

Mar 4th, 9:00 AM - 10:30 AM

Dynamic and Adaptive Training for Enhanced Aviation Knowledge Transfer and Retention

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Dynamic and Adaptive Training for Pilots and Air Traffic Controllers



32nd National Training Aircraft Symposium

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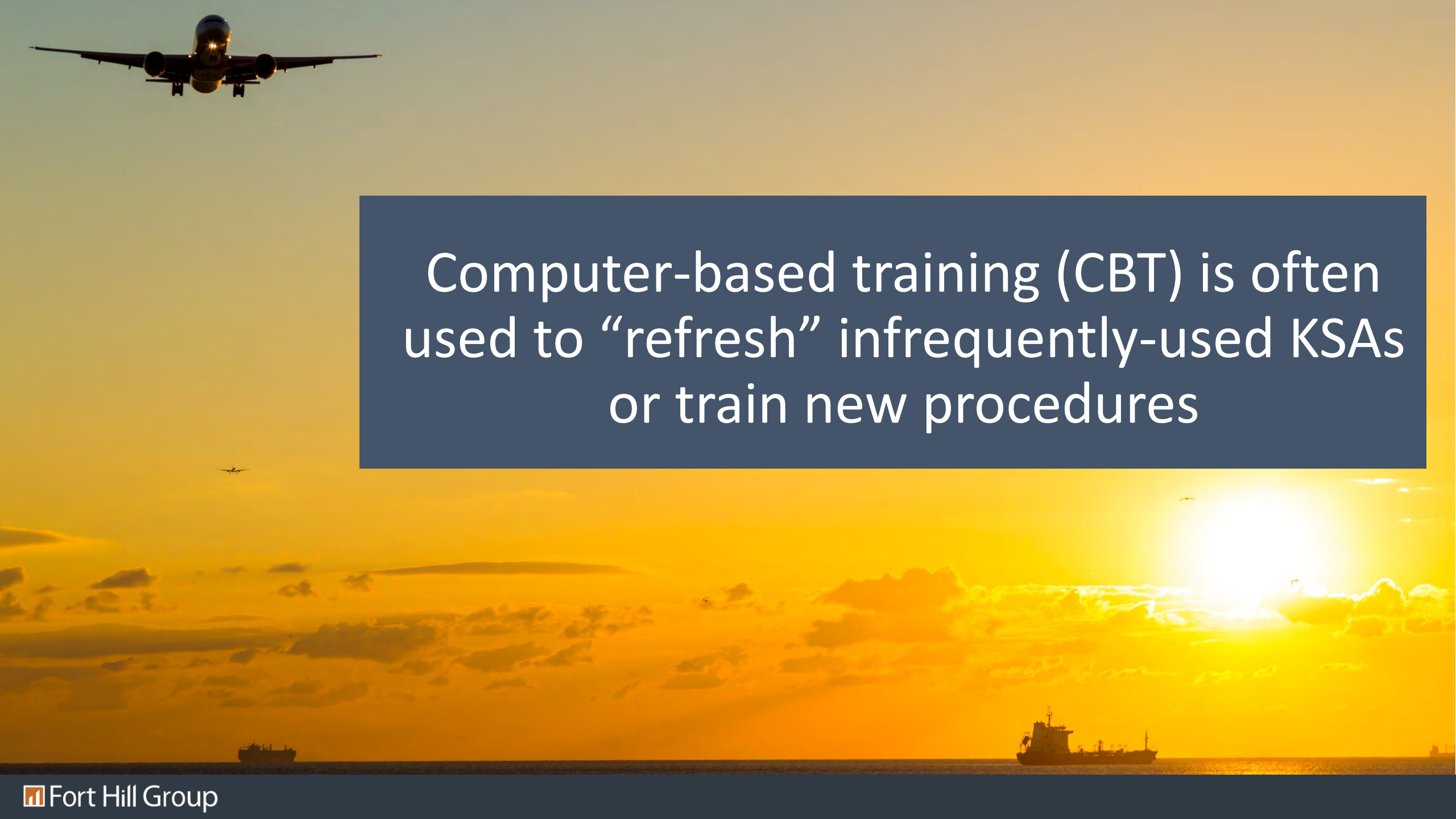
Katherine Berry Ph.D.

