



VIR



NNJR "Trackside Classroom"

Car Balance:

Avoid Understeer & Oversteer

October 26, 2020



Porsche Club of America



NNJR Agenda



- The big picture
 - Handling debrief
 - How to learn?
- The driver
 - How to fix understeer
 - How to fix oversteer
- Tuning your car's handling
 - How to fix understeer
 - How to fix oversteer
 - Tire pressures
- Q&A



"A racing car is an animal with a thousand adjustments." - Mario Andretti



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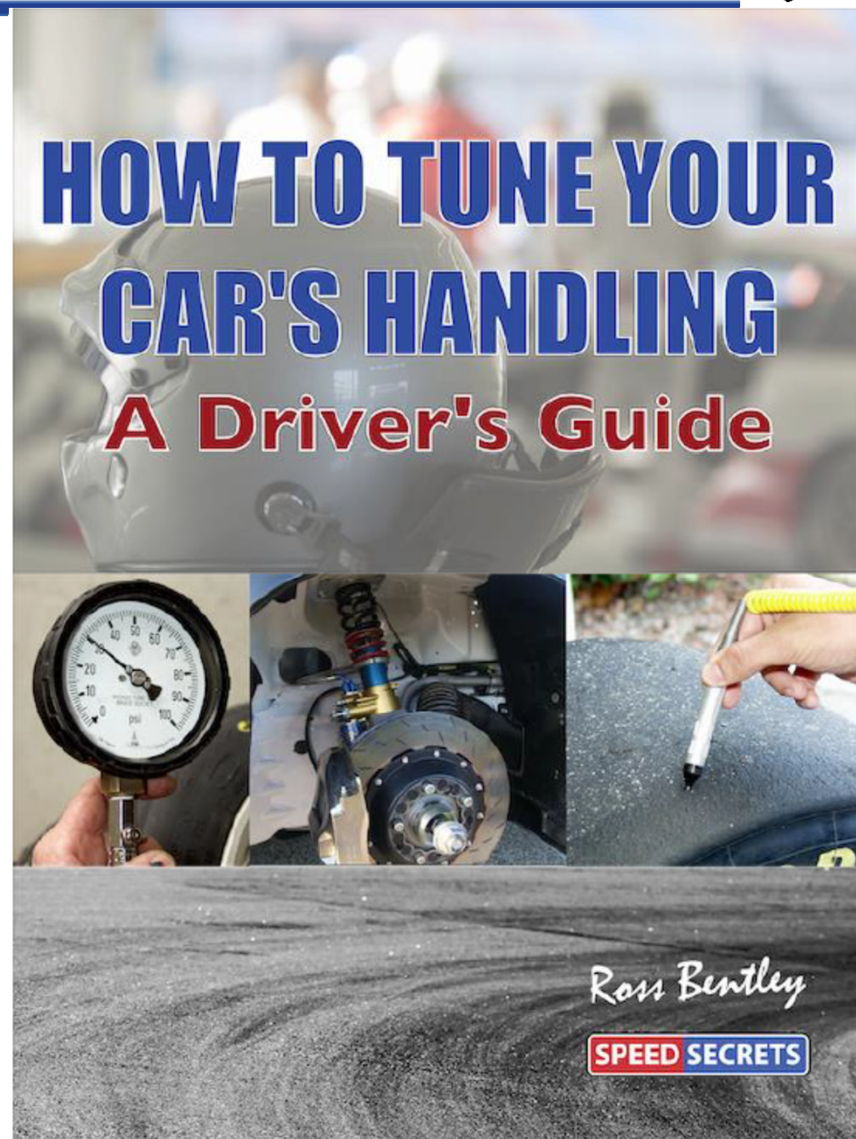
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NNJR Fact Check



- Many opinions on car setup
- Know/trust your source(s)
- Ask and understand
 - Why?



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Big Picture: “Principles”



- Balance is more important than overall grip
- Avoid pre-conceived ideas
- Copying an adjustment from someone else rarely works
- All cars have handling “issues”, but
 - If you don’t feel them, focus on driving (it’s not the car)
 - You can’t judge them unless you are (very) consistent
 - If you feel them, start with a diagnosis

Ross Bentley: How to Turn Your Car’s Handling



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Handling Debrief



- Quick Debrief
 1. Better or worse? Was car's handling better or worse than before the change?
 2. If I could have the car do just one thing better, what would it be?

Ross Bentley: How to Turn Your Car's Handling



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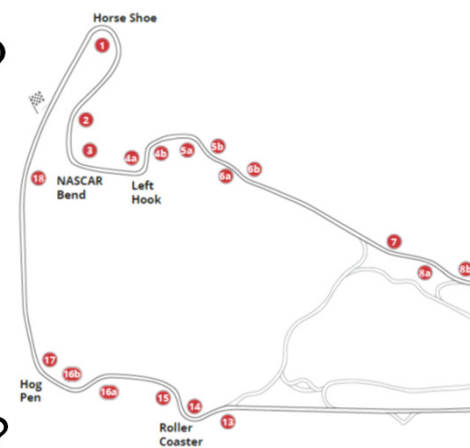


NNJR Handling Debrief



- Detailed debrief (with track map)
 1. What is the car doing? Understeering or oversteering? Slow to respond?
 2. Where is the car doing it? Which corner(s)?
 3. Where in the corner(s)? Entry, mid or exit?
 4. What am I doing when the car does this?
 - Braking?
 - Turning in?
 - Trail braking?
 - Coasting?
 - Maintenance throttle?
 - Maximum cornering?
 - Beginning to apply throttle?
 - On power?
 - Unwinding the steering?
 5. How bad is it on a scale of 1 to 5 (1 = slight; 5 = serious)?
 6. Is it the car or me? Am I inducing the handling problem, or is it the car?

