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HUMAN PERFORMANCE IN THE SPOTLIGHT: MENTAL PRACTICE

In this series, human performance issues are addressed by leading researchers and practitioners in the field. **Steven Shorrock** gives some insights on the concept of mental practice.

WHAT IS MENTAL PRACTICE?

"Mental practice is the deliberate rehearsal of a task in imagination without large physical movements."

Air traffic controllers, pilots, and astronauts all rehearse complex procedures in their minds as part of learning and preparation. This is called 'mental practice' and has a long history in other sectors, from sport to surgery.

Mental practice is the deliberate rehearsal of a task in imagination without large physical movements. It is something that we do spontaneously in everyday life, especially when learning a new skill, but is done in a more structured and deliberate way by some professionals.

HOW DOES MENTAL PRACTICE WORK?

Much research suggests that practising a task in imagination can improve motor and cognitive skills. Imagery plays both a motivational and a cognitive role in influencing behaviour. At a motivational level, imagery helps to manage arousal and affect, and helps with motivation for specific goals and activities. At a cognitive level, imagery helps to represent general strategies and practise specific skills.

There is now much evidence from cognitive psychology, neuroscience, and performance research for the 'functional equivalence' of mental and physical practice, particularly in skill learning. This means that engaging in mental imagery during mental rehearsal can elicit similar cognitive and physiological responses to those involved in actually performing the task. The brain treats imagery and physical practice in similar ways.

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This equivalence stems from the brain's tendency to process imagined actions in a manner analogous to real actions. Research in neuroscience, using techniques like functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG), has consistently shown that mental imagery and physical practice activate overlapping brain regions. For example, studies show significant activation in the occipital lobe, which processes visual information, both when individuals imagine visual scenes and when they see the scenes. This suggests that the brain processes the imagined action in a way that closely resembles the processing of the actual action.

HOW DOES MENTAL PRACTICE COMPARE WITH PHYSICAL PRACTICE?

A common research finding is that mental practice is more effective than no practice but less effective than physical practice. However, the most effective approach is usually a combination of mental and physical practice.



WHAT KINDS OF TASKS BENEFIT FROM MENTAL PRACTICE?

Mental practice is particularly effective for relatively complex tasks that rely heavily on mental activities such as problem-solving, decision-making, planning, sequencing, spatial reasoning and visualisation, anticipation, and coordination. These mental activities are fundamental to the tasks of air traffic controllers and pilots. As well as the type of task or skill, mental practice is affected by the type of instructions, and the individual's skill level, imagery ability, and motivation.

WHY SHOULD AIR TRAFFIC CONTROLLERS AND PILOTS DO MENTAL PRACTICE?

Mental practice can enhance skill learning in tasks with a strong cognitive component, which are typical of controlling and flying. Air traffic controllers highlight the importance of their 'mental picture' of the airspace and traffic. Research suggests that some controllers use mental imagery to create and maintain this picture.

Controllers could integrate mental practice into training to rehearse scenarios and skills, such as conflict scenarios, communication and coordination, and procedures for using equipment. Mental practice could also help controllers improve their ability to recover from equipment failure.

Mental practice can be incorporated into pilot training to rehearse procedures, improve decision-making in emergency situations, and enhance spatial awareness during flight. This is often termed 'chair flying' and has been the subject of research. Mental practice could be particularly beneficial in the early stages of learning.

Mental practice has been found to be effective for training in other professions such as surgery, but has been researched most extensively in the context of sport.

WHO WOULD BENEFIT MOST FROM MENTAL PRACTICE?

Individuals with pre-existing strengths in generating, maintaining, and manipulating mental images seem to get most benefit from mental practice. Research has found that this includes controllers and pilots. Within the controller and pilot population, and in other professions such as surgery and sport, individuals with stronger imagery abilities would likely benefit most. Imagery abilities include vividness, controllability, and accuracy of reference.

Vividness refers to the clarity of the images evoked in the mind. Individuals with high vividness experience images that are more lifelike and detailed. They are also more likely to report using imagery in their daily lives. Controllability refers to the ease with which an individual can manipulate mental images. This encompasses the ability to generate, maintain, inspect, and transform images at will. Individuals with high controllability can readily manipulate their mental image of a scene, situation or scenario to explore different possibilities. Accuracy of reference refers to the fidelity of the image's content in relation to the real world, encompassing dimensions and magnitude of visual images and movements. Those with high accuracy of reference would have a mental picture that accurately reflects relative distances, directions and trajectories, for instance.

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WHO WOULD BENEFIT MOST FROM MENTAL PRACTICE?

Mental practice can be effectively incorporated into training programmes for professions that rely heavily on cognitive skills and spatial reasoning, via the following activities:

- **Identify cognitive components:** Begin by identifying the specific cognitive components of the skills being trained. For example, in air traffic control, this could include spatial reasoning, decision-making under pressure, communication protocols, and methods of use for equipment.
- **Develop realistic scenarios:** Create realistic training scenarios that require trainees to engage these cognitive skills. The scenarios should simulate the challenges and complexities that trainees would encounter in real-world situations.
- **Guide imagery techniques:** Provide clear instructions on how to employ mental imagery during practice. This could include techniques for image generation, maintenance, inspection, and transformation. Encourage trainees to practise with both eyes open and closed to determine what works best for them.
- **Incorporate into existing programmes:** Integrate mental practice as a complementary component within existing training programmes. This could involve dedicating specific sessions to mental practice or incorporating short periods of mental rehearsal before, during, or after physical practice sessions.
- **Target early stages of learning:** Emphasise the use of mental practice during the early stages of learning when trainees are still developing their understanding of the task and forming cognitive schemas.
- **Tailor to individual needs:** Provide opportunities for trainees to assess and enhance their imagery skills through targeted exercises. Consider individual preferences.
- **Address potential interference:** Educate trainees on the potential for interference effects between imagery and perception. This could involve discussing situations where relying too heavily on imagery might hinder their ability to perceive and respond to actual information.
- **Combine with physical practice:** Emphasise that mental practice is most effective when combined with physical practice. Use mental practice to supplement and reinforce the learning gained through hands-on experience.



FURTHER READING

Shorrock, S. T., & Isaac, A. (2010). Mental imagery in air traffic control. *International Journal of Aviation Psychology*, 20 (4), 309-324. <https://bit.ly/3Y1GcQU>

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