Fort Hill Group – Washington, DC

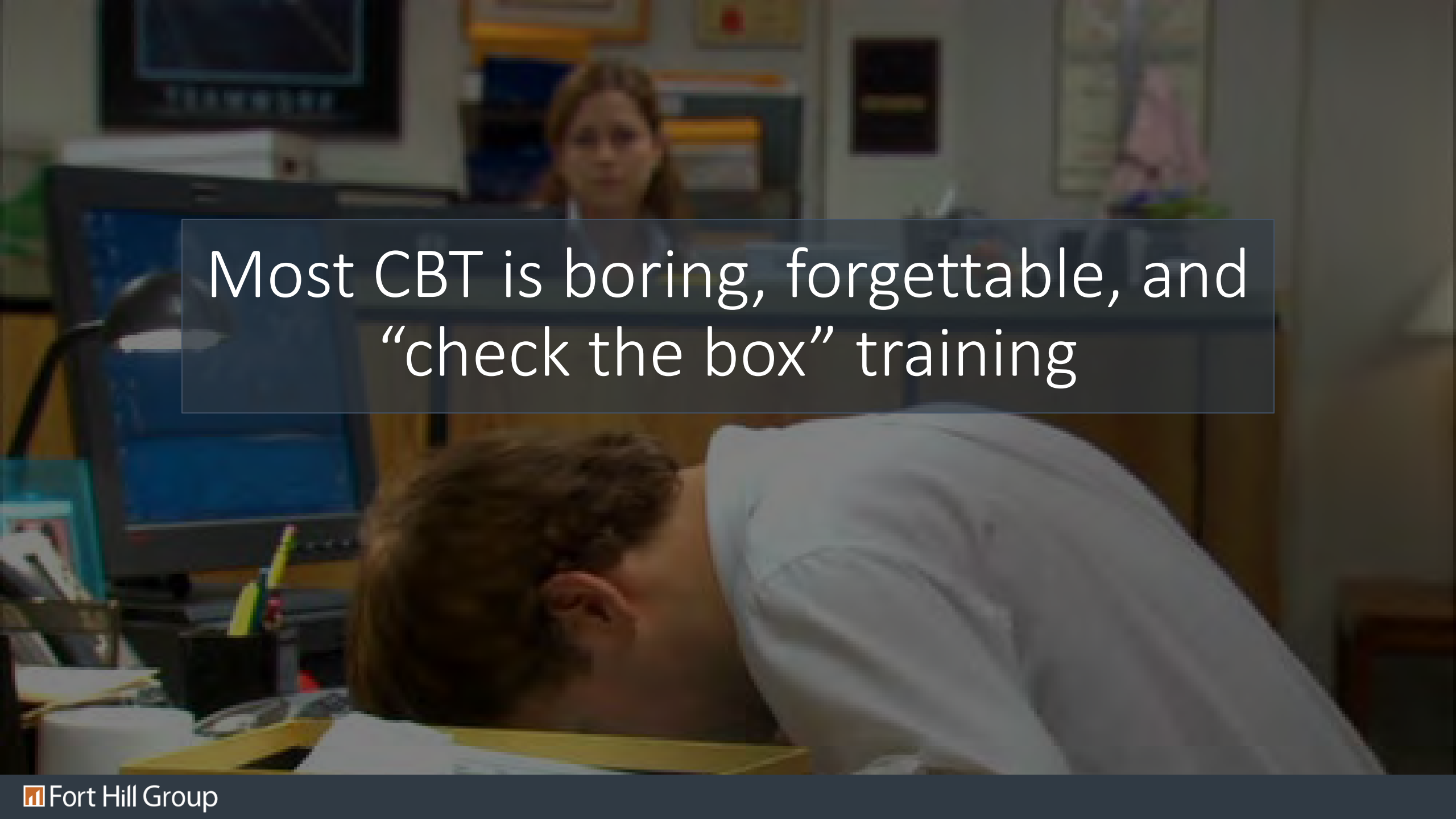
March 4, 2020 – Daytona Beach, FL

A large commercial airplane is shown from a rear perspective, flying over a control tower. The scene is set against a sunset sky with orange and blue hues. The control tower is a tall, dark structure with a glass-enclosed top section. The airplane has four engines and its landing gear is visible.

