

How VR and Eye-tracking can Optimize Pilot Training



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Tobii and VTR

Started collaborating with VTR in 2020

Eye tracking technology enhances the training experience, validates visual behavior, and provides additional insights about cognitive performance.

Four years later, VTR is revolutionizing how pilots are training using these off-the-shelf VR headsets



Expertise in Aviation



Pilots are one of the most well-understood populations of professionals in the cognitive science literature.

Flying has a highly visual and motor nature that empowers experimenters.

50+ years of literature on skill learning in aviation.

Decades of support for the scientific basis of VR and eye tracking.

What Does an Expert Pilot Look Like?

Ericsson:



"Experienced pilots have exhibited expert cognitive performance through keen, quick, confident decisions and almost a direct perception of the proper course of action."



"The expert pilot is adaptive. He/she can perceive the necessity to alter (or not to alter) ingrained conceptual and procedural knowledge based upon the parameters and dynamics (cues and context) of the problem or situation encountered."

Three Stages of Building Expertise

1

Cognitive

Skills are supported through extensive thinking and analysis.

2

Associative

Skill performance becomes smoother, and errors are corrected.

3

Autonomous

Skills become automated and can be performed during multi-tasking.

First Stage of Skill Development

Cognitive Stage:

Pilot memorizes
sets of facts
about a skill.

- Novice pilots learning stall recovery will memorize:
 - recognize the stall, lower the nose, apply full power, level the wings and minimize altitude loss.
- Novices are learning to use their general knowledge about aviation to guide their specific problem of how to keep the aircraft flying.
- The problem-solving capabilities and level of expertise in this stage are very basic.
- Novices spend a lot of time searching and moving around knowledge.

Second Stage of Skill Development

Associative Stage:

Pilot detects and eliminates initial errors in understanding.

- After the novice pilot learns to coordinate the nose drop, power application and rudder application for a smooth stall recovery.
- Second, the connections between the various elements required for successful performance are strengthened.
- The pilot does not sit for a few seconds trying to decide which action to perform first after 'lowering the nose'.
- Basically, **the outcome of the associative stage is a learned procedure or production rule for performing a desired response to a known situation.**

Third and Final Stage - Autonomous

Autonomous Stage:

Problem solving
procedures
become faster
and more
automated.

- Over time, as the associative stage teaches the pilot about the connections between the different elements.
- The expert pilot's perception of the whole situation involves a sense of relations that include physical, cognitive and internal effects which are used to both store and retrieve knowledge.
- Pilots can perform complex tasks automatically while keeping cognitive load low enough to analyze and act on higher order problems.

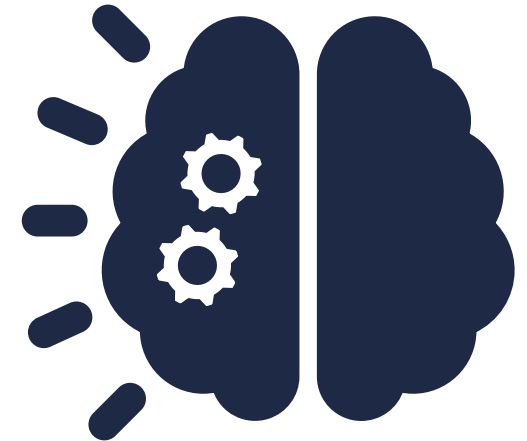
How to Optimize These Steps?

The retrieval of information and problem-solving procedures will improve the more closely the cues and context during training match the real "experience."

These techniques stress kinesthetic experiences, and the connections between associating ideas with experiences that can later be recalled and used "intuitively."

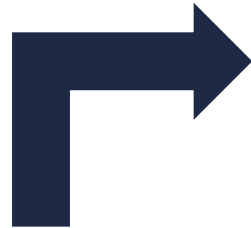
The appropriateness of the synthetic experience will be critical to the subjective associations between the elements of the situation and the schema/global pattern used to hold the solution in mind for later use.

Translates to: **The closer the training context matches the performance context, the more effectively pilots will move from the first to the third stage.**



The Gap in Pilot Skill Training

Need for updates
of pilot skill
training syllabi.