VIR FULL



Ross Bentley: How to Turn Your Car's Handling



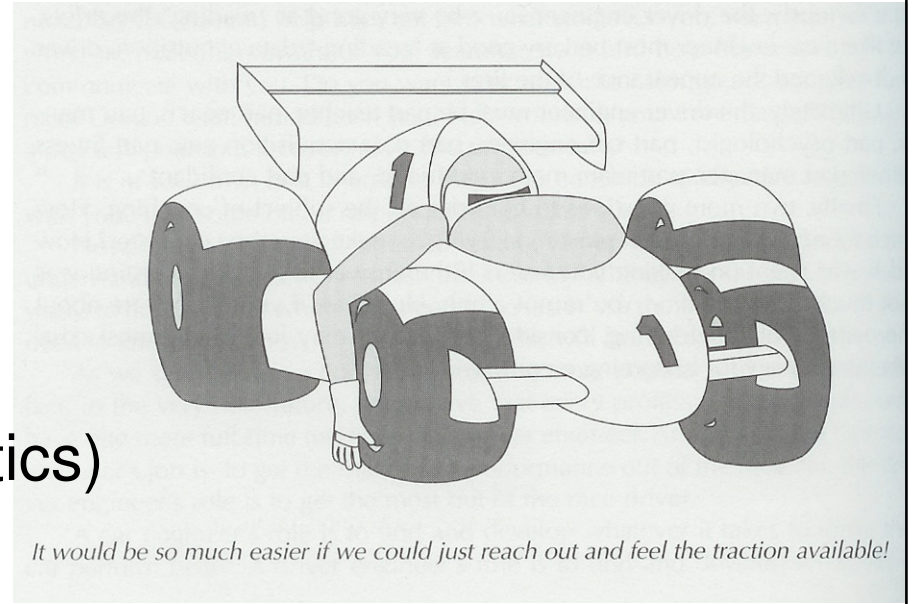
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- Do you know if your car is understeering?
 - Oversteering?
 - Both (at different times)?
- Sensory input sessions
 - Sound
 - “Seat of the pants” (Kinesthetics)
 - Feel in the steering wheel
 - Vision: car’s path vs. intended path
- *PSM intervenes!*



- The driver!



NNJR Understeer



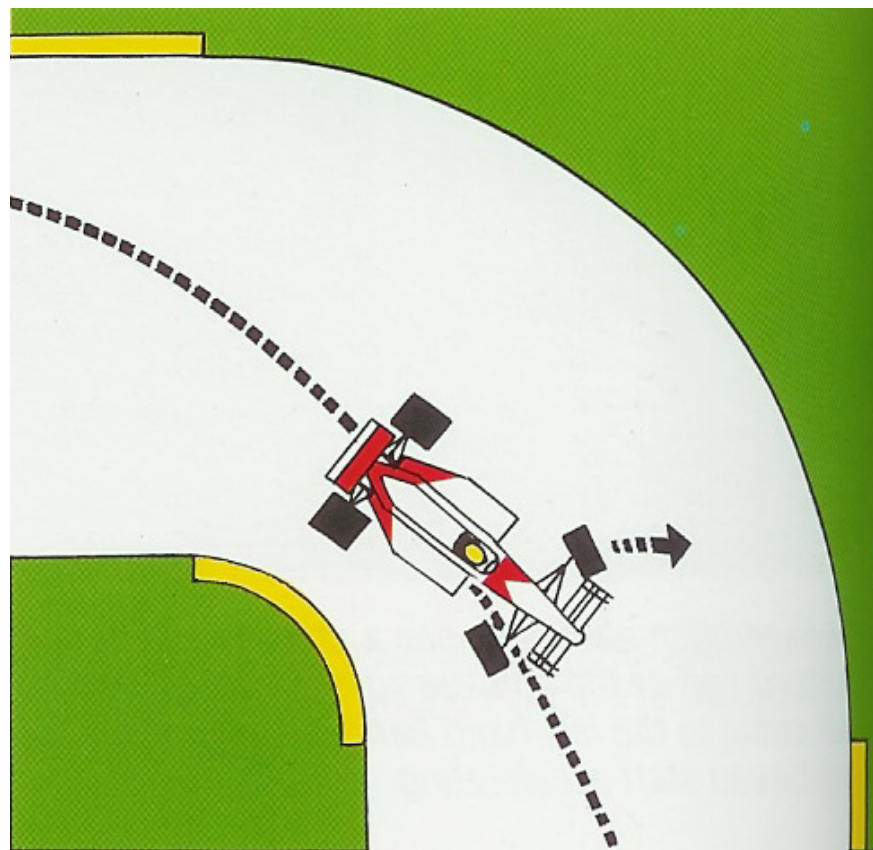
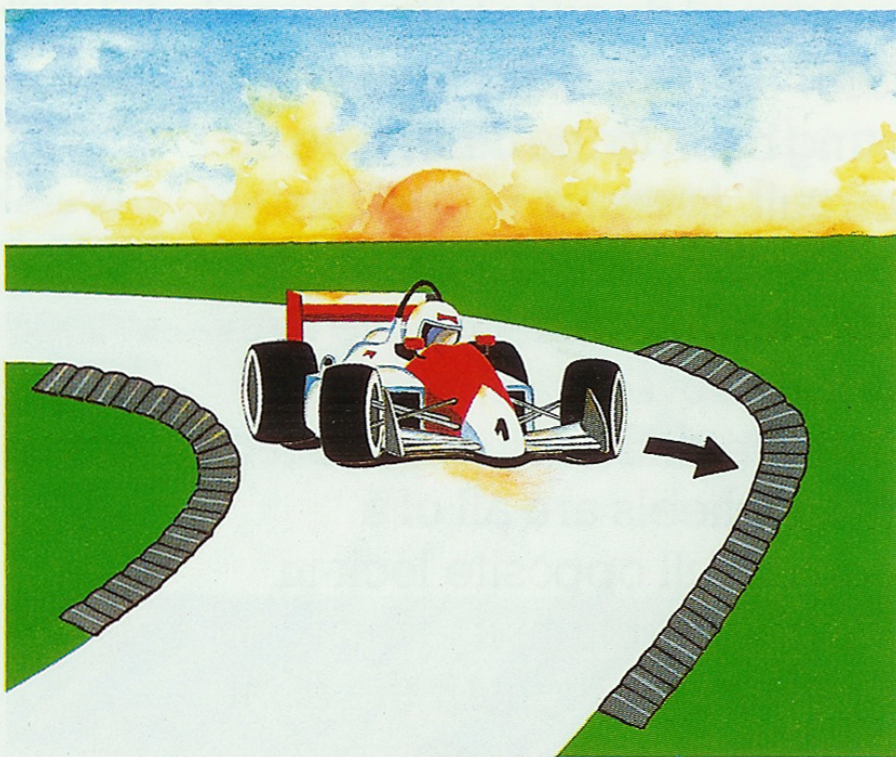
- Front tires have less traction than the rears
 - Car is not turning as much as you want
 - Increases radius of the turn
- Often referred to as “pushing”, “tight” or “plowing”
- The car is turning **less** than you had hoped and **less** than the steering input would normally dictate



