Welcome to National Auto Sport Association High Performance Driver Education

John Santiago & Bob Ellis, HPDE 1 Group Leaders
WHAT SETS NASA APART FROM OTHER TRACK DAY PROVIDERS?
WHAT SETS NASA APART FROM OTHER TRACK DAY PROVIDERS?
What to Expect in HPDE

- Focused *curriculum* with greater emphasis on learning specific driving concepts
  - Group drills to facilitate learning
  - **Staying in run groups longer** to achieve mastery of driving concepts

- Introduction of the 4 pillars in HPDE 1-4
NASA HPDE Ladder System Overview

- **HPDE 1: Introducing High Performance Driving**
  - Fundamentals of car control, the “school” driving line, braking, & passing with emphasis on safety
  - In-car instruction/drills every session
  - **Goals:** Comfort/Safety on track & competent self-evaluation

- **HPDE 2: Reinforcing High Performance Driving Skills**
  - Intermediate techniques in braking, throttle, passing, and additional driving lines used
  - Continued in-car instruction/drills during some sessions
  - **Goals:** Strong command of basic high-performance driving skills driving solo, and skilled self-evaluation to further self-development
NASA HPDE Ladder System Overview

• HPDE 3: Mastering High Performance Driving Skills
  – Advanced skills to develop seat of the pants awareness
  – In-car coaching offered, data use modeled/recommended
  – **Goals:** High-level driving skills

• HPDE 4: Honing One’s Craft (& poss. Prepare for W2W)
  – Race-level skills developed - Driving off-line, very fast paced driving
  – Emphasis on spatial awareness - Passing anywhere
  – **Goals:** Individual driver enhancement, preparation to move to NASA TT or race groups if desired
HPDE Protocols

• Warm-up Sessions:
  – Held on first session of each day
  – “Warm-up” really means warming up / recon

• Mandatory driver’s meeting after each session in HPDE 1
  – Classroom Content, Session Downloads, & Group Updates
  – Track passes handed out – no attendance, no pass

• Passenger Permissions
  – HPDE 1, 2, & Hyperdrive: no passengers (except in-car instructors)
  – HPDE 3, 4, & TT: passengers permitted (18-yrs and over)

• Team HPDE!
  – This is not a race...
  – We are a team...here to work together towards a common goals: Growth & FUN!
Getting Started – Basic Gear Required

• General Attire
  – Cotton shirt (pref. long-sleeve)
  – Long pants – cotton
  – Socks – cotton
  – Closed-toe shoes

• Helmet
  – Up to date SA-rated helmet (SA2010 or newer)
  – No M-rated helmets
Safety Check

• The Walk Around
  – Windows down
  – Tire pressure good
  – Completely cleaned out interior (esp. Sunday morning)

• **Torque lug nuts** (torque to spec when cold/cooled down)

• **Oil and Fuel level** – avoid “*the tow of shame!*”

• **Brakes pads** (check *brake fluid* level at lunch)

• **Car Number** (they can fall off)

• **Tech Sticker** (updated if advancing)
ADJUST MIRRORS

BAD – Other car is in a blind spot

GOOD – Other car is visible

Mirror Position
Car Control *Begins with Your Position*

**Seating Position**
- Sit upright and in the seat
- Sit close to the wheel and pedals
  - Elbows and knees slightly bent
  - Allow for *SMOOTH* outputs
- Lock seat belts (if possible)

**Hand Position**
- Keep hands at 3 and 9 o’clock on the wheel
- Keep *relaxed grip* on wheel (sensitivity numbs w/a death grip)
Pit Out

1. When you get the signal from grid worker -- Go!
2. Driver’s responsibility to enter track safely
3. Stay in entrance lane, then blend…always…

*MIND the blend line!*

4. When already on track, watch for incoming cars entering the track every time you pass pit out

*Watches Pit Out, Watches Traffic*
CLASSROOM SESSION 1
Welcome to National Auto Sport Association Great Lakes High Performance Driver Education
NASA Education

We run Car Control Clinics
Today’s Classroom Session Topics

• Classroom 1 – Rules and procedures, Flags
• Classroom 2 – the “School Driving Line” and Apex Approaches (Early, Mid, and Late )
• Classroom 3 – Trouble Scenarios, Vision & Reference Points
A FEW GROUND RULES