Need for improved
assessments for
practice-based
methods.



The disconnect
between
traditional training
and optimal
training.



Need increased
sophistication and
authentic practice-
based training
activities for pilots.

Mavin, T. J., & Murray, P. S. (2010). The Development of Airline Pilot Skills through Simulated Practice:

Why VR is So Critical

Transfer happens when skills learned can be translated to new situations and contexts.

Training in high-fidelity environments transfers to the cockpit.

VR maximizes transfer by offering massive increases in cockpit time.

This is especially important for early stages of skill acquisition- when declarative/relational learning are at their peak.

VR offers presence and puts you “in the moment.”

I.e., The Paper Tiger would be better for expert pilots who already have an advanced internalized relational schema of the cockpit. For novices, it's suboptimal because the training environment is so different than the performance environment.

Optimal Learning Experiences with VR

Provides authentic contexts reflecting the way the knowledge will be used in real life.

Provides authentic activities.

Provides access to expert performances and the modeling of processes.

Provides multiple roles and perspectives.

Supports the collaborative construction of knowledge.

Provides coaching and scaffolding at critical times.

Promotes reflection to enable the formation of abstractions.

Promotes articulation to enable tacit knowledge to be made explicit.

Provides for integrated assessment of learning within the tasks.

One Key Advantage of VR: Eye Tracking

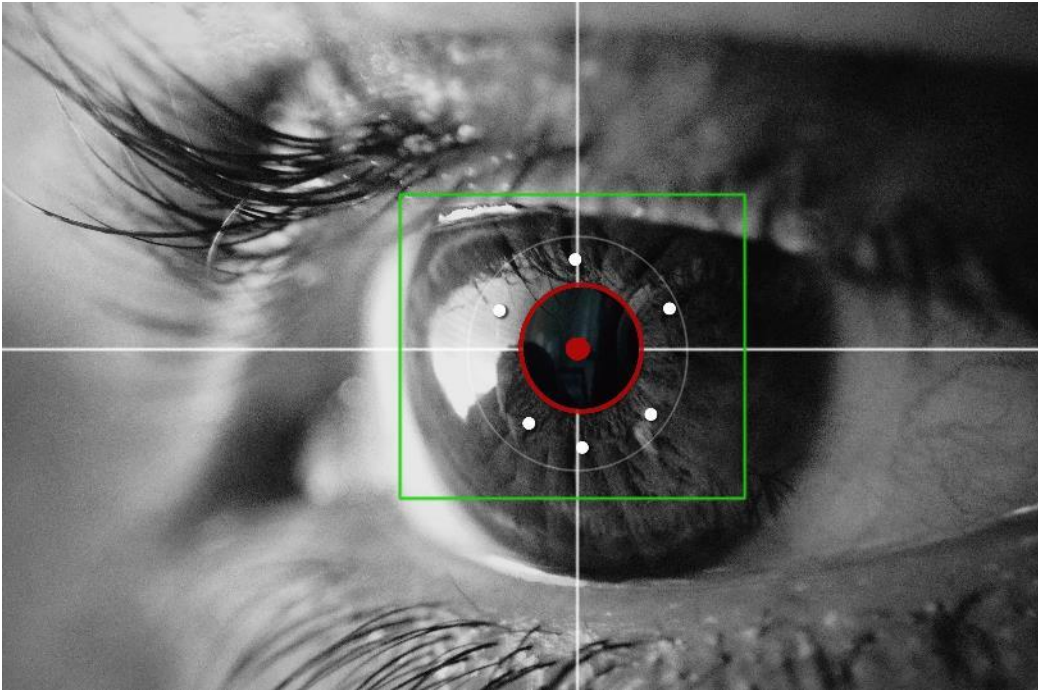
High-quality, scalable, eye tracking that is fully integrated seamlessly with the training environment.

Cheaper, less than simulator-based eye tracking.

Higher throughput (more eye tracking per pilot).

Higher quality eye tracking: target locking.

Why is Vision Important?

















Vision for Action



Eye tracking uncovers key hidden processes.