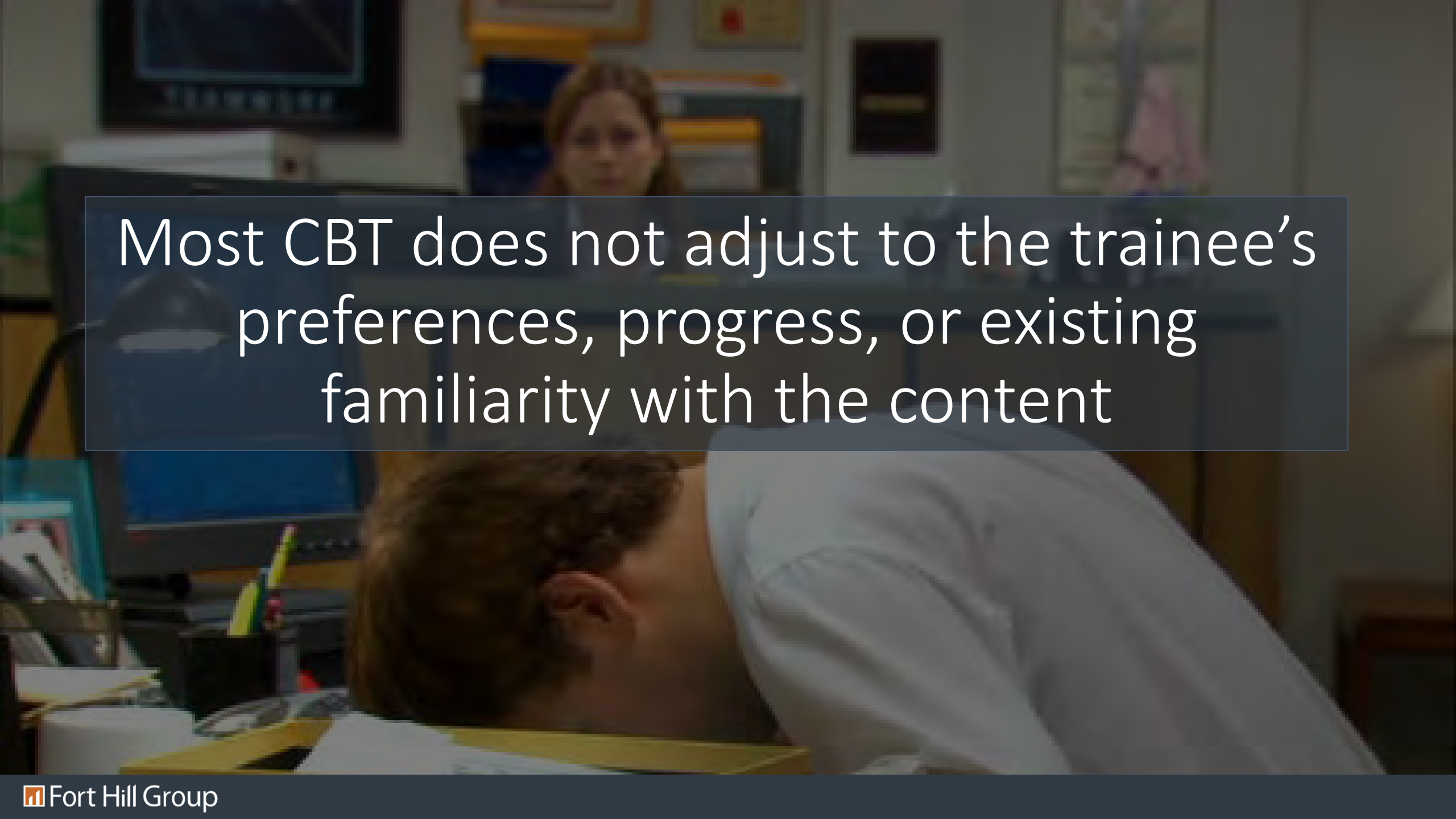
Knowledge, skills, and abilities (KSAs)
deteriorate over time if not used or
applied routinely



Computer-based training (CBT) is often used to “refresh” infrequently-used KSAs or train new procedures

A photograph of an office setting. In the foreground, a man with dark hair is slumped over his desk, appearing to be asleep. He is wearing a light-colored shirt. In the background, a woman with long brown hair is sitting at her desk, looking towards the camera with a neutral expression. The office has several computer monitors, papers, and a desk lamp. The overall lighting is somewhat dim, and the image has a slightly desaturated, professional feel.