1. Do not do anything to frighten your instructor

2. You must remain in control of your car
   - You are RESPONSIBLE for what you and your car do
   - Body contact will not be tolerated (harsh penalties are imposed for at fault parties including, but not limited to, permanent ejection from NASA)
A FEW GROUND RULES

3. Do not exceed your safety comfort level
   – Remember, you are in the driver’s seat
   – Communicate with your instructors

4. You are here to learn to be a better driver...
   that means developing SMOOTH car control skills...
   ...speed is a by-product of control
UNDERSTANDING FLAGS

• On-Track *Communication*
  – Provide *Information*
  – Give *Commands*

• Connection to Entire Track
  – Links your car to fellow drivers’ cars & track/corner conditions
  – Vital to Everyone’s Safety

• *Courtesy:* Drivers thank flag workers with a wave during cool down laps at the end of track session
Course Layout, Flags/Stations, Observes All
GREEN

Command Flag – All cars

Your Session/Race is on

Green track flag *may* be shown after a “Yellow” section
(NOTE: no flag at a manned flag station = green)

Green indicates a “HOT TRACK”
YELLOW

*Command* Flag – All cars

1. **Standing**
   - Means: Caution
   - Action: **Reduce Speed** to be 100% in control
   - Action: **No Passing** on this section of track

2. **Waving**
   1. Means: Incident just ahead, on track or very near it
   2. Action: **Slow Down**, be observant/ready for evasive maneuvers
   3. Action: **No Passing** on this section of track

NOTE: “...this section of track” means the track remains Yellow *until you cross the next manned corner station* displaying no flag or green flag
DOUBLE YELLOW

Command Flag – All cars

- FCY (full course yellow) condition exists
- Drivers should proceed with caution but **not** slam on brakes
  - Be prepared to encounter pace car or emergency vehicles
  - Be prepared to encounter a slow moving pack and other local flag conditions.

**ABSOLUTELY NO PASSING is permitted**, until the Pace Car (if on track) has pulled off **AND** the driver has passed the **next manned flag station** that is not displaying any Yellow Flag(s). [Ref:(25.4.1)]

The first lap on track **MAY be on standing or double yellow flags.** It is possible that additional initial laps will be yellow.
BLACK

*Command* Flag – Individual cars

***Furled*** (Rolled-Up)
If pointed at you in a “rolled-up” condition it is a warning that you have done something wrong and will be called in if you do it again

***Open***
Return to Pits (Mandatory) – someone will be there to discuss any possible infraction with you.

The Black Flag Station is usually located in the HOT PIT area.

This flag will be acknowledged to the Flagging Official with a wave so they know that you have seen it.
Common Reasons for a Black Flag

• You passed under a Yellow Flag (local or full course)

• You passed in a non-passing zone
  – Remember: Passing zones *may change* during the weekend

• You had an “off track” excursion; which in HPDE 1 includes:
  – Two or more wheels off track
  – On track spin: this can include anything over 90 deg. yaw

• Your windows are up/partially up

• Passenger has an arm out the window, holding camera, etc.

• You’re driving down the track backwards...*just kidding!*
BLACK “Meatball”  
*Command Flag* – Individual cars

Flagging Officials have observed something wrong with your car

Similar to the Black flag + info

Carefully return to the pits if possible trying to *stay off the line*

Try to determine what it is:
- Hanging bodywork
- Leaking fluids, etc.

This flag will be acknowledged to the Flagging Official with a wave so they know that you have seen it.

*Rules/Procedures, Flags/Stations, Observes All*
RED

*Command Flag – All cars*

Come to a **complete stop** pulling to the side of the track where you can see the next flag station

**Do NOT** slam on your brakes  
**Do NOT** drive past the current station to see the next station  
**DO** check your mirrors to make sure the car behind sees the flag also

Pull to the side of the track to give rescue vehicles room  
Wait for instructions from Flagging Officials or Pace Car before moving

Rules/Procedures, Flags/Stations, Observes All
YELLOW/RED

Advisory Flag – All cars

There is debris on the track surface:
- Water
- Oil or Anti-freeze
- Car parts
- Rocks/Dirt
- Critter remains

Remember, when this flag is taken down it does not mean the condition no longer exists.

