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?

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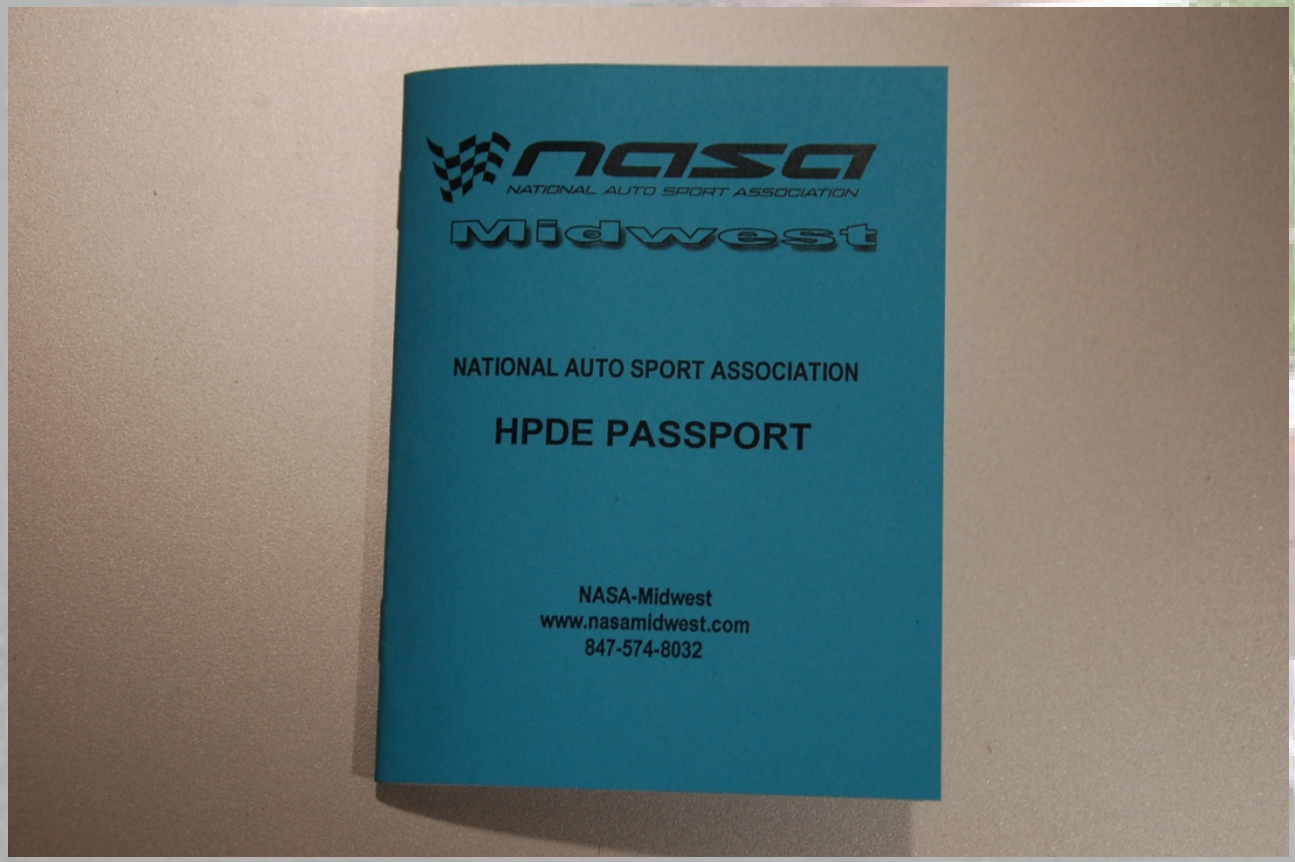


What to Expect in HPDE

- **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!