Most CBT is boring, forgettable, and
“check the box” training

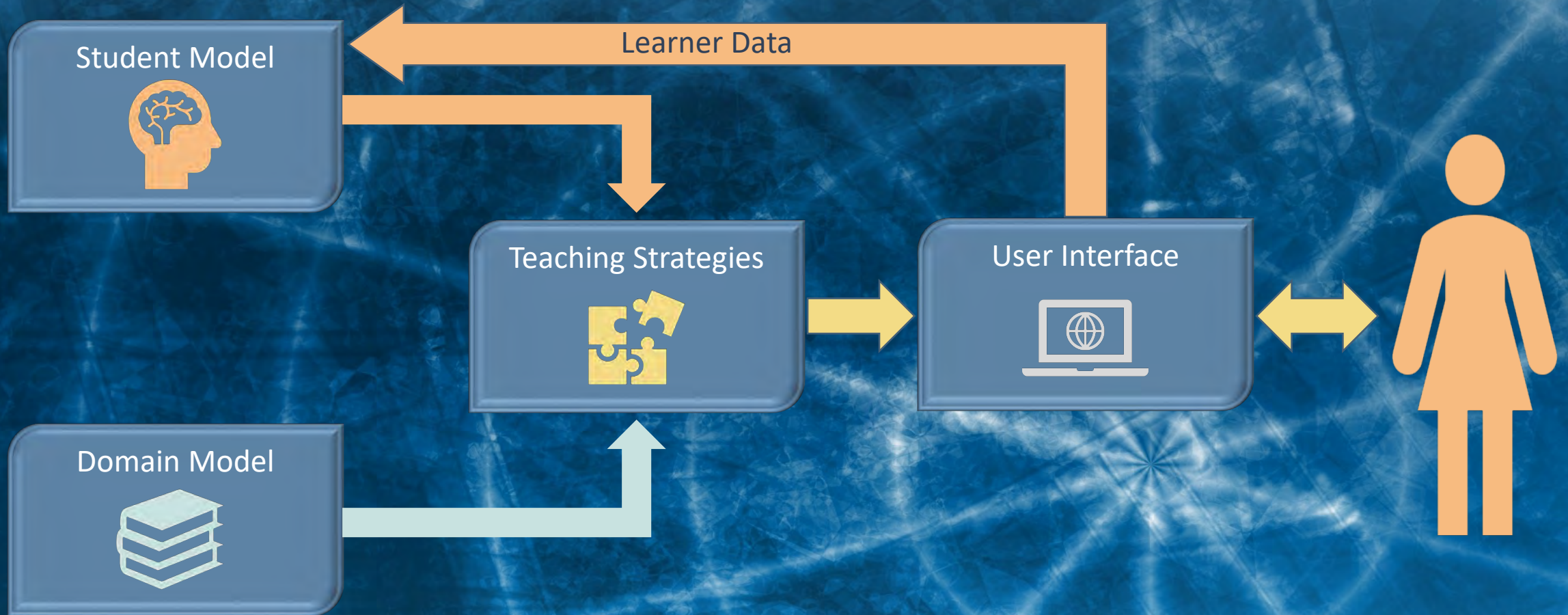


Most CBT does not adjust to the trainee's preferences, progress, or existing familiarity with the content

Adaptive Instructional System (AIS)

- ▶ Intelligent agent monitors learner
- ▶ Strategies and actions change based on:
 - Learner variability and attributes
 - Preferences
 - Proficiency
 - Attention and engagement

Basic Adaptive Instructional System



Key Elements of Effective Training	Traditional CBT	Adaptive Instructional Systems	Evidence
Efficiency			
Development cost	Green	Yellow	<ul style="list-style-type: none"> • Bove, 2019 • McCarthy, Kennedy, Grant, & Bailey, 2019 • Sottolare & Brawner, 2018
Required infrastructure	Green	Yellow	
Ease of distribution	Green	Green	
Individualization (progress, preferences)	Yellow	Green	
Relevance			
Domain accuracy	Green	Green	<ul style="list-style-type: none"> • Khan & Mustafa, 2019 • Mavroudi, A., & Hadzilacos, 2016
Context specific	Yellow	Green	
Engagement			
Degree of engagement	Yellow	Green	<ul style="list-style-type: none"> • Carroll, Kokini, Champney, Sottolare & Goldberg, 2011 • Petrovica, Anohina-Naumeca, & Ekenel, 2017 • Robison, McQuiggan, & Lester, 2009
Engagement metrics	Yellow	Green	



Adaptive Dynamic and Personalized Training

Combines traditional CBT and AIS elements to improve

- ▶ Efficiency
- ▶ Relevance
- ▶ Engagement



Adaptive
Dynamic
and
Personalized
Training

Data sources inform ADaPT's algorithm

- ▶ Pre- and post-test
- ▶ Response time and accuracy
- ▶ Learner preferences
- ▶ Engagement metrics
 - Affect