Rules/Procedures, Flags/Stations, Observes All
WHITE

Advisory Flag – all cars

Indicates a slow moving vehicle on the track

You may pass that vehicle

Rules/Procedures, Flags/Stations, Observes All
WHITE/RED CROSS

*Advisory Flag – All cars*

Emergency Vehicle on track in front of you

You may pass *in a safe* manner – an *unmistakably SAFE* manner

Be prepared to slow down and follow the directions of the safety crew

- Always follow the directions of the safety crew

*Rules/Procedures, Flags/Stations, Observes All*
**CHECKER**

*Command Flag – All cars*

Session or Race is over

Slow down and proceed to pits

Give the car a chance to cool down

Drive *cool down lap* without having to touch brakes

Cars *may pass after* the checkered flag

*Rules/Procedures, Flags/Stations, Observes All*
PITTING IN

(Anytime: at the end of the session or otherwise)

Signal – a RAISED FIST out window

Get over and prepare to exit track

Once you raise fist, you’ve committed to pitting out (do not change your mind)

SLOW DOWN on your approach to the pit...

Power to the People Ya’ll!

Rules/Procedures, Course Layout, Knows Pit Entrance Procedures
WHY WARM UP & COOL DOWN?

1. Avoid thermal shock to:
   - Tires
   - Engine
   - Brakes - DO NOT set the Emergency Brake!

2. Process the track/line in a different state of mind
BLUE yellow stripe

Advisory Flag – Individual cars

Check mirrors, someone is in or is approaching a position to pass you and may want to pass
- Use your mirrors on every strait

The passing vehicle is responsible for a safe pass

When in a passing zone, signal the driver behind you with a point-by

You may need to lift slightly to aid the passing car, but do not brake
PASSING IN HPDE 1

• NEVER pass without a point-by signal from the driver

• Give one clear point-by for each car you want to pass

• Overtaken car: MAINTAIN YOUR LINE
  – Do not “move over” to be “polite”
  – Do be predictable and easily read
  – Do tap mirror to announce you’ll give a point-by after next corner

• Overtaking car: ALWAYS GOES OFF-LINE

• Point sooner rather than later (i.e. as soon as you track out)

• NOTE: Passing zones may change during the weekend
Session Evaluation Packets

• Keep these packets in your car all weekend
  – Your instructor will complete one sheet per session
  – One side: Drills & Pillar commentary
  – One side: Track Map

• Bring *completed* top sheet to class
  – Show completed sheet = Track Pass
    • You keep the completed sheets for your own review
    • Questions/clarifications/inquiries invited
  – Use to ID goals for next session / next day
End of Classroom Session 1

• The Point-By Drill (1 lap)
  – The *Out Lap* will be FCY
  – Braking Prior to Passing Zone: *quickly* scan mirrors
  – Exiting Corner: *quickly* scan mirrors
  – On Exit: give point by *immediately* once your car has entered passing zone

  – NOTES:
    • If you don’t remember passing zones, ask your instructor if one is coming up *prior to braking* for a corner
    • See if you can give two or more point bys on straights
End of Classroom Session 1

• The Hands Drill (2 flying laps)
  – Entire Lap: Double check your hand placement
  – Entire Lap (straights): Flex/relax your fingers
  – Sweepers: Gradually relax your grip while loaded up
  – Focus on how much you really need to grip the wheel

• Remember:
  – Get your Track Pass Now
  – Be 10 minutes early to grid
  – Hydrate after your session
CLASSROOM SESSION 2

Track Session Download

HOW DID YOUR HANDS FEEL?

Track Layout, Instructional Attitude
3 Basic Principles of High Performance Driving

1. Be Smooth
   a. Driver outputs should never be jerky; *squeeze* and *dial in* outputs
   b. Driver outputs should be singular and definite

2. Use the Rule of One
   a. Do one thing at a time at a maximum
   b. When you do two things at once, trade off outputs to stay within one

3. Keep Your Mind Ahead of the Car
   a. Feed your mind information early – easiest done by using *your eyes* to look ahead
   b. Use information – Anticipate how car will react & what needs to be done
HPDE 1

4 Pillars

CONTINUOUS LEARNING

- BRAKING
- CORNERING
- THROTTLE
- PASSING

SEAT TIME
NASA HPDE Four Performance Pillars

1. Braking Techniques
   a) Lift off throttle to a Light Brush of the brakes
   b) Medium Pressure Braking
   c) Threshold Braking

2. Cornering Lines
   a) Early Apex
   b) Mid-Apex
   c) Late Apex

3. Throttle Application
   a) Maintenance Throttle
   b) Slow Application of Throttle ("roll into it")
   c) Full Throttle (a.k.a. "go, go, go!")

