

Thunderbolt



NNJR "Trackside Classroom" Weight Transfer and Car Balance May 28-29, 2022













Disclaimer

The techniques shown here have been compiled from experienced sources believed to be reliable and to represent the best current opinions on driving on track. But they are advisory only. Driving at speed at Thunderbolt, or any other track, requires skill, judgment and experience. These techniques assume the reader has high performance driving knowledge and applies them as applicable to their level of driving experience.

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- Weight transfer NJMP-THUNDERBOLT
 - Why do we care?
- How to deal with it?
 - Understeer
 - Oversteer
 - Balance











$A = W \times \mu$

 $\begin{aligned} A &= Adhesion \\ W &= Weight \\ \mu &= Coefficient of adhesion (surface) \end{aligned}$

Why do you care?

Traction is based on weight!

Car cornering at constant radius and constant speed





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Weight Transfer: Acceleration and Braking



Braking: Weight Forward Corollary: Less Rear Grip









Reight Transfer: Cornering









All cars transfer weight during cornering Fanatio



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MR Weight Transfer Model

Braking: 300+ pounds per front tire !



Cornering: 500 pounds per outside tire !

Rules of Thumb

Lateral Weight Transfer $\geq 30\%$ of car weight Braking Weight Transfer $\approx 20\%$ of car weight $1000 \ lbs \ for \ a \ stock \ Porsche \ !!$ Both are proportional to Weight, CG, and wheelbase/track inverse



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Cornering





- Lateral load transfer (lb) =
- Lateral Acceleration (g) x center of gravity height (in.) x Weight(lb) ÷ Track Width (in)
- Longitudinal load transfer (lb) =
 Acceleration (g) x center of gravity height (in) x Weight (lb) ÷ Wheelbase (in)







Vertical Load

- 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!

Ross Bentley: How to Turn Your Car's Handling









- Weight transfer is inevitable
- But...sudden is bad
 - Weight should move smoothly, and only once
- And...less is better
 - Cornering: Outside tire gain < Inside tire loss
 - Braking: Front tire gain < Rear tire loss









- 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







- 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!

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It would be so much easier if we could just reach out and feel the traction available!









- Steering
 - Turn progressively and once: take a "set"
 - Always know where center is
 - Smooth: wind and unwind
 - Practice every day
- Shifting
 - Each shift upsets the car, takes time
 - Learn it the right way (3 steps)
 - Practice every day









- Critical part of balance, hardest to learn
 - Move foot smoothly (heel on floor)
 - Smooth but hard initial pressure
 - Push against pressure
 - Gentle Brake Release
- On track, brakes are <u>not</u> for stopping! They
 - Set entry speed for a turn
 - Determine car attitude
- Focus on the End of Braking

Mario Andretti: "Its amazing how many drivers, even at the F1 level, think the brakes are for slowing the car down."







- Insufficient weight on front tires due to:
 - Abrupt brake release (on entry) –e.g. Turn 5, Turn 9
 - Too aggressive throttle (on exit) –e.g. Turn 5, turn 10
- Steering input too rapid or too much steering angle

-e.g. Turn 10







- More/longer trail braking (maybe)
- Smoother Brake Release
- Smoother Turn-In
 - i.e. more progressive
- Be a detective
 - Why isn't enough weight on front tires?







More Weight Transfer: Oversteer

- Too much trail brake
 - e.g. Turn 5, Turn 9
- Rapid lift when car isn't straight
 e.g. Turn 9
- Aggressive braking mid-turn
 - e.g. Turn 10
- Too much power, too soon (high powered cars)
 - e.g. Turn 5, Turn 10







- Less trail braking (probably)
- Smoother brake release
- More progressive steering input
- Less and/or later gas (smooth!)
- Be a detective
 - Why isn't enough weight on back tires?









- Understeer is slow
- Oversteer is scary!













- Balance = moving weight when, and where you choose to do so
- Vic Elford: "You will notice that professional drivers often act extremely quickly, but they are rarely in a hurry. Turning from a straight must be a smooth flowing transition into and then out of the corner."
- Jackie Stewart (1985): "Senna is mellow on and off the throttle, calmly, smoothly, almost slowly."







Deliberate Practice for Balance *



- (Re)Learn the Track
 - Reference Points
 - Track Surface
 - Safety features
- 2. (Re)Learn the Car
 - Brake Application
 - Brake Release
 - Throttle
 - Steering

* How you practice is more important than amount

Do it in a focused way, With clear goals, Plan for reaching goals, and A way to monitor your progress

- (Re)Learn the Traffic
 - Mirrors
 - What Would I Do If?
- 1. Sensory Input
 - Vision
 - Kinesthetics
 - Hearing

Sources: Ross Bentley, Speed Secrets Weekly 322 and 370; Talent is Overrated by Geoff Colvin, and Peak. Secrets from the New Science of Expertise by Anders Ericsson and Robert Pool

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Deliberate Practice Worksheets





Topics for Sensory Input Worksheets Use these topics with your printed track map

Reference Points

- Not cones!
- Cracks, posts, seams, curbs, etc.
- BOB, TI, EOB, A, TO, in between
- Track Surface
 - · Sealer, color change, etc. Elevation
- One new feature per lap

Safety

- How soon/far ahead can I see flag stations?
- Bail out area(s) for each corner
- Which curbs could I drive on? Not?

Etc.

Brake Application

- Quick and hard enough? Too much?
- Does the car get upset?
- Totally consistent lap to lap?
- · Get money in the bank early in the brake zone (Cass Whitehead)
- "On like a lion, off like a lamb" (Pobst) Etc.

Brake Release

- Modulating pressure thru brake zone properly?
- Beginning release at the right point?
- · Right rate? Slow, medium, fast
- Totally consistent lap to lap?
- · Come off the brakes politely (Peter Argetsinger) Etc.

Throttle

- Squeezing too soon? Too quickly? Not enough?
- o Pause between brake and gas? On floor until brake application?
- How are you using it (vs when)
- Use only the top half? (David Murry)
- Etc.

- Is turn-in crisp/flowing or gentle/progressive
 - Both correct, depends on corner
 - Etc.

exit

Steering

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- Mirrors
 - Adjusted properly?
 - How many cars behind? o End of back straight?

Is turn-in from track edge?

Closing speed; is car in mirror closer or further away?

Especially how you unwind on corner

- o What color(s) is/are cars behind?
- Etc.
- What Would I Do If
 - I smell anti-freeze?
 - · Car in front swerves under braking?
 - Brake pedal soft in middle of traffic
 - entering bus stop? off camber? Two fast cars, you give one signal, can't
 - see second one? E10

Vision

- Everything you can see on and off the •
- track surface
- o Something new each lap
- o e.g. Horizon change during
- cornering
- How far ahead can you see?
- . Etc.

Kinesthetics

- Steering wheel feedback . .
- How g-loads build; weight transfer
- Feel the track surface Etc.

Hearing

- · Wind noise, tires, brakes
- Cornering vs. straight •
- Different parts of track
- Etc.
- Remember: Capture learning right away: in the first 10 minutes
- · Write down what you saw, heard, felt
- Before lap times, data, video, socializing

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SPEE

Speed

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NJMP - THUNDERBOLT



"There's a huge difference between knowing what you need to do and being able to execute it." -- David Murry











- Large amounts of weight move on track
 Inevitable
- Improving weight transfer improves traction
 - Requires smoothness with controls
 - Objective = **Balance**
- Learn to be a "weight transfer detective"