NNJR Understeer / Push



- “The car won’t turn!”
- Front slip angle > rear slip angle



Alain Prost: *Competition Driving*



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Driver Causes of Understeer



- Corner entry too fast: exceeding traction limits of front tires
- Steering input too rapid or too much steering angle
- Insufficient weight on front tires due to:
 - Abrupt brake release (on entry)
 - e.g. Turn 1
 - Too aggressive throttle (on exit)
 - e.g. Turn 1, turn 4, Oaktree
- Not releasing the wheel/steering angle on exit





How to Fix Understeer



PREVENT

- Early understeer
 - Slower Corner Entry
 - Brake earlier and/or harder
 - More/longer trail braking (maybe)
 - Smoother (more progressive) Turn-In
- Mid-corner understeer
 - Slightly later turn in
 - Wait to go to the gas
- PATIENCE!

COMPENSATE

- Straighten the steering
 - Opposite of instinct!
- Slow down / lift (carefully)
- Brake (maybe)



NNJR Oversteer



- Rear tires have less traction than front tires
- Commonly referred to as “loose”, “fishtailing” or “hanging out the tail”
- Car is turning **more** than you had hoped and **more** than steering input would normally dictate
- Car rotates so front points to inside of the turn rather than track out



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NNJR: Nor



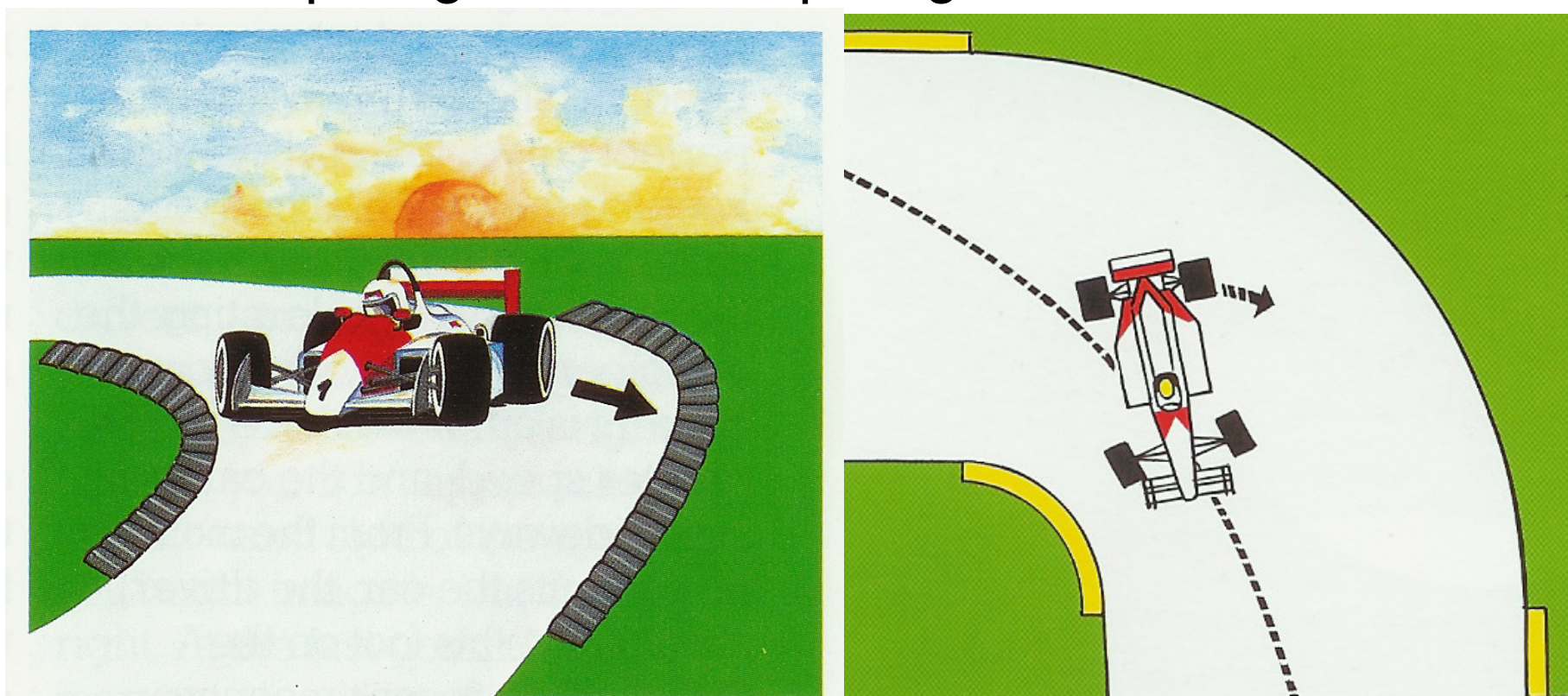
- Understeer is slow
- Oversteer is scary!