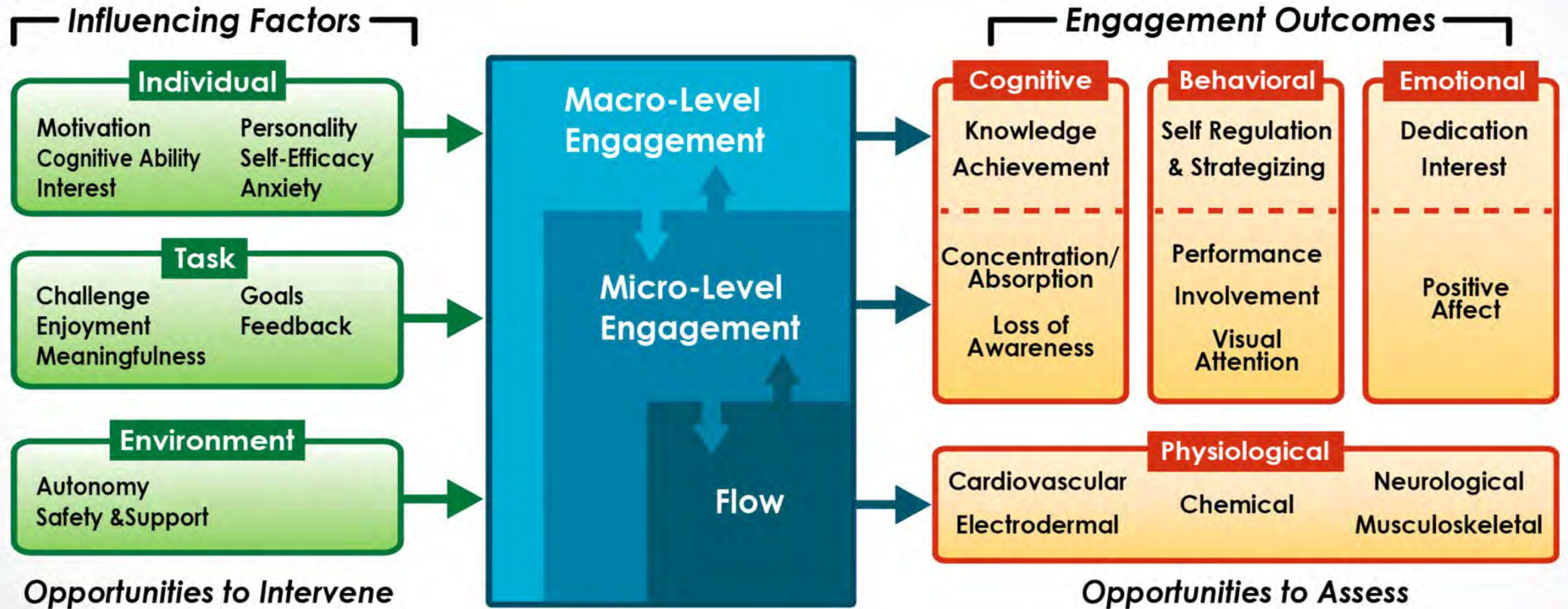


Adaptive
Dynamic
and
Personalized
Training

Algorithm generates optimal strategies for efficiency and engagement

- ▶ Personalized
 - Context and trainee level
- ▶ Module format
- ▶ Metacognitive prompting
- ▶ Attention maintenance

Applied Model of Learner Engagement



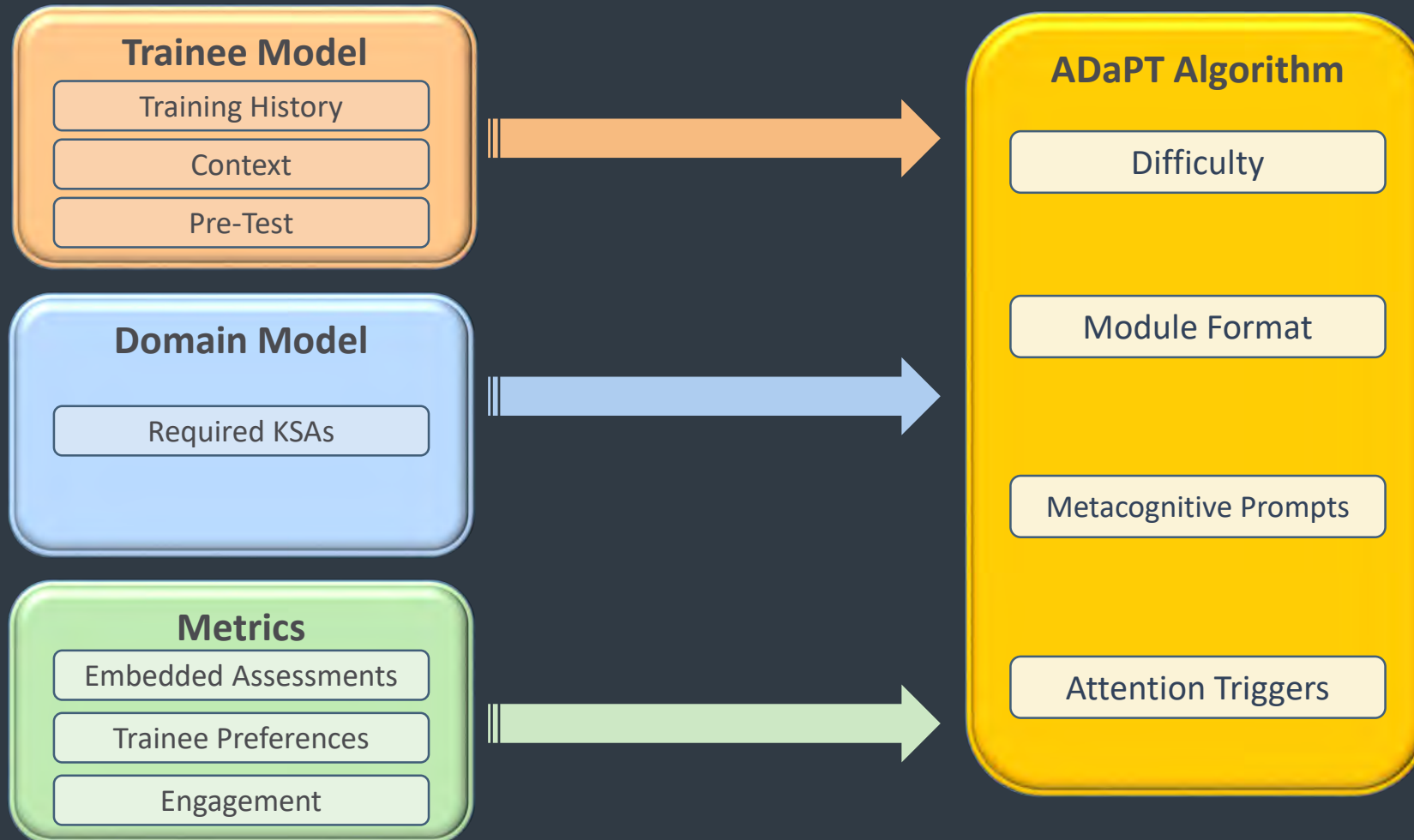
Carroll, M., Lindsey, S., Chaparro, M., & Winslow, B. (2019). An applied model of learner engagement and strategies for increasing learner engagement in the modern educational environment. *Interactive Learning Environments*, DOI: 10.1080/10494820.2019.1636083.