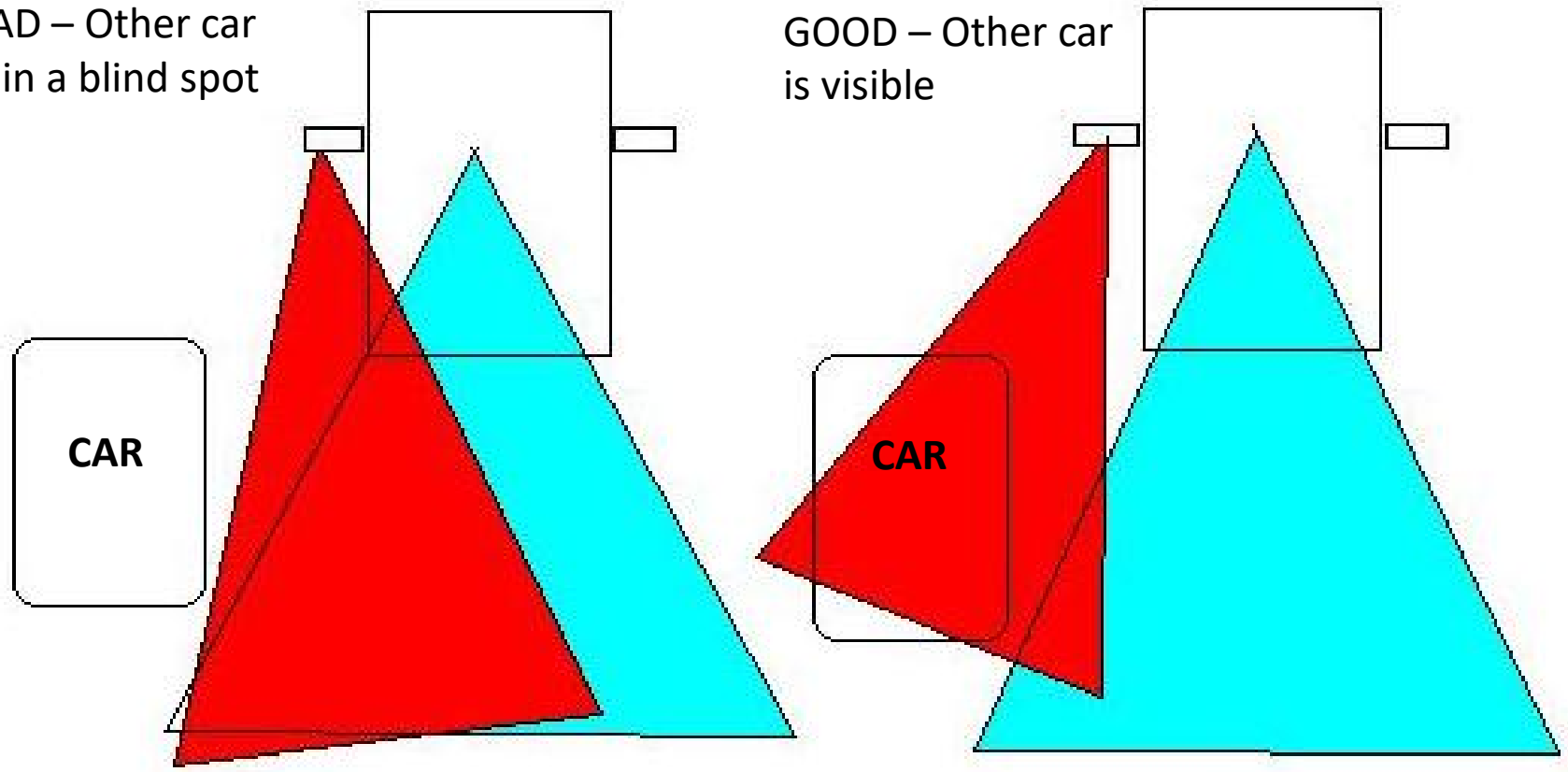
Getting Started – Basic Gear Required

- **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)

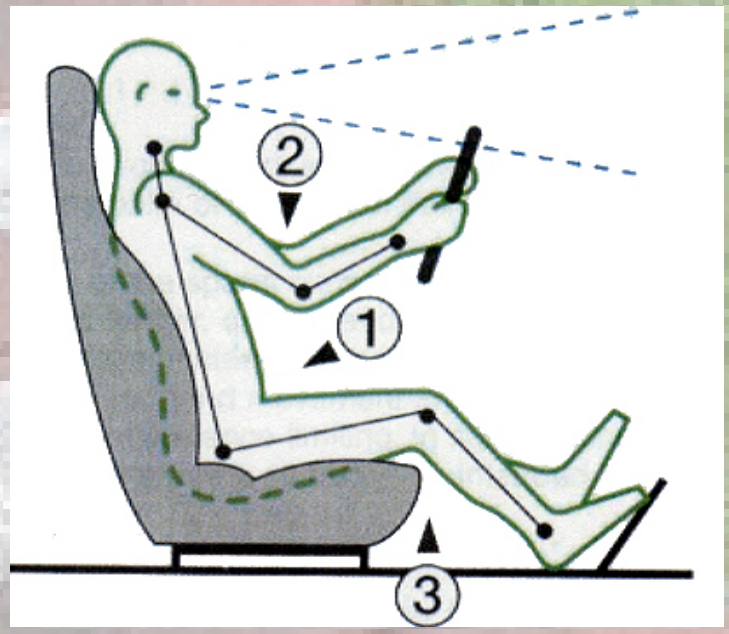
ADJUST MIRRORS



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 **A**uto **S**port **A**ssociation