4. Passing
   a) Setting it up
   b) Pulling Past
   c) Being Safe & Efficient
Classic “School Line” (Dry Line)

- Fastest, smoothest, safest line around a track
- Note Rhythm: O-I-O
  Outside
  Inside
  Outside
- Other “lines” exist for different reasons:
  - Rain Line, Defensive Line, Qualifying Line, etc.
Basic Brake & Throttle Input

Gradual application of the accelerator just prior to the apex, with full throttle being applied at the corner exit point.

Steady state throttle to maintain rpm.

Gradual release of brake force to prevent lockup, and to ease the change in weight transfer.

Full force limit braking.

Rapid, but not instant application.
Rhythm in Turning the Car

**Brake**: Threshold but *do not lock up*. Wheels still need to rotate

**Maintenance**: Don’t decelerate, don’t accelerate – a Steady Throttle
Allow the suspension to “settle” for turn-in

**Turn-in**: “Set” the car for cornering

**Modulate**: Slowly add/reduce throttle to assist balance but wait until you are at the apex to *start* to *roll on* to full power

**Accelerate**: Roll on to full power by exit up to the next brake zone
Brake – Maint. – Turn-in

– NOTE: Excessive maintenance throttle can limit overall performance
– Minimizing maintenance throttle is a long-term objective
– So the order of these inputs can/will vary

As you advance in your skills, you will refine and adjust the transitions here
Definition: The location where the turn is initiated

Note: This is the point at which your speed has to be correct for the corner – we brake to target this speed

Caution: Most new students turn in too early...
**Geometric Definition:**
The location where the vehicle comes closest to (i.e. clips) the inside edge of a turn

**Dynamic Definition:**
The point where you stop entering a turn and start exiting

*Also the point where you transition from entering the turn to exiting the turn*
Types of Apex

**Early Apex**: Arriving at the inside edge of track *before* geometric center of turn

**Geometric Apex (mid-apex)**: Arriving at inside edge of track *at* geometric center of turn

**Late Apex**: Arriving at inside edge of track *after* geometric center of turn
Types of Apex

**Early Apex**: Fastest line **INTO** a corner – *leaves least amount of room on exit*

**Geometric Apex**: Fastest line **THROUGH** corner (in theory)

**Late Apex**: Fastest line **OUT** of a corner – *leaves most amount of room on exit* (also safest line through a corner)
Dangers of an Early Apex

Complete straight line braking (early)
Dangers of an Early Apex

Turn in (too early)
Dangers of an Early Apex

Early apex (before corner)
Dangers of an Early Apex

Too much speed (unable to brake in straight line)
Dangers of an Early Apex

Running out of track!
Dangers of an Early Apex

Off course (spin likely)
Dangers of an Early Apex

Danger, Danger!
No abrupt movements,
Keep the wheels straight,
Get slowed down,
Pull back on track slowly.
Benefits of a Late Apex

Complete max-braking effort early – and in a straight line
Benefits of a Late Apex

Begin turn-in
Benefits of a Late Apex

Aim for your apex
You drive where you look
Benefits of a Late Apex

Apex closest to inside edge beyond midpoint of corner
Benefits of a Late Apex

Accelerate and unwind wheel
Benefits of a Late Apex

Aim toward outer edge of track while accelerating continue to unwind the wheel
Benefits of a Late Apex

Exit turn
Prepare for next section
Early vs Late Apex

Late apex
Requires slower entry
but allows faster exit
(no braking in the turn)

Early apex
Allows faster entry
but requires slower exit
(where to brake?)
Apex – Typical corner styles

- Decreasing or uniform radius with a late apex
- Increasing radius with an early apex (room to exit)
- Sweeper with a normal apex (almost straight line)
Corner Elements to Consider