NNJR Oversteer / Loose



- “The car is turning too much!”
- “The car wants to spin!”
- Rear slip angle > front slip angle



Alain Prost: Competition Driving



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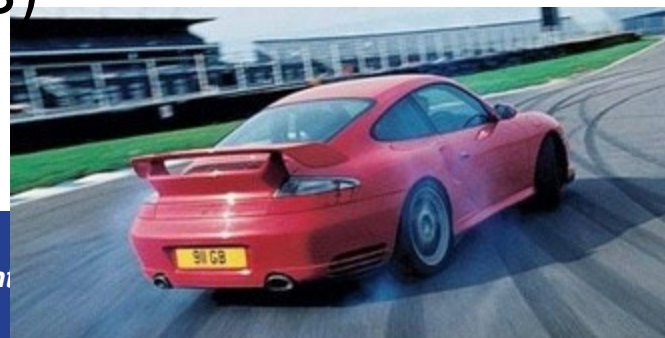




Driver Causes of Oversteer



- Corner entry with excessive brake force
 - e.g. Turn 1, 14
- Lifting off the throttle may result in “trailing throttle” oversteer
 - Weight transfers forward off rear tires
- Aggressive braking mid-turn
- Excessive steering input in downhill turn
- Power oversteer – throttle application too aggressive (high powered vehicles)





How to Fix Oversteer



PREVENT

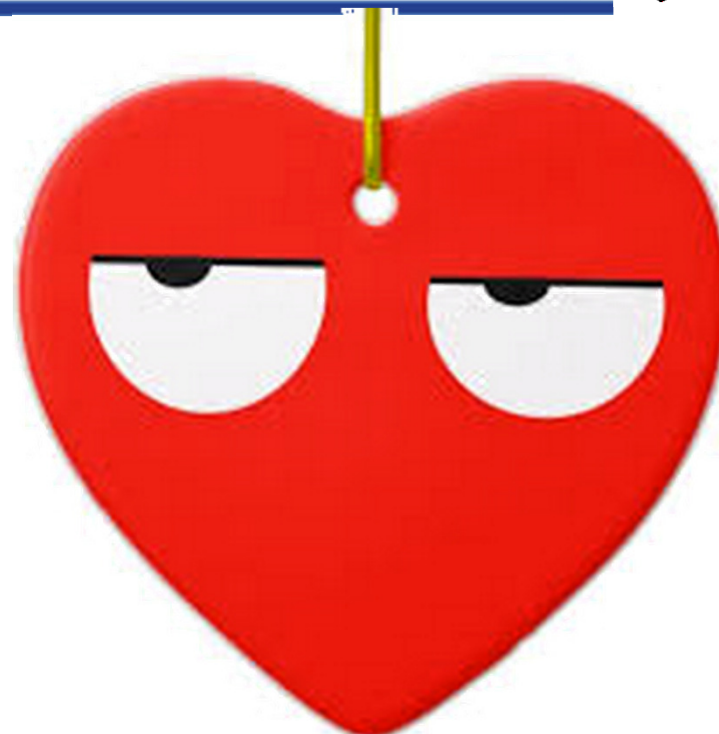
- Less trail braking (probably)
- Smoother transition off the brakes
- More progressive steering input
- Less and/or later gas (smooth!)

COMPENSATE

- Countersteer (requires practice!)
- CPR



- **Correct** (steering input)
 - Do it NOW
- **Pause**
 - Allow the car to settle
- **Recover**
 - Bring the car under control
 - Use all the track you need
 - Sacrifice your line if you need more pavement to slow down



Look where you want to go!

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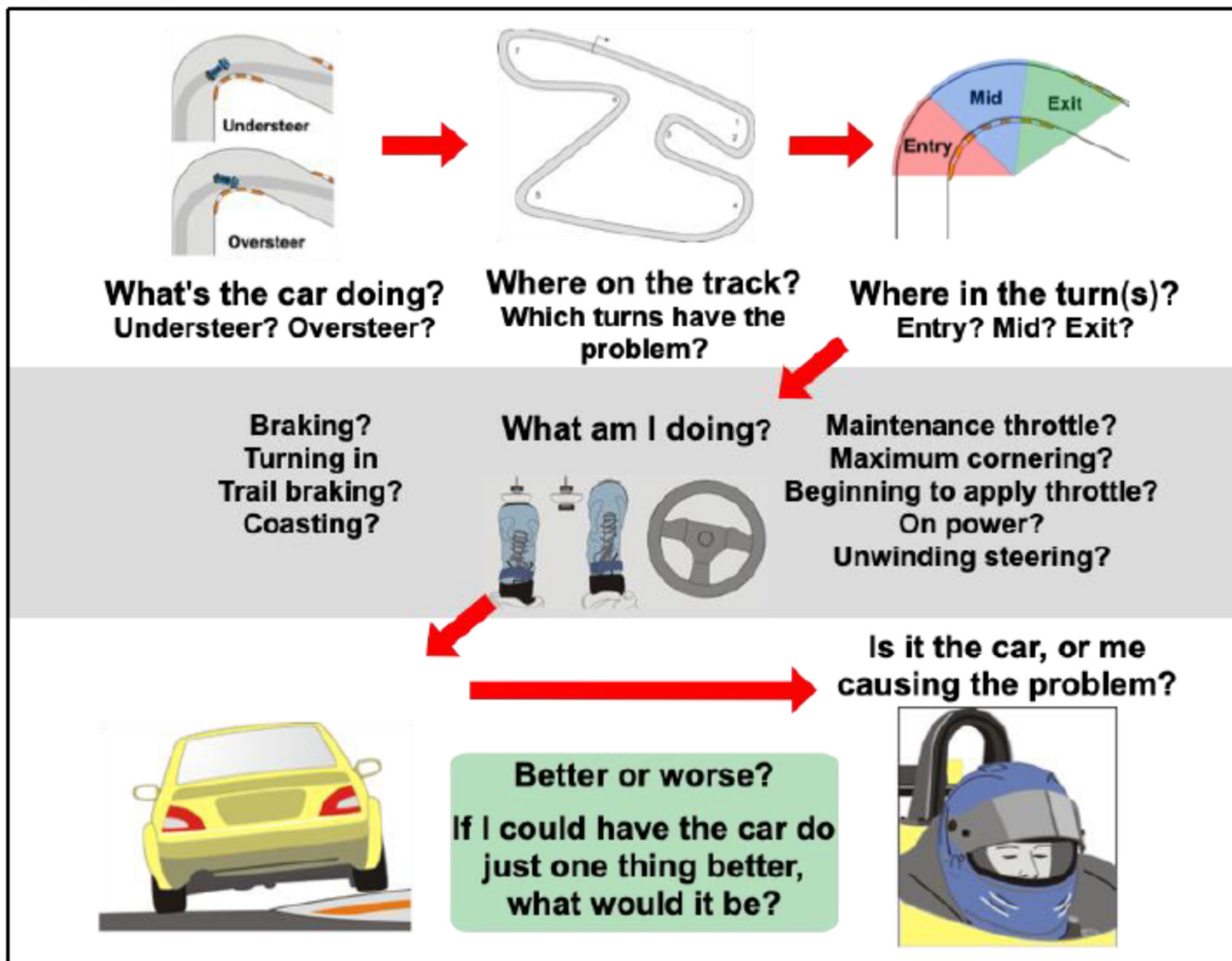