Great Lakes

High **P**erformance **D**river **E**ducation

NASA

HPDE

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…**

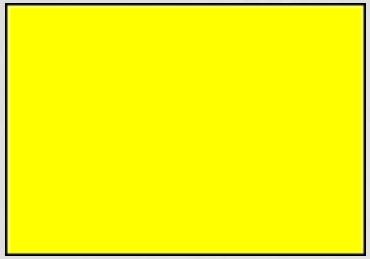
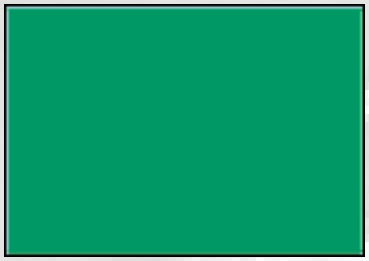
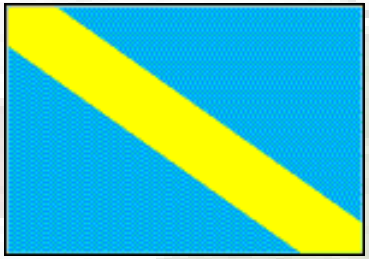
   that means developing SMOOTH car control skills…

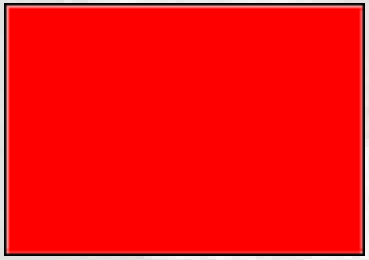
   …*speed is a by-product of control*

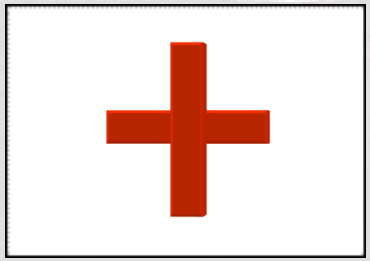
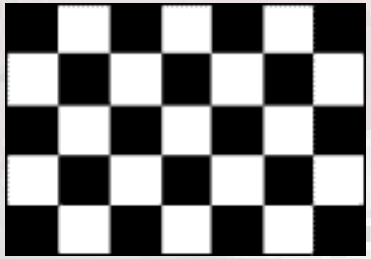
UNDERSTANDING FLAGS

- **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

HPDE 1



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"**

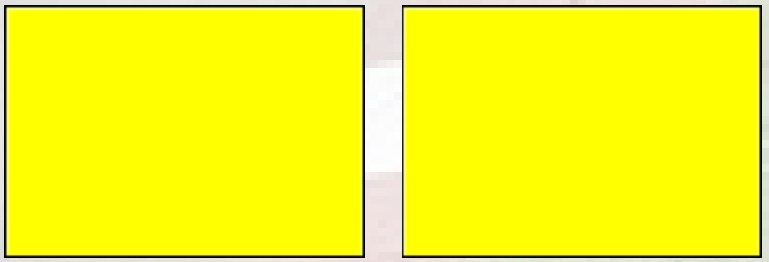
YELLOW

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.