• Corner Types determined by...
  – *Speed* through corner: slow, medium, fast
  – *Radius* of the corner: small to large
  – *Distance* along corner (and thus, time in corner)
  – *Relations* to straight and/or other corners

• Analysis: Understanding combinations of corner elements above helps ID the main driving line priorities
End of Classroom Session 2

• The Apex Drill (2 laps)
  – 1\textsuperscript{st} Lap: Take a very \textit{early apex} on every corner
  – 2\textsuperscript{nd} Lap: Take a very \textit{late apex} on every corner
  – Keep pace at around 70\% normal pace
  – Focus on \textit{the outcome} of the apex you take

• Remember:
  – Get your Track Pass Now
  – Be 10 minutes early to grid
  – Hydrate after your session
CLASSROOM SESSION 3

Track Session Download

Were you able to judge your apex executions as Early, Mid, or Late?
Which apex approaches worked for you?

DID YOU FEEL A SENSE RHYTHM START TO BUILD THROUGH THE CORNERS?
Trouble Scenarios – We’re Going In Hot!

If you are carrying too much speed into a corner...

- **KEEP BRAKING** in a Straight Line
- **Wait to Turn In**

Butchering a Corner

- Ugly? Yes...but **MUCH SAFER** than Going Off Track
- Don’t Force a Corner You Know You Cannot Make
Trouble Scenarios
We’re Not Gonna Make it!
Scenario #1

• You almost make it...but the car drops *two outside wheels* off track at the exit
  – Keep driving the car straight with half on / half off the track
  – Gently slow down
  – **DO NOT** JERK THE WHEEL TO BRING THE CAR BACK ON TRACK!

• Once you have slowed and gained control...
  – Ease back on track if clear
  – Get Off-Line and Pit In
Scenario #2

• You just can’t make the turn...the whole car is going to go off track
  – Straighten the Wheel, and...
  – Drive Straight Off Track
  – Try to Drive Off as Close to Perpendicular as Feasible

• This is far less likely to cause a roll-over
Scenario #3

• You Spin the Car
  – “In a spin, both feet in”
  – Apply both brake and clutch until full stop

• Look to flag station corner worker for signal
  – They’ll tell you when it’s safe to return to the track
  – Get off-line (if it was an off-track spin)
  – Proceed to black flag station
Other Trouble Scenarios

• Brake Fade or Failure
  – Identify ahead of time – *set a baseline* pedal feel
  – Use off-track procedures (if necessary)

• General Mechanical Problems
  – Drive Off-Line to Pits (if possible)
  – DO NOT get out of car to fix it off track
VISION: Eyes Up / Eyes Moving

• The Car Goes Where Your Eyes Go
  – Use Long Vision: look \textit{up} \& look \textit{far down} the track
  – Prevent Target Fixation –
    • Don’t dwell on bad things (“…look at happy things”)
    • Don’t stare at the car in front of you
    • Don’t stare at reference points on the track

• Scan \& Sweep
  – Keep eyes in constant motion
  – Sweep mirrors – don’t fixate on the car(s) in them
  – Check gauges on long straights
PICK FIXED REFERENCE POINTS

• A “fixed” visual object on or near the course to aid in executing or completing a maneuver

• Fixed means *it will NOT move*. Cones, dirt, and people move

• Poles, signs, painted markers, pavement cracks, etc... do not move
Look Where You Want to Go!

Gilles Villeneuve (see his eyes!)
The Focus of Vision

• Civilians: focus on Quality of vision
  – Concerned with *IF* they can see (near-sighted, blurry vision, etc.)

• Novice Drivers: focus on Content of vision
  – Concerned with *WHAT* to look at (#3 marker, black patch, cones)

• Seasoned Drivers: focus on Timing of vision
  – Concerned with *WHEN* to look at things...
KEEP YOUR EYES AHEAD

As You Approach...

- Braking Point
- Turn In
- Apex
- Exit

Shift Eyes To...