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NNJR Handling Tradeoffs



- Whenever you're tuning the handling of your car, think in terms of
 - Balance,
 - Responsiveness, and
 - Overall grip

Ross Bentley: Speed Secrets Weekly 378



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NNJR Tuning your car's handling



- What do I want?
 - More front grip (car is understeering)
 - More rear grip (car is oversteering)
 - More responsiveness to steering wheel
 - More overall grip
- Where do I want it?

– Specific corner(s)	– Off throttle
– Brake zone	– Maintenance throttle
– Turn in	– On power
– Brake release	– Corner exit
– Mid corner	

Ross Bentley: How to Turn Your Car's Handling



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How to Make Adjustments



- One change at a time
- Big enough you are sure to feel
- Take notes (on track map)
- Learning what doesn't work is important
- Understand why?
- Work on end of car that needs improvement
- Work with what you have
- Easiest adjustment to get direction from
- A-B-A tests

Ross Bentley: How to Turn Your Car's Handling



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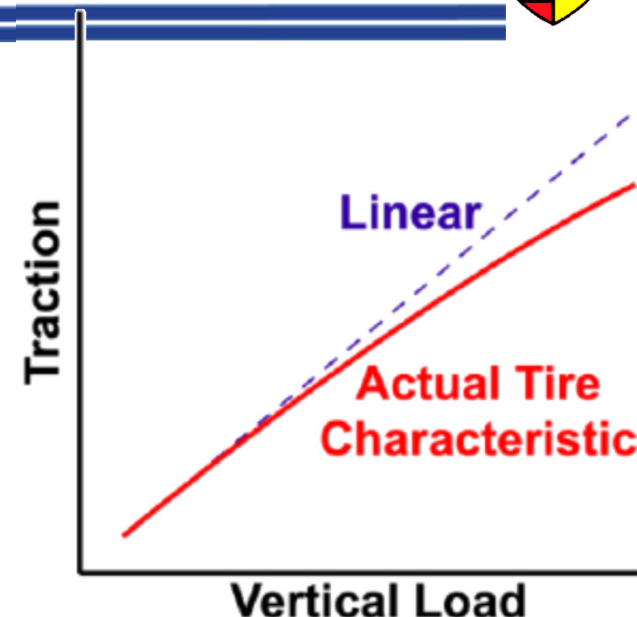
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NNJR Vehicle Dynamics



- Lateral loads (cornering) cause roll
 - With weight transfer
- More weight transfer = less grip
- Front vs rear roll stiffness is critical



- General rule: soften the end of the car that needs more grip
 - Anti-roll bars, springs, shocks
- Exception: too much roll (common) requires the opposite!

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Setup Changes to Reduce Understeer



- Adjust tire pressures Front vs. Rear
 - e.g. +4 lbs in front (maybe)
- Softer front sway bar or stiffer rear bar
- Larger front tires
- Increase front downforce (e.g. splitter)
- Softer or stiffer front (too much roll or not?)
 - Opposite for rear springs
- Shocks: reduce front low-speed bump (maybe)

