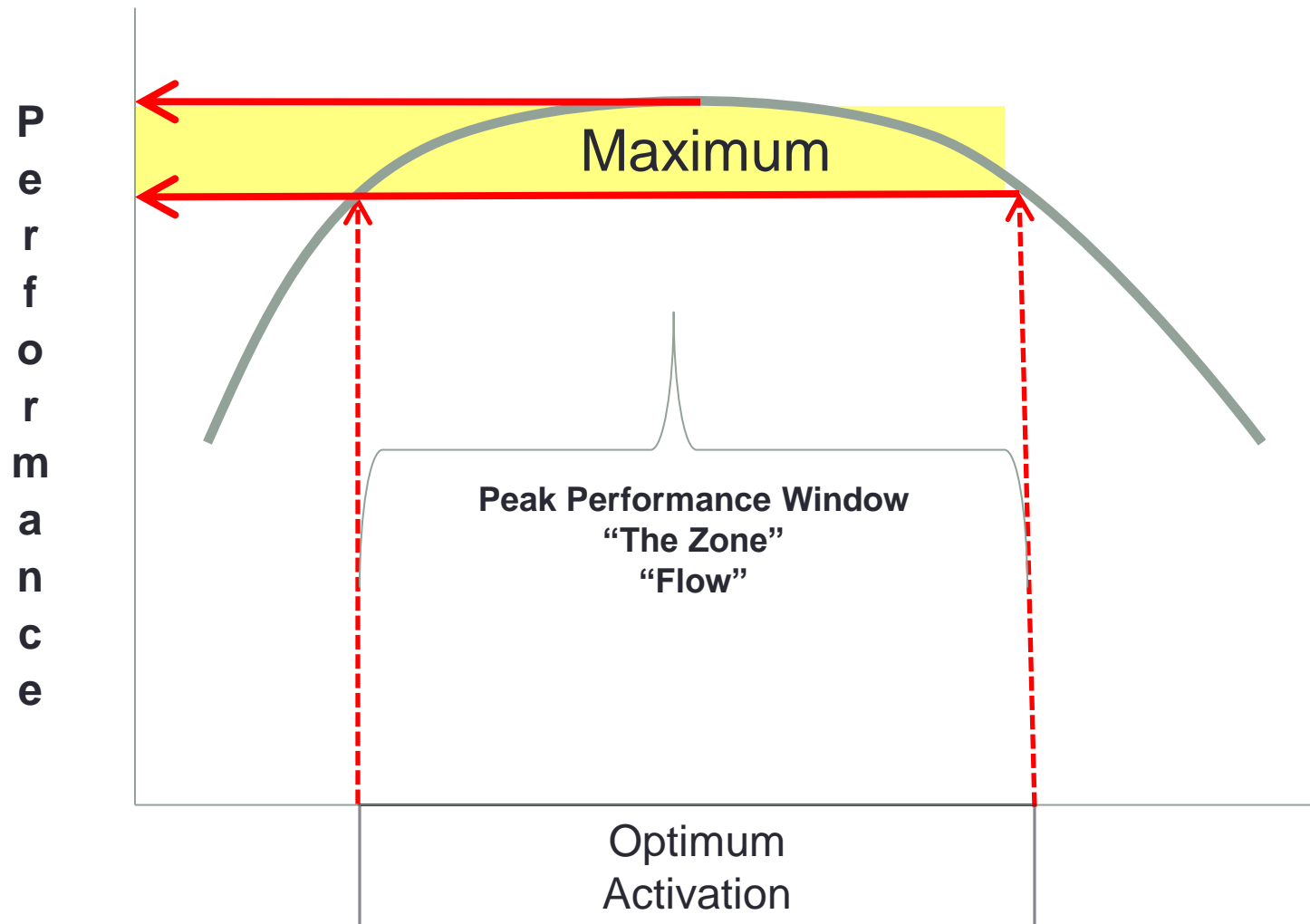
- Simple tasks produce a linear arousal - performance curve.
- To the degree the task is complex, the curvilinear arousal mechanism predominates.
 - Multi-sensory
 - High-attention
 - Creativity and innovation
 - Complex problem-solving
 - Competitive athletic performance
 - Across different sports and different athletes, the simple-complex differential is consistently observed.