Taxonomy of Interventions and Learning Environments

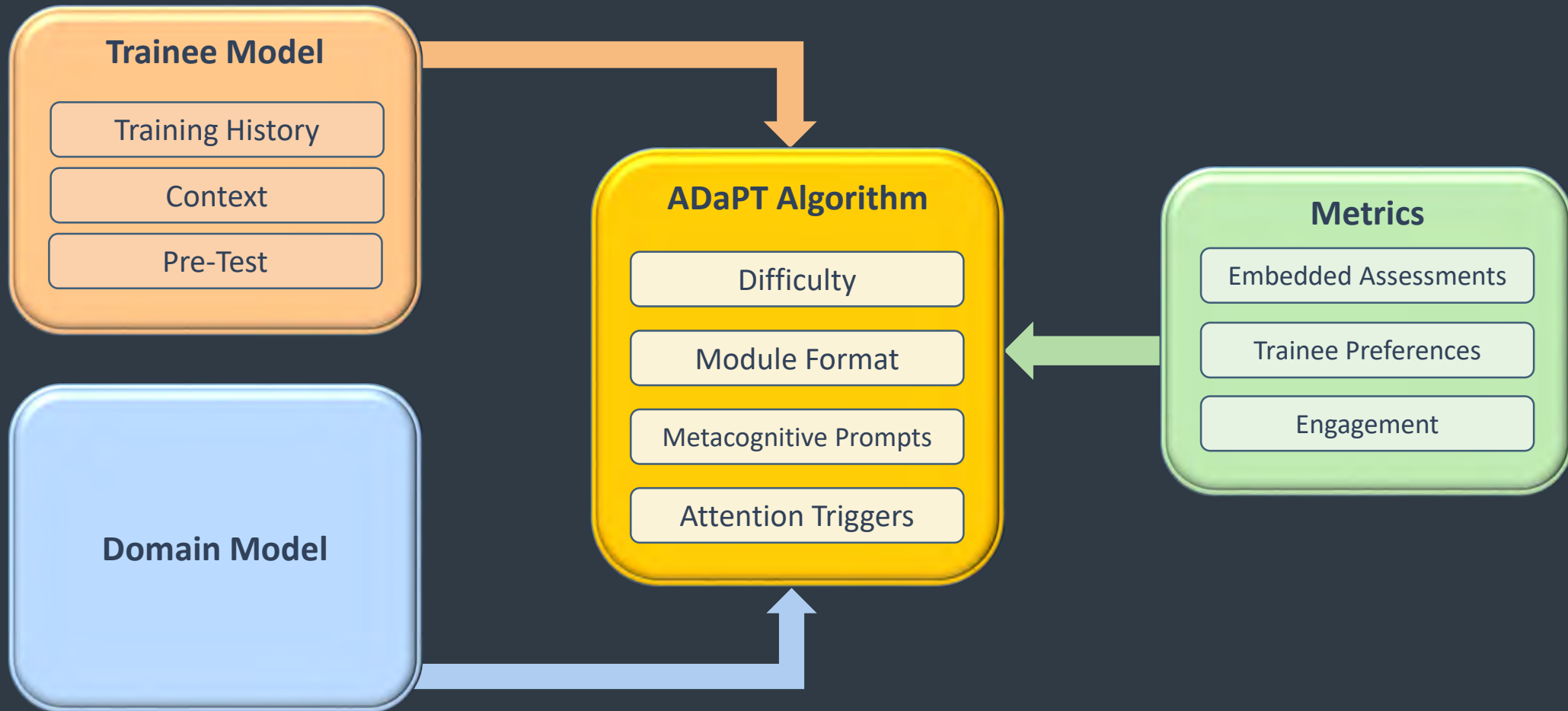
Instructional Intervention	Effective Environments			Shown to Improve		
	Traditional	Virtual	Live	Engagement	Knowledge	Skills & Performance
1. Metacognitive Intervention	●	●	●	●	●	●
2. Challenge Level Optimization		●		●	●	●
3. Goal Clarity	●	●	●	●	●	●
4. Feedback	●	●		●	●	●
5. Autonomous Self-Regulated Learning	●	●	●	●	●	●
6. Personalization	●	●		●	●	●
7. Experiential Learning	●	●		●	●	
8. Game Based Learning	●	●		●	●	●
9. Interactivity and Multimedia	●	●	●	●	●	●
10. Meaningful Learning	●			●	●	