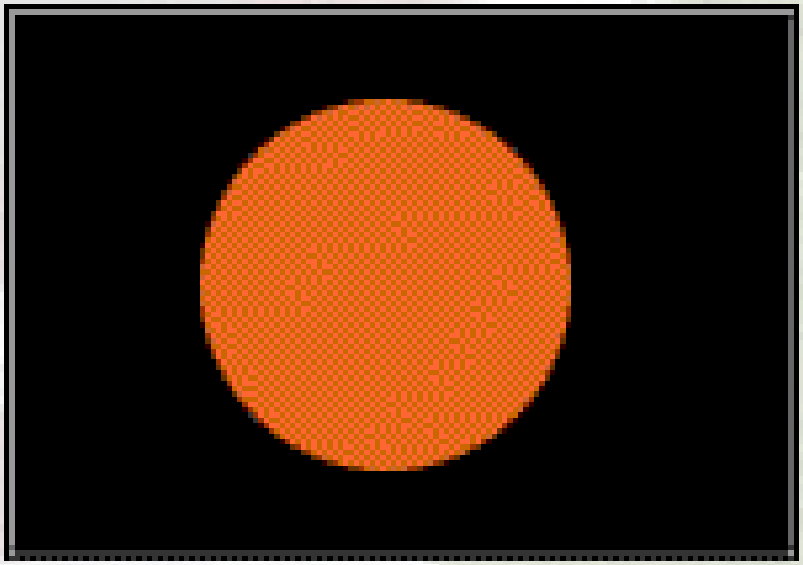
Common Reasons for a Black Flag

- 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.

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

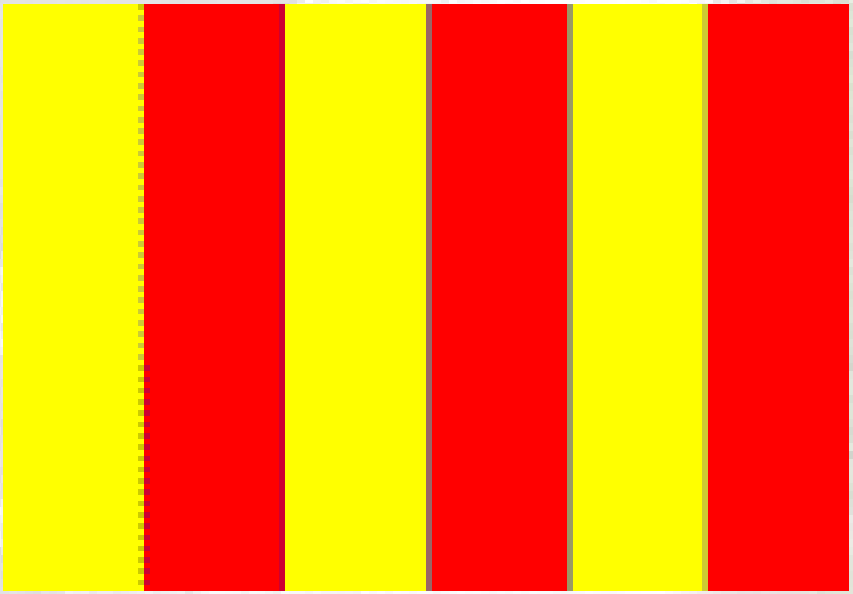
Do NOT slam on your brakes
Do NOT drive past the current station to see the next station
DO check your mirrors to make sure the car behind sees the flag also

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.

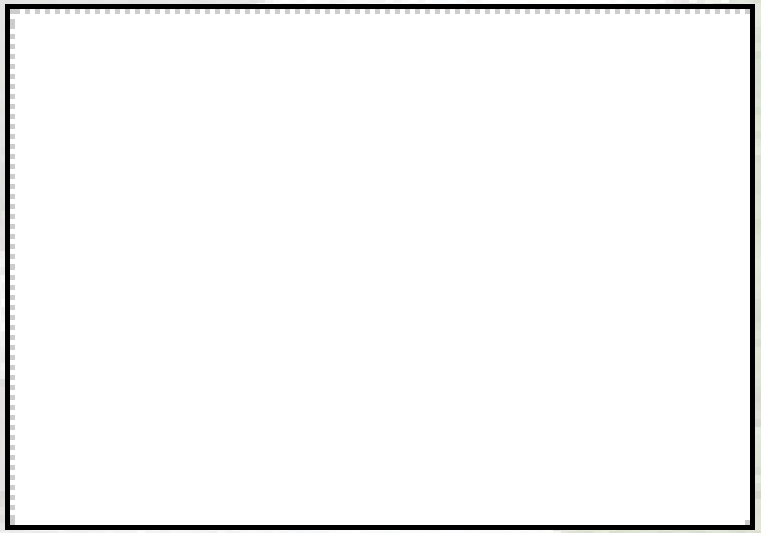
Rules/Procedures, Flags/Stations, Observes All