Activation-Performance Modulators

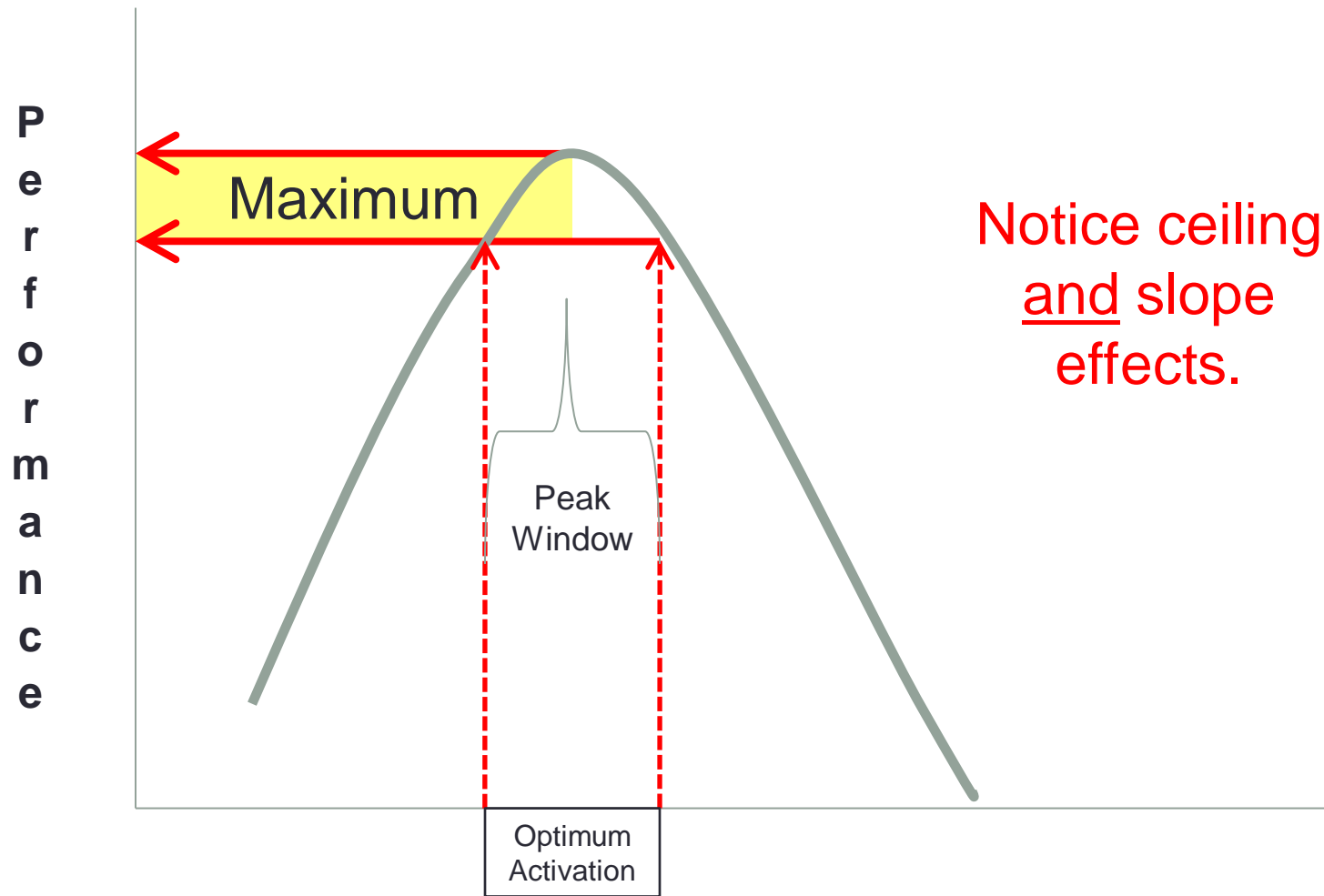
- A partial and incomplete list:
 - Pain
 - Fatigue
 - Opioid Pain Medications
 - Anxiety & PTSD
 - Depression
 - SSRIs & SNRIs
 - Aerobic Exercise
 - Nicotine & Caffeine
 - Alcohol & Marijuana
 - Amphetamines
 - Meditation & Prayer
 - Anabolic-Androgen Steroids
 - Rest & Timeout

mTBI
places a ceiling
on performance
and interacts with
modulators to
make the slopes
more severe.