- Turn In
  - (and flag stand)
- Apex
- Exit
  - (and flag stand)
- Down Track
KEEP YOUR MIND AHEAD

3-Points Define an Arc

Point #1:
Where you are **Right Now**

Point #2:
Where you **Will Act**

Point #3:
Where you are **Going**  

(vid)
End of Classroom Session 3

• The Vision Drill (2 laps)
  – Verbally acknowledge what you see through every phase of every corner (e.g. “Eyes on black patch”)
  – Focus on the timing of your vision and the flow of the car through the corner

• Remember:
  – Get your Track Pass now & be 10 min. early to grid
  – Hydrate after your session
  – Review 1-3-5 docs to set goals for tomorrow

• Awards Dinner! (6:00 pm)
SUNDAY CLASSROOM SESSION 1

Track Session Download

How well did you judge your passing opportunities?

Have you defined your goals for today?
Get to know your fellow HPDE 1 drivers:

Name & Occupation

Car and Color

1 or 2 Goals for Today
Why spend time on this?

*Understand Diversity*
- Recognize the range of cars and experience
- Get to know and understand driving styles
- Understand why others are here

*HPDE 1 is a TEAM*
- We keep one another safe through common knowledge and good communication
- Aggression, impatience, ‘road rage’ have no place
- Build friendships within your HPDE cohort
Today’s Classroom Session Topics

• Classroom 1 – Braking & Turn-In Target Speed

• Classroom 2 – Weight Transfer, Understeer & Oversteer

• Classroom 3 – Using Track Time, Car Modifications
Reviewing Key Concepts to Performance Driving

1. **Be Smooth** – driver outputs should be executed smoothly to avoid upsetting car balance

2. **Rule of One** – do one thing at a time when done at a maximum

3. **Mind Ahead of Car** – constant data gathering to inform your decisions *before you make them* (stay ahead of the car)

4. **Car Communicating** – be able to feel what the car is doing, know how the car reacts to your outputs and the track environment

5. **Consistency** – driver outputs should be executed consistently to establish benchmark for evaluation and experimentation
The Braking Zone

- Braking Zone: the *area* of track where you will decelerate...
  - To obtain an *ideal target speed* right at corner entry
  - Tailored to you and your car
BoB: The Beginning of Braking

- Braking Point: the location where braking is initiated ("brake lights on")
- Braking Marker: reference point for braking
**EoB: The End of Braking**

- Releasing the Brakes: the *gradual process* of easing pressure on the brake pedal
- Coming Off the Brakes (EoB): point at which no further pressure is on brakes (“brake lights off”)

![Braking Zone Diagram](image-url)
HPDE X

Four Common Braking Errors, so...

• Don’t: Coast Before Initiating Braking
  – DO: Be at full-throttle right up to the braking point

• Don’t: Use Lazy Street/Highway Braking
  – DO: Quickly/Smoothly initiate full-force braking
  – DO: Ease off braking at end of braking zone

• Don’t: Brake Hard Too Soon
  – DO: Use only as much of the braking zone as needed

• Don’t: Brake Hard Too Late
  – DO: Brake late, but maintain balance at turn in
Finding the Correct Amount of Braking

Q: How do you know when you are braking enough?
A: When you can hit your apex with as much speed as the car can carry

Q: How do you know this is achieved?
A: You find out, *inch by inch*...

• Start conservative, *consistently* hit your apex
• In very short amounts, adjust deceleration to a new target speed
• When you *just miss* the apex, dial back braking to last successful deceleration
Dialing in Your Braking for **Balanced** Entry

- Adjust braking with *target speed at corner entry* in mind
  - Let compressing the braking zone come naturally
- Avoid going in “*with your hair on fire!*” ...and the car severely unbalanced
Different Brakes for Different Corners

- Braking Effort – (in general) the greater the speed differential (from top speed to corner entry), the greater the pedal pressure required
  - Large deceleration to enter: Threshold braking
  - Small deceleration to enter: Medium to Brush
- Speed of Corner & Future Concerns...shhhhh...
  - Slow & Medium speed: trail braking potential
  - Fast: less trail braking potential
Legendary Braking

“Nobody has ever said to me that there is an art in taking your foot off the brake, but believe me, there is.

The most important thing I've ever learned is how to take the brakes off a car. Anybody can put on the brakes, but very few people can take them off.”