WHITE

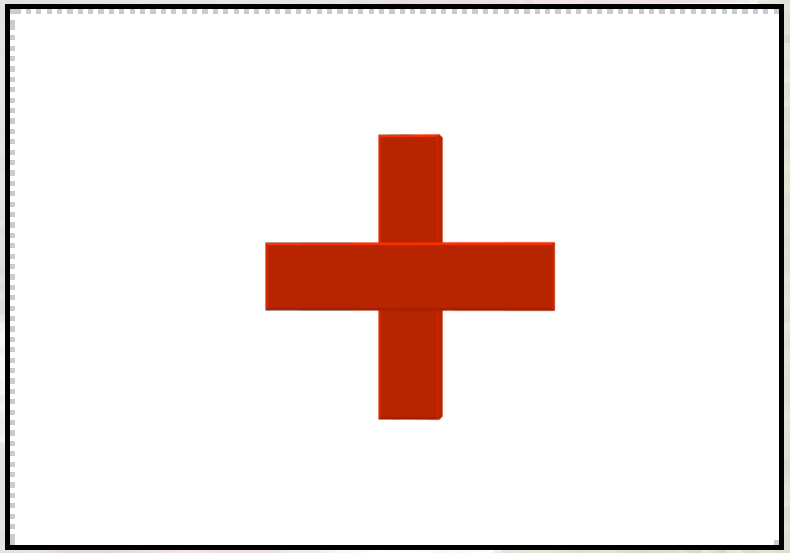
***Advisory* Flag – all cars**

Indicates a slow moving vehicle on the track

You may pass that vehicle



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

CHECKER

***Command* Flag – All cars**

Session or Race is over

Slow down and proceed to pits

Give the car a chance to cool down

Cars **may pass** *after* the checkered flag

Drive *cool down lap* without having to touch brakes

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

Power to the People Ya'll!

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

SLOW DOWN on your approach to the pit…

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

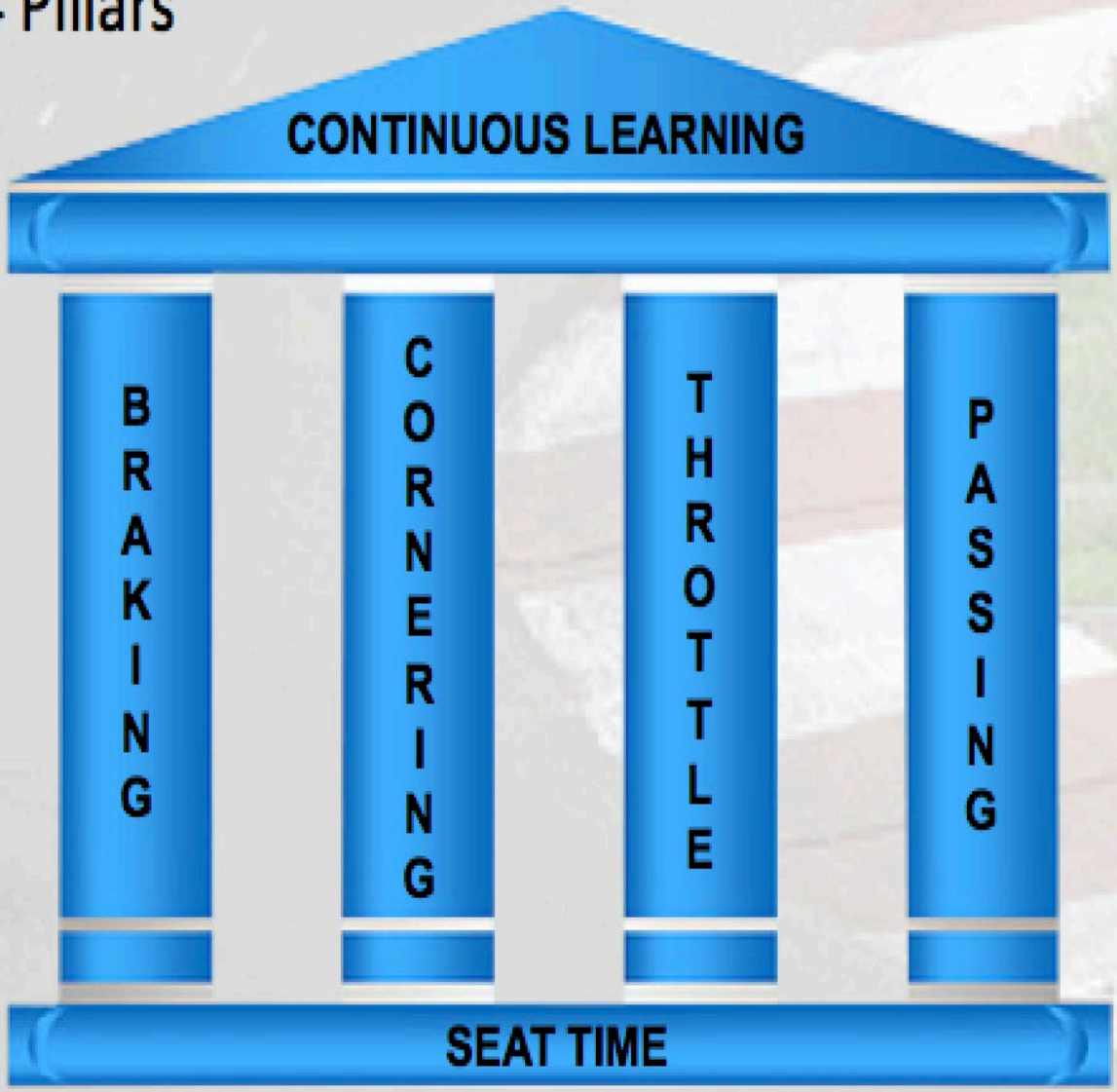
HOW DID YOUR HANDS FEEL?