Carroll, M., Lindsey, S., & Chaparro, M. (2019, July).

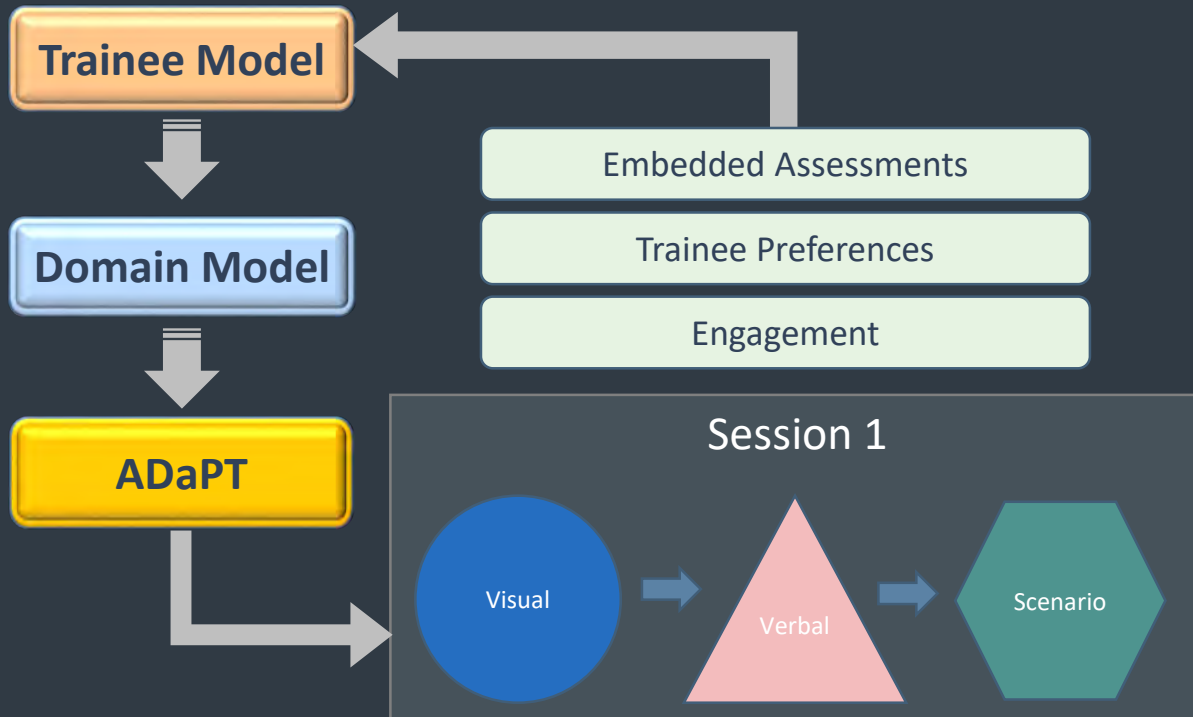
ADaPT Basic Structure



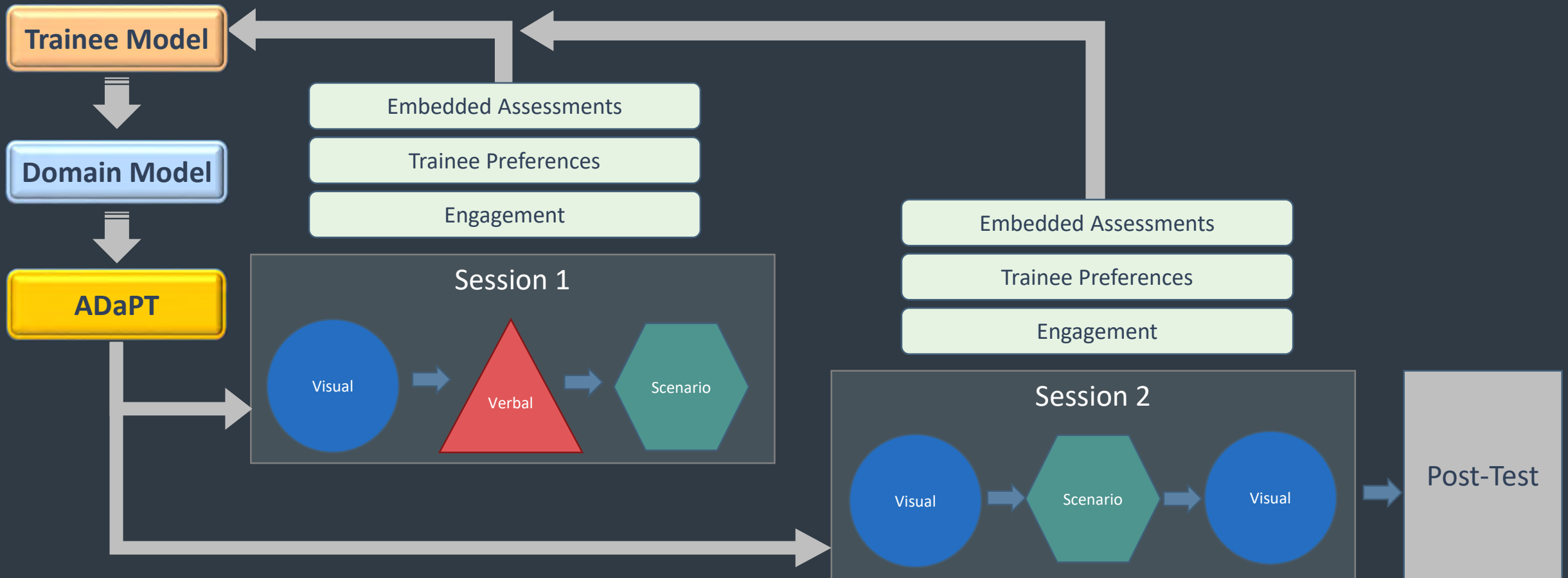
ADaPT Basic Structure



ADaPT Basic Structure



ADaPT Basic Structure





Priorities

- Decrease training development costs
- Increase engagement
- Function within existing infrastructure

Next Steps

- Iterative algorithm testing
- Prototype testing
- Guidance and collaboration



References

- Bove, L. K. (2019, July). Adaptive training: Designing training for the way people work and learn. In *International Conference on Human-Computer Interaction* (pp. 28-39). Springer, Cham.
- Carroll, M., Kokini, C., Champney, R., Sottolare, R., & Goldberg, B. (2011, November). Modeling trainee affective and cognitive state using low cost sensors. In *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC 2011)*.
- Carroll, M., Lindsey, S., & Chaparro, M. (2019, July). Integrating engagement inducing interventions into traditional, virtual and embedded learning environments. In *International Conference on Human-Computer Interaction* (pp. 263-281). Springer, Cham.
- Khan, M. J., & Mustafa, K. (2019). Modelling adaptive hypermedia instructional system: a framework. *Multimedia Tools and Applications*, 78(11), 14397-14424.
- Kokini, C., Carroll, M., Ramirez-Padron, R., Hale, K., Sottolare, R., & Goldberg, B. (2012, December). Quantification of trainee affective and cognitive state in real-time. In *Proceedings of Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC 2012)*.