Vision for Action



Eye tracking uncovers key
hidden processes

Expert

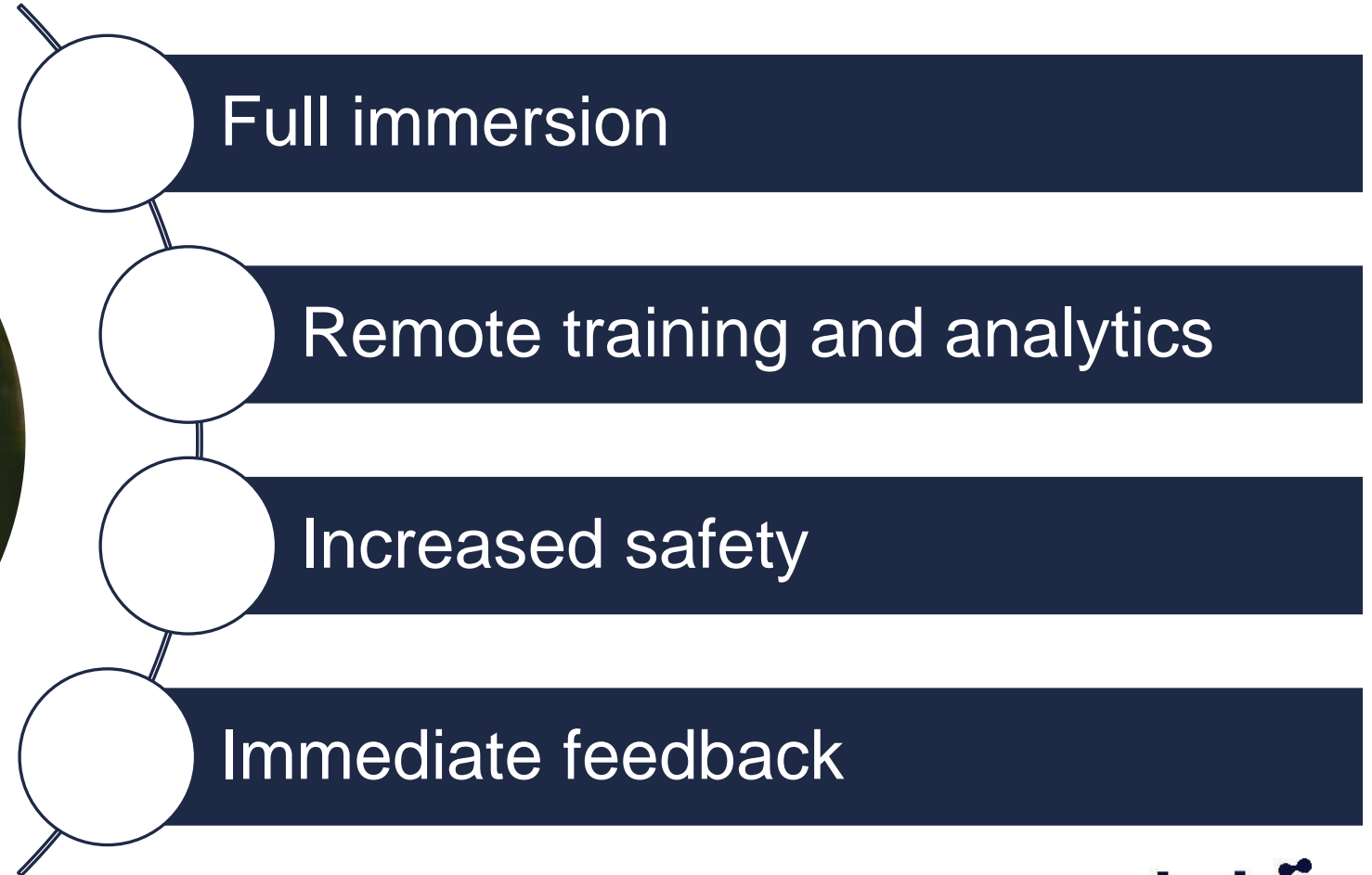


Novice



Ayala et al., 2023; WISA

Skill Development in VR



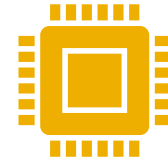
Visionary Training Resources



VTR's FlightDeckToGo product uses best practices in cognitive science to maximize skill retention and transfer to real-world scenarios.