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

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

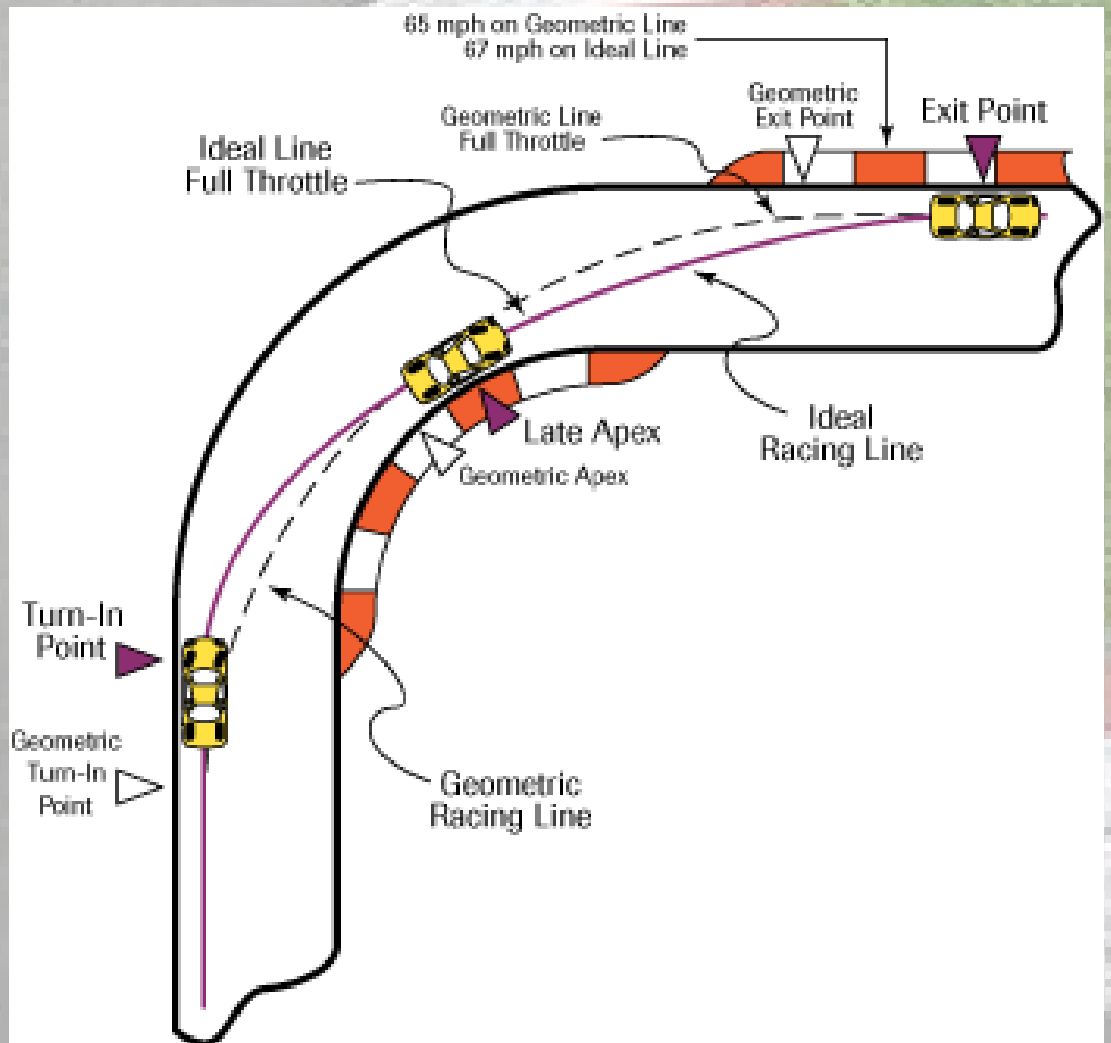
a) Setting it up

b) Pulling Past

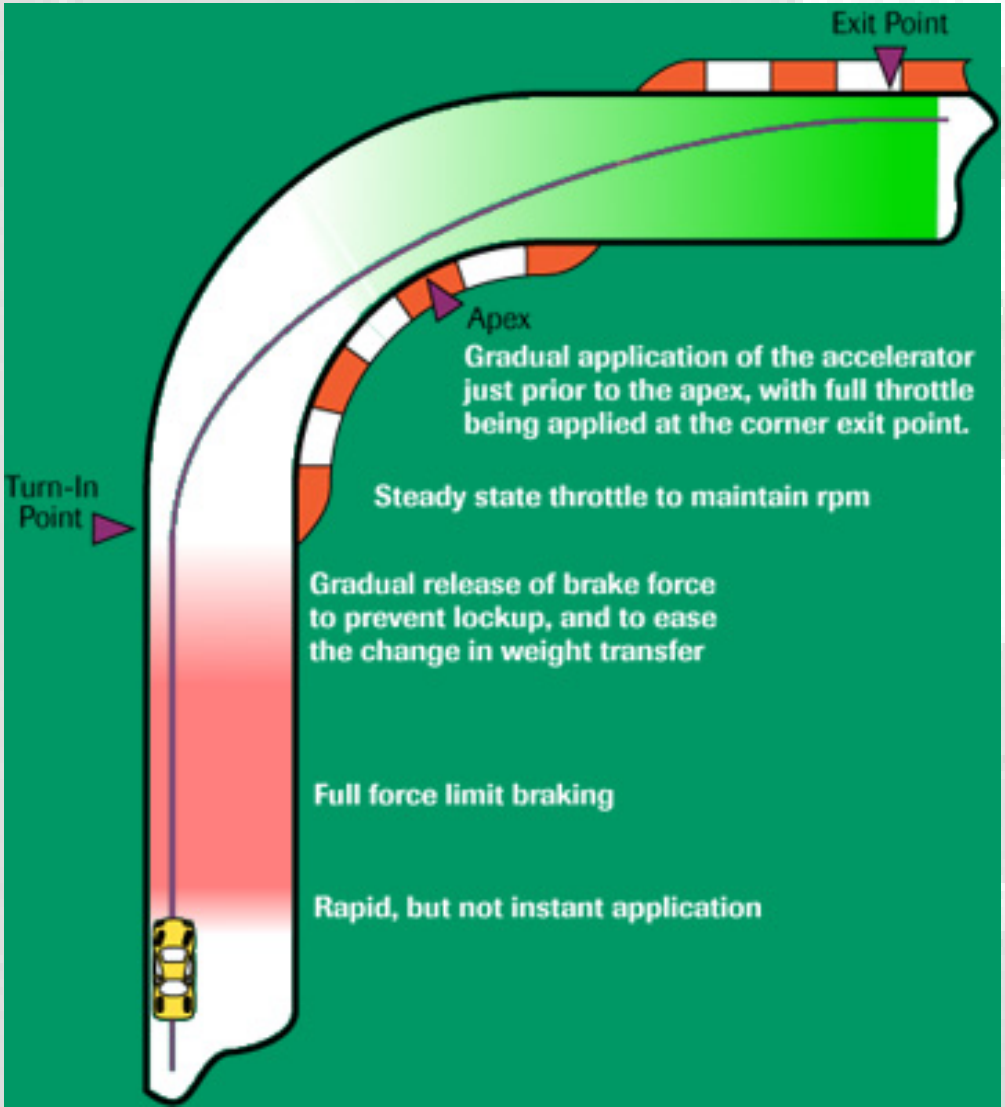
c) Being Safe & