The Neuroscience of Sim Racing

Why Some Tracks Are Harder to Memorize Than Others

By **Filippo Barbieri**

This article is part of our ongoing 'Neuroscience of Sim Racing' series, exploring how brain function impacts performance in the virtual racing world.

In sim racing, track memorization is fundamental to improving lap times, consistency, and racecraft. However, not all tracks are equally easy to learn. Some, like **Twin Ring Motegi**, feel intuitive and natural, while others, like **Le Mans**, demand significantly more effort. Why does this happen? The answer lies in **neuroscience**—specifically, how the brain encodes spatial information, processes visual cues, and develops procedural memory for driving.

The Brain's Role in Track Memorization

When learning a track, multiple regions of the brain work together to create a **mental map** of the circuit:

- **Hippocampus** – Encodes spatial memory, helping drivers recognize the track layout.
- **Parietal Lobe** – Processes visual-spatial relationships, allowing drivers to judge distances and turn angles.
- **Basal Ganglia** – Converts conscious learning into **habitual, automated motor sequences**, making it easier to drive instinctively.
- **Cerebellum** – Refines timing and precision for braking, throttle application, and car control.

Initially, memorizing a track requires **working memory** (prefrontal cortex engagement), but with repetition, it shifts to **procedural memory**, allowing for faster reactions and improved consistency. However, some tracks make this transition more difficult due to their structure and complexity.

What Makes a Track Easier to Memorize?

1. Repetitive and Predictable Layouts

Tracks that feature **consistent corner sequences** allow the brain to recognize patterns more easily. This helps form **strong neural associations** between visual inputs and motor actions.

Example: Twin Ring Motegi

- Features mostly **90-degree turns**, making braking and turn-in points predictable.
- **Symmetrical left-right balance**, reducing variability in driving rhythm.
- **Minimal elevation change**, keeping visual references consistent.

Since similar corners repeat throughout the lap, the **hippocampus can encode the circuit faster**, while the **basal ganglia** strengthens procedural memory with fewer laps.

2. Short Lap Length

Shorter circuits have fewer distinct sections to memorize, reducing **cognitive load** on the hippocampus. Tracks like Motegi, Brands Hatch Indy, and Tsukuba allow for **rapid repetition**, reinforcing memory more quickly.

What Makes a Track Harder to Memorize?

1. Long and Complex Layouts

The longer the circuit, the more spatial information the brain must **store and retrieve** in real-time. This increases **mental workload** and the likelihood of forgetting corner sequences, especially at high speeds.

Example: Circuit de la Sarthe (Le Mans)

- **13.6 km (8.5 miles)** long, making it twice the size of many tracks.
- Features both **permanent racetrack sections and public roads**, creating **inconsistent grip and visual references**.
- Has multiple **long straights** (e.g., Mulsanne), where the brain momentarily disengages, leading to memory gaps before the next turn.

Since Le Mans features many **unique turns with no repetition**, drivers must consciously recall each braking zone rather than rely on pattern recognition, making learning significantly harder.

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2. Lack of Visual Reference Points

Tracks that lack **distinct landmarks**—such as braking markers, elevation shifts, or unique trackside features—are harder for the brain to orient within. Without consistent visual anchors, **spatial mapping in the hippocampus becomes less reliable**.

Example: Silverstone

- Many of its corners **look visually similar**, making it easy to misjudge braking zones.
- Few **elevation changes** to help with depth perception.
- High-speed sections require precise inputs but offer **minimal visual feedback** before turn-in.

Because of the **lack of contrast between different sections**, drivers must rely more on **muscle memory** than visual recognition, which takes longer to develop.

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3. Blind or Deceptive Corners

Tracks with **blind apexes, sudden elevation changes, or deceptive entry angles** require additional cognitive effort. The brain must **predict the corner shape before seeing it**, which engages more working memory and increases reaction time demands.

Example: Laguna Seca (Corkscrew Section)

- The **Corkscrew** is a **blind, downhill chicane**, making braking and turn-in extremely difficult to judge.
- **Steep elevation drops** alter perception, forcing drivers to rely on internal timing rather than visual cues.
- A small mistake in entry leads to **compounding errors through the exit**, making the section harder to master.

Blind corners require the **parietal lobe and cerebellum** to work harder to compensate for the **lack of direct visual information**, delaying memorization.

Strategies to Improve Track Memory on Difficult Circuits

1. Segmenting the Circuit (Chunking)

Breaking a long track into **smaller, manageable sections** reduces **cognitive load**. Instead of learning Le Mans as a **single massive track**, divide it into parts:

- **Tertre Rouge → Mulsanne Chicanes**
- **Indianapolis → Arnage**
- **Porsche Curves → Ford Chicane**

This method allows the **hippocampus to encode smaller portions first**, leading to faster recall of the full circuit.

2. Strengthening Spatial Cues

- Use **fences, trees, or tire barriers** as braking markers.
- Identify **shadows or track surface changes** to assist in turn-in timing.
- Study **trackside details (curb color, distance boards, pit entry signs)** for additional spatial anchoring.

3. Slow Recon Laps Before High-Speed Practice

Driving **below race pace** helps the brain **actively encode corner sequences** before engaging in full-speed execution.

4. Mental Rehearsal & Onboard Study

- Watch **onboard laps** to study braking and throttle application.
- Use **track maps** to mentally drive each corner before a session.
- Review **heatmaps** to understand where mistakes are likely to occur.

Conclusion

Some tracks are easier to memorize because they align well with how the **brain naturally encodes spatial information**—using pattern recognition, visual cues, and procedural memory.

- **Easier tracks** (Motegi, Tsukuba) have **predictable layouts, repetition, and clear landmarks**, making learning more intuitive.
- **Harder tracks** (Le Mans, Silverstone, Laguna Seca) introduce **longer layouts, fewer landmarks, and blind elevation changes**, increasing cognitive load.

By understanding the **neuroscience behind track learning**, sim racers can train their brains more efficiently, leading to **better memorization, faster lap times, and improved racing consistency.**

Written by Filippo Barbieri, Neuroscientist, Exercise Scientist & Sim Racer
For more insights on neuroscience in sim racing, follow our monthly write-ups at Dream to Inspire.