Notes: Factory settings tend toward understeer

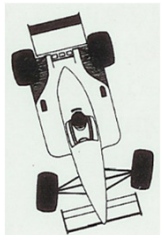
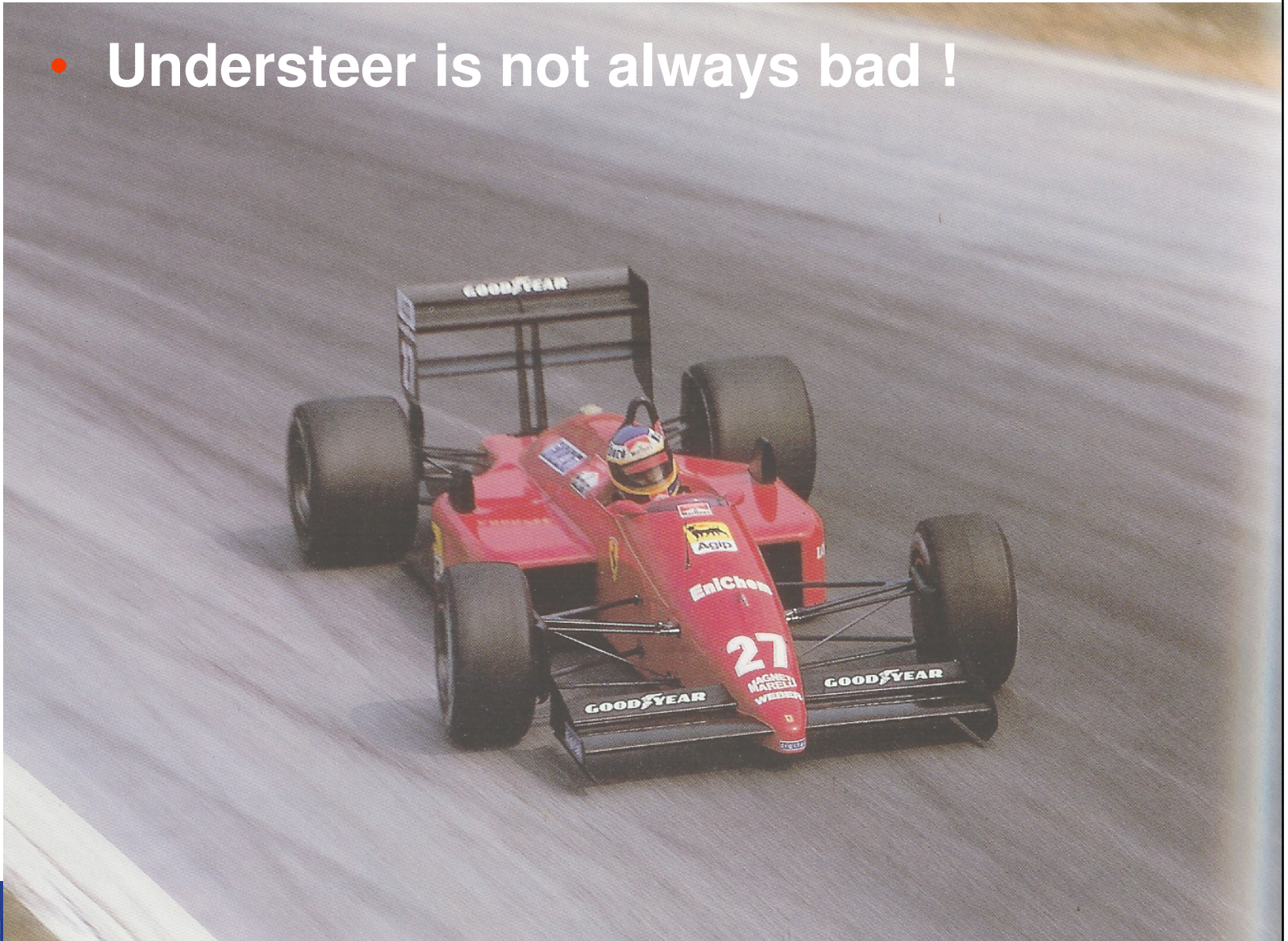
Assumes car setup within “normal” parameters



NJR Understeer



- Understeer is not always bad !



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PORSCHE



Setup Changes to Reduce Oversteer



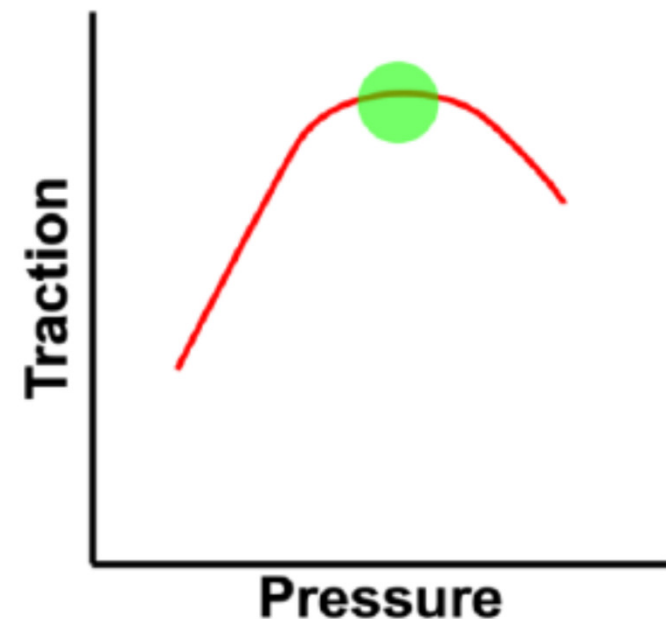
- Adjust tire pressures Front vs. Rear
 - e.g. + 4 lbs in rear or - 4 lbs in rear (esp. 911)
- Softer rear sway bar or stiffer front bar
- Smaller front tires
- Increase rear downforce (e.g. wing)
- Softer or stiffer rear springs (too much roll or not?)
 - Opposite for front springs
- Shocks: reduce rear low-speed bump (maybe)

Notes: Factory settings tend toward understeer

Assumes car setup within “normal” parameters

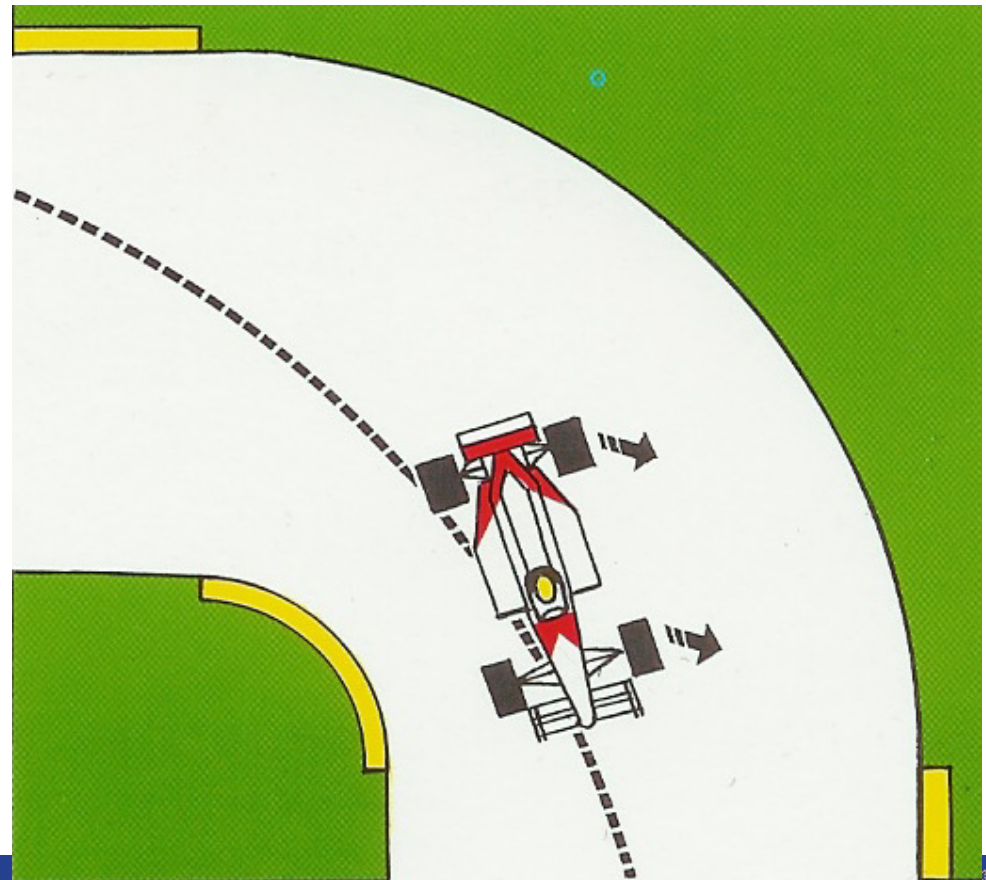


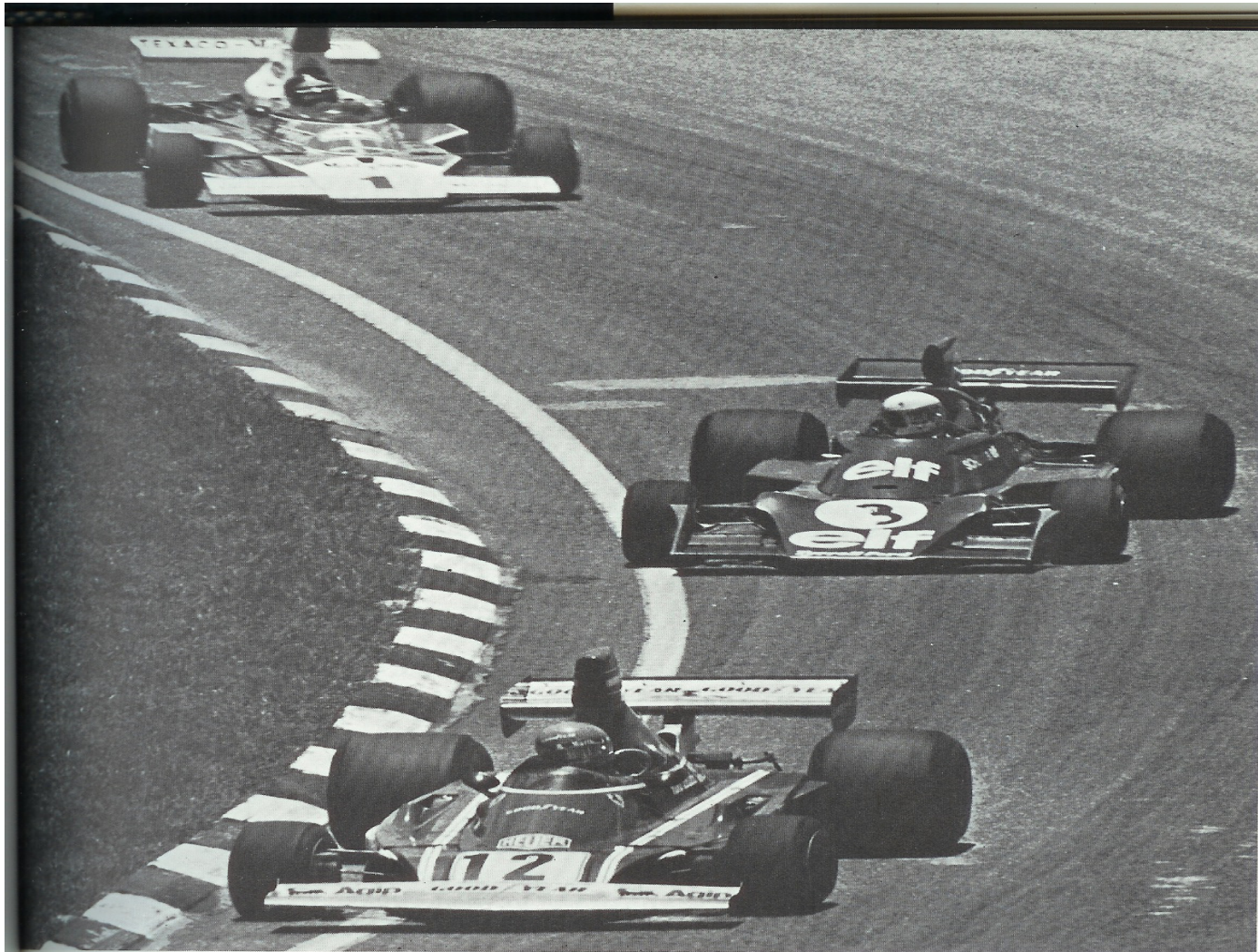
- Increase or decrease for more grip?
 - It depends!
- Not sure? Do a “sweep”
 - One run with baseline
 - Second run + 4 lbs
 - Third run - 4 lbs (vs baseline)
 - Refine



Ross Bentley: *How to Tune Your Car's Handling*

- Front slip angle = rear slip angle
- Steer with throttle and/or fingertips





A remarkable photograph from the 1975 season showing three cars, each handling completely differently. My Ferrari (Number 12) is absolutely neutral; Jody Scheckter's Tyrrell (Number 3) is slightly oversteering, and Fittipaldi's McLaren (Number 1) is heavily understeering.

What Are You Sensing?

- Yaw (Body Slip Angle, Rotation)
- G-loads
- Weight (Load) transfer
- Steering effort/vibrations (steering is output & input device)
- Visual picture
- Tire/wind/engine sound

Improving Sensing (Learned skills)

- Personal sense of balance
- Exercises:
 - Centering
 - Sports/training (cycling, balance board/ball, etc.)
- Deliberate Practice sensing the car
 - Street practice
 - Light hands
 - Sensory Input Sessions
 - G-load sessions
 - Setup sweeps
 - Skid pad
 - Test the limits – steering, braking, accelerating
 - Make car show its weakness



Ross Bentley: How to Turn Your Car's Handling

- Must first know what the car is doing!
 - Sensory input sessions: kinesthetics
 - Key part of “advanced driving”
- Many “static” factors affect handling
- In modern Porsches, most Understeer / Oversteer “handling issues” are caused by the driver, not the car
- Many “static” factors affect handling
- Cars can, and do, understeer and oversteer in the same corner

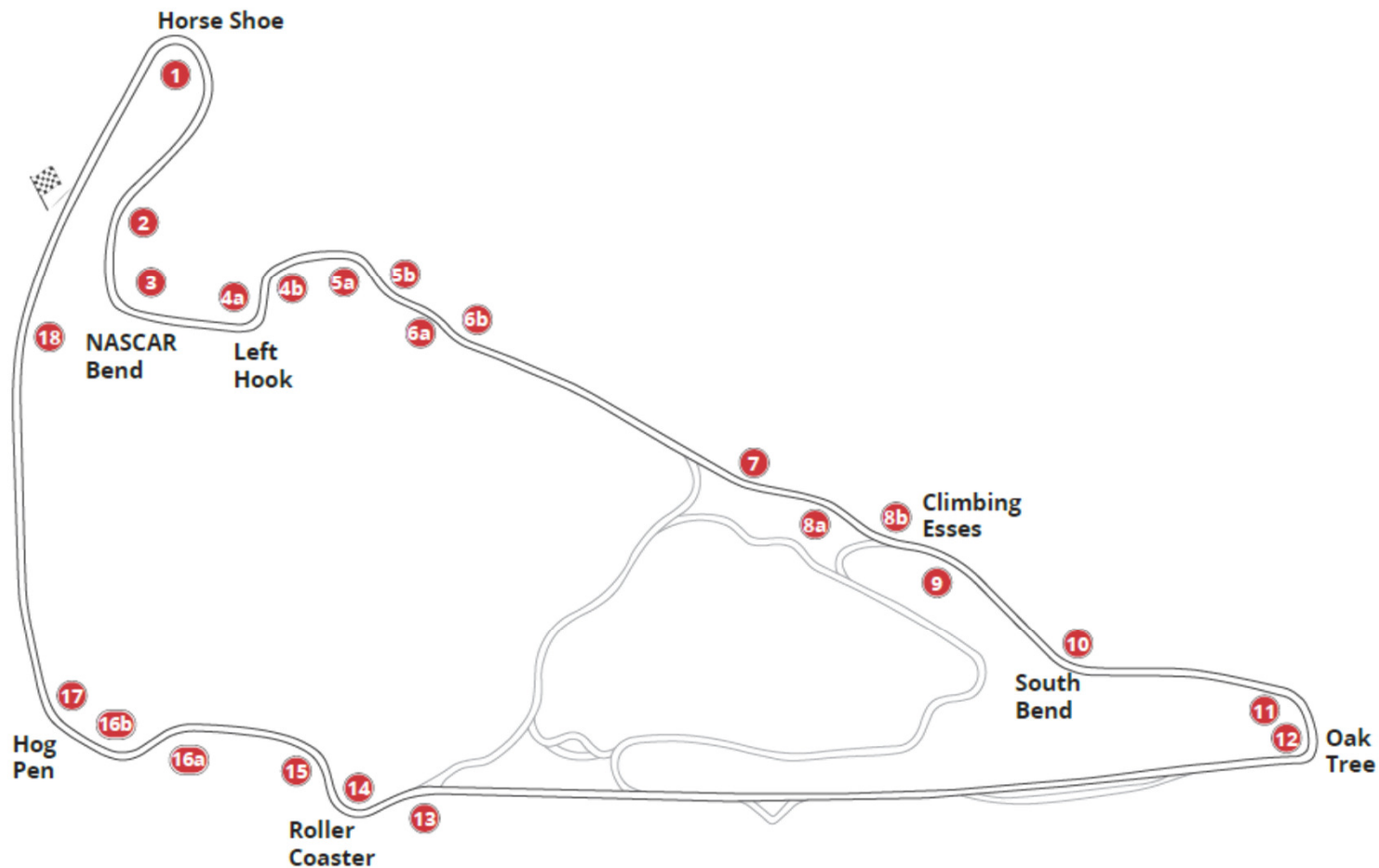




VIR Turn by Turn



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SPEED SECRETS
SpeedSecrets.com



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