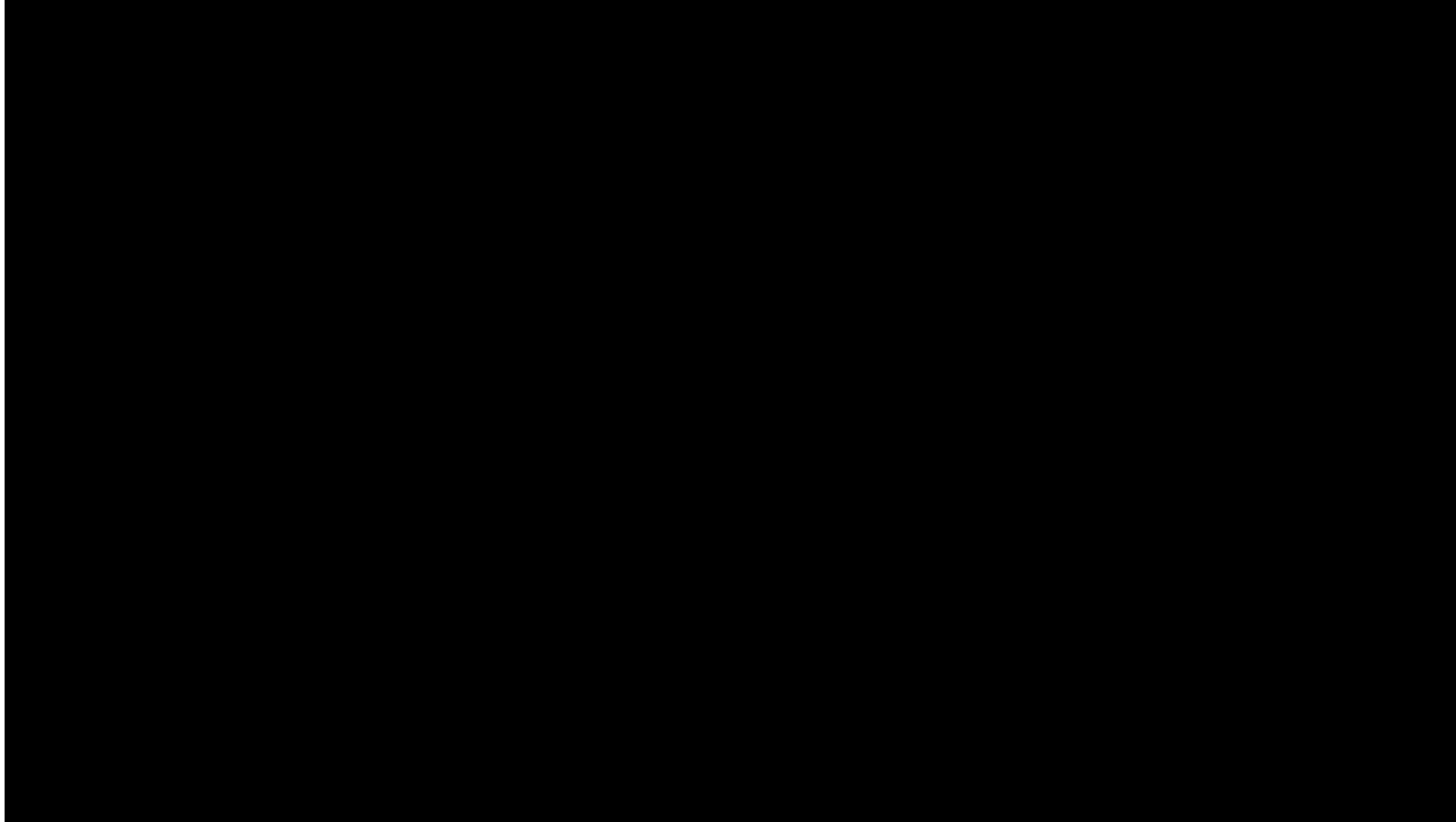


We use cutting edge eye tracking data collection and analysis capabilities to personalize and optimize the pilot training experience.



All the data we collect can be used with machine learning based predictive modeling to help pilots understand their performance better.

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Thank you.



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