Arousal / Activation - Performance Curve



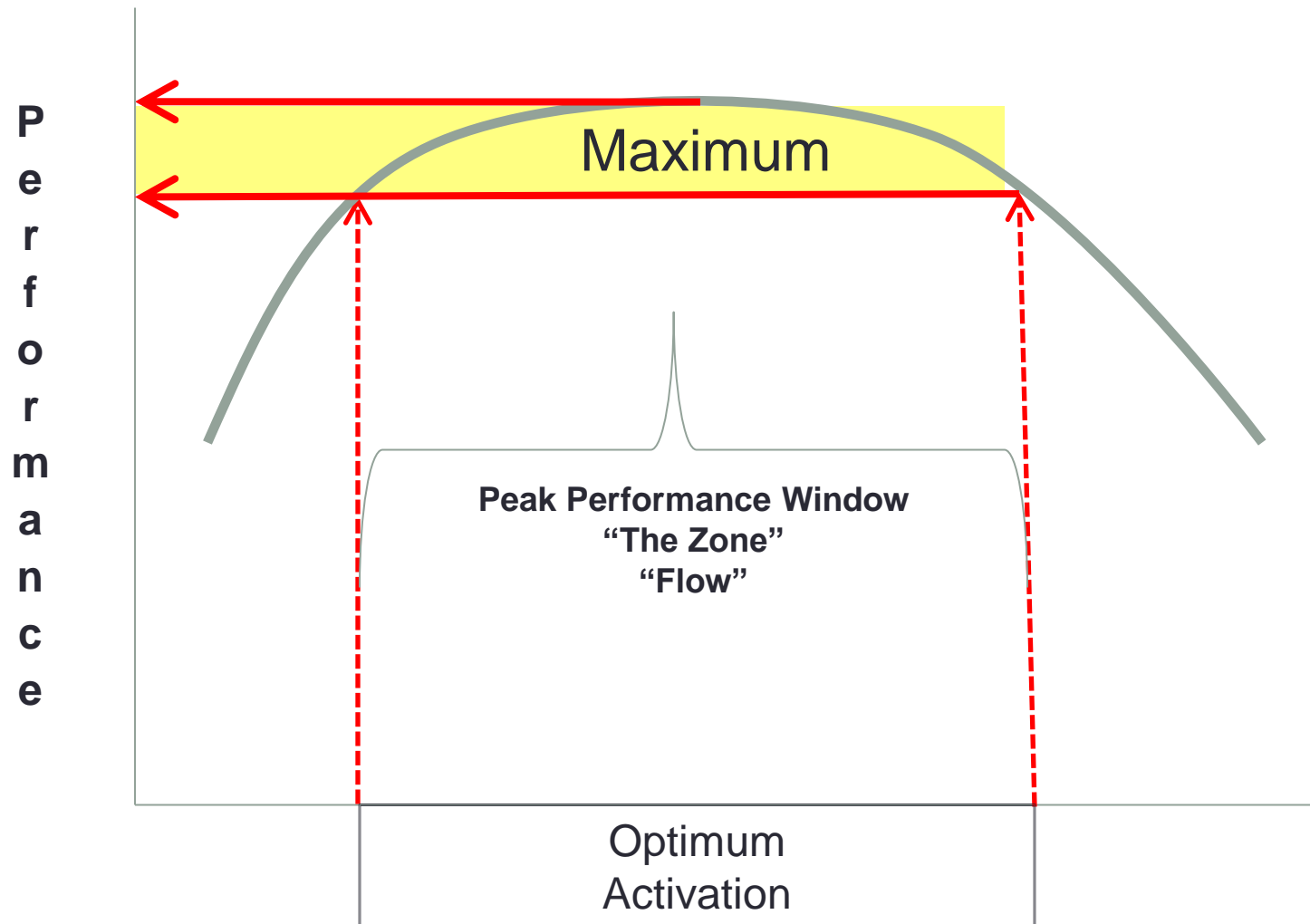
Arousal / Activation - Performance Curve