- Mavroudi, A., & Hadzilacos, T. (2016). Historical overview of adaptive e-learning approaches focusing on the underlying pedagogy. In *State-of-the-Art and Future Directions of Smart Learning* (pp. 115-121). Springer, Singapore.
- McCarthy, J. E., Kennedy, J., Grant, J., & Bailey, M. (2019, July). Developing authoring tools for simulation-based intelligent tutoring systems: Lessons learned. In *International Conference on Human-Computer Interaction* (pp. 118-129). Springer, Cham.
- Petrovica, S., Anohina-Naumeca, A., & Ekenel, H. K. (2017). Emotion recognition in affective tutoring systems: Collection of ground-truth data. *Procedia Computer Science*, 104, 437-444.
- Robison, J., McQuiggan, S., & Lester, J. (2009, September). Evaluating the consequences of affective feedback in intelligent tutoring systems. In *2009 3rd international conference on affective computing and intelligent interaction and workshops* (pp. 1-6). IEEE.

A photograph of an air traffic control tower silhouetted against a dramatic sunset sky with orange and yellow clouds. The tower is a tall, cylindrical structure with a glass-enclosed top section. In the background, a city skyline is visible under the twilight sky.

Thank you

Fort Hill Group provides strategic guidance, analysis, and training to empower organizations to improve human performance and reduce operational risks.

 **Fort Hill Group**

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