- Jackie Stewart
PLANTING SEEDS: *Legendary Braking*

Street Drills – *every day / every opportunity*

- **SENSITIVITY: Control Brake Release**
  - Focus attention on how you lift your foot
  - Aim for an imperceptible finish to a full stop

- **TIMING: Brake Release for Cornering**
  - Compress braking zone for a corner by adjusting EoB
  - Turn steering wheel *after starting* to release brake
End of Sunday Classroom Session 1

• Turn-In Speed: Braking Drill # 1 (2 laps)
  – Identify at least one “good” corner to work on
  – Adjust braking in small increments
  – Focus on your targeting your turn-in speed
  – ID the impact this has on your apex

• Remember:
  – Get your Track Pass Now
  – Be 10 minutes early to grid
End of Sunday Classroom Session 1

• The Book of EoB: Braking Drill #2 (2 laps)
  – On Track: focus on precise point of the EoB for every corner
  – On Track: be aware of your pedal release method
  – Off Track: use track map to note intensity & EoBs
  – ID the EoB *relative to* track position *and* your steering

• Remember:
  – Get your Track Pass Now
  – Be 10 minutes early to grid
WHAT WERE YOU LOOKING AT ON TRACK?

Instructional Attitude, Knows Problem Procedures
### LOAD & TIRE CONTACT PATCH

Figure 15.4: Flat surface contact conditions of a passenger tire

<table>
<thead>
<tr>
<th>Inflation</th>
<th>Load = 44% max</th>
<th>Load = 78% max</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 bar (45 psi)</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>2.1 bar (31 psi)</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>1.1 bar (16 psi)</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Contact Pressure

#### Color Key:
- 0 (0)
- 0.7 (10)
- 1.4 (20)
- 2.1 (30)
- 2.8 (40)
- 4.1 (60)
- 4.8 (70)
- 5.5 (80)
- 6.9 (100)
- 8.3 (120)
- 9.0 (130)
- 9.7 (140)
- 10.3 (150)

Parameters/Conditions: P205/60R16 SL on 16x6.0 rim, maximum load capacity = 615 kg (1356 lbs)
WEIGHT TRANSFER WHILE TURNING
For a given load on a tire, there is only so much grip it can give.

You can use that grip to Accelerate, Brake, or Corner.

Spending Your Grip Budget Wisely – spend on one area, leaves less to spend on another.

**Moral:** There’s only so much goodness to go around...something has to give...
Actual Traction Circle: a G-G Diagram

- Data logging accelerations produces a record of tire use

Images courtesy of Temporal Images and John McIver, *The GG Diagram*
Traction Circle: beginner

- Sequential accelerations record *marginal* tire use
Traction Circle: *very* advanced

- Blended accelerations record *maximum* tire use
Understeer (a.k.a. “Push”) and Oversteer (a.k.a. “Loose”)

Throttle at (turn) exit, Understeer, Oversteer, Knows problem procedures
Correcting for a Misbehaving Car

• Know where the car is not happy...
  – Corner **Entry**?
  – Mid-corner / **Apex**?
  – Corner **Exit**?

• Know what **you** were doing at that point...
  – Braking hard?
  – On throttle hard?
  – Turning wheel hard?
Correcting for Understeer – Increase Front Grip

• On Corner Entry – a basic approach
  – Roll off maintenance throttle (“modulate throttle”) to get weight transfer to front tires
  – Smoothly roll back on gas to maintenance once course correction is completed

• On Mid-Corner
  – Modulate throttle: likely too eager and transferred weight off the front

• On Corner Exit
  – Open steering wheel: *may* be pinching corner and fighting car
  – Modulate throttle/Re-tighten Steering Wheel: also may have been too eager, hold maintenance and gently dial in more steering

• Always-Always: LOOK where you want the car to go
Correcting for Oversteer – Increase Rear Grip

• On Corner Entry
  – Roll off the brake: likely kept braking hard while increasing steering input
  – Open steering wheel slightly: slow and settle the car first

• On Mid-Corner
  – Open steering wheel slightly (begin to “steer into a spin”)
  – Gently apply more throttle to transfer load to rear (“catch it with throttle”)

• On Corner Exit
  – Modulate throttle: go to maintenance, likely too eager and over-taxied your rear grip budget (i.e. “throttle-on oversteer”)
  – Steer into the spin, then adjust as you roll back on gas

• Always-Always: LOOK where you want the car to go
Correcting for Severe Oversteer

Correct – Pause – Recover (CPR Bondurant)

**Correct**  Steer in the direction the rear of the car is going. Rear going right, then steer to the right.

**Pause**  If you have corrected enough, there is a distinct moment of pause when the rear stops going one way and gets ready to come back.