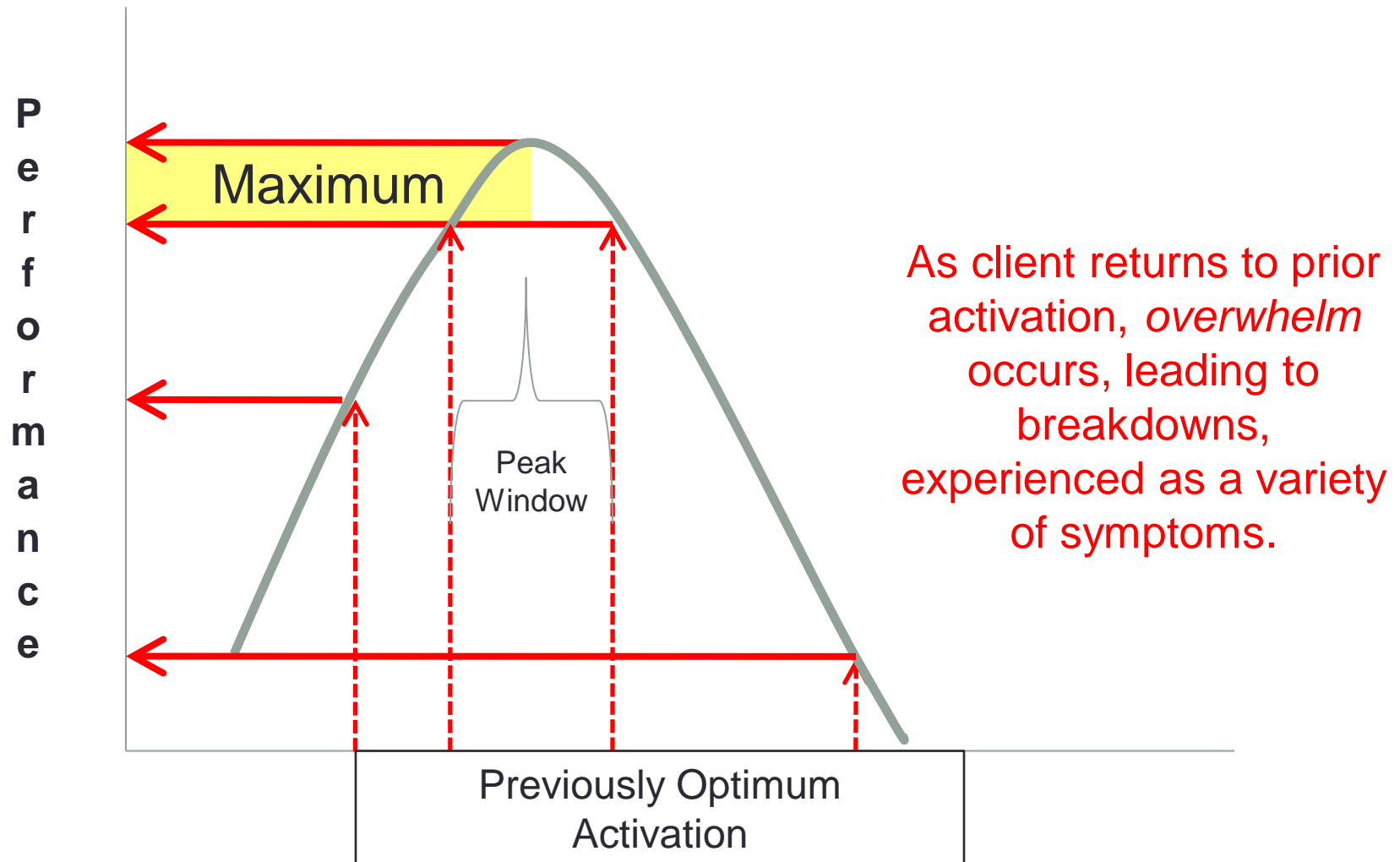
Ceiling - Slope Interaction

- If treated immediately, the ceiling effect of an mTBI is likely to be temporary.
- However, it produces anxiety when it is not understood or means to resolve are not provided.
- This new anxiety adds to arousal factors, which leads to asymmetrical diminution of performance (slope narrowing) and episodic breakdowns.
- Detrimental effects of anxiety are greatly under-appreciated.

Arousal / Activation - Performance Curve



Arousal / Activation - Performance Curve



Ceiling - Slope Interaction

- The ceiling-anxiety arousal can trigger a self-perpetuating cycle.
- Un-checked, this will be resolved by the client with maladaptive methods.
 - Pain medication with tolerance and dependence.
 - Marijuana & alcohol use with tolerance & dependence.
 - Heroin and other opiates paired with anxiolytics; with tolerance & dependence, but high risk of overdose in the initial trials leading to coma and death.

Thank you!

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Please contact Dr. Matheson with comments or questions.
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