**Recover**  At the moment of pause, immediately bring the steering back to straight.

ALWAYS-ALWAYS LOOK WHERE YOU WANT TO GO
PLANTING SEEDS: *Driving at the Limit*

- The Limit of Grip is not the limit of traction
  - *Don’t panic* at the onset of a car that starts moving under you
  - *There’s still more* performance in the car
- Traction continues into a zone of tire slip
  - Slip is not = slide/spin
  - Slip is not = loss of control
  - Slip is allowing the tire to work at its peak
PLANTING SEEDS:  
Is My Car Misbehaving?

• Q: What is the difference between these? Oversteer vs. Rotating the car

• A: Oversteer *happens to you*  
  Rotation is what *you make happen*

  • One you react to, one you anticipate/plan/execute
  • One you have to correct – because it wasn’t part of the plan
  • One you *have to allow* – because that part of the plan needs to unfold
PLANTING SEEDS:

The Apex Revisited: AOA

• Q: Why would we want to rotate the car?

• Hint: Remember the Apex Drill...what was one of the key advantages of a late apex?

• A: To gain a better line out of the corner
PLANTING SEEDS:
The Apex Revisited: AOA

• Q: Who will be able to put down *full power* sooner?
End of Sunday Classroom Session 2

- Throttle Modulation Drill (2 laps)
  - Pick 1 corner to practice on (long sweepers are best)
  - Enter mid-track at reduced speed (75%) & set the car
  - Gently squeeze throttle on / feather throttle off
  - Focus on *the effect of weight transfer* on position

- Remember:
  - Get your Track Pass now & be 10 min. early to grid
  - Hydrate after your session
End of Sunday Classroom Session 2

• The Sensory Session Drill (2 laps)
  – Verbally acknowledge when you feel the car finally take a set in each corner (e.g. “set”)
  – Alt.: Verbally call out when the car has settled enough from braking and is ready to turn in (e.g. “ready”)
  – Focus attention on the weight transfer of the car

• Remember:
  – Get your Track Pass now & be 10 min. early to grid
  – Hydrate after your session
SUNDAY CLASSROOM SESSION 3
Track Session Download

WHAT DID YOU FEEL YOUR CAR DOING?

ANY AREAS ON TRACK WHERE YOU FEEL YOU DON’T KNOW WHERE TO GO IN AN OFF-TRACK INCIDENT?

Race Control Report
Car Modifications

The first and most important modification...

TIGHTEN THE NUT BEHIND THE WHEEL

Which means:

Seat time, seat time, seat time...
What Makes the FASTEST Lap Times?

– Christopher Brown, Squigglylines.com

90% Driver Skill – coaching & practice

7% Car Set Up – making it easier to drive

3% Car Set Up – making it faster/harder to drive
The Nut Behind the Wheel

• Have a specific purpose every time on track
  – Think ahead of time about *just one or two* things to work on
  – *Ex.: Specific skills, techniques, track use, awareness*

• Make 100% use of your track time
  – From start to finish, learn from everything
  – Q: “What can I do to make this a productive moment on track?”

• Adjust purpose to fit the circumstance
  – Recognize opportunity in unplanned track event
  – *Different line, setting up a pass, reading body lang.*
7 Things That Performance Drivers Do (That No One Else Does)

1. They look beyond the car in front of them.
2. They use the brakes for more than just slowing down – they use them to manage the balance of the car.
3. They focus their vision on the End-of-Braking point when approaching corners.
4. They use their throttle to manage the weight balance of their car, managing its handling characteristics.
5. They look for the apex of every corner, whether on the track, a city street, freeway off-ramp, or mountain highway.
6. They think about their driving, and how they can improve it.
7. They enjoy driving!
CAR MODS

Tires and/or Brakes then...

Suspension then...

Race Car! Or...(lastly)... Power
THANK YOU!

DRIVE WELL on your last session!

DRIVE SAFE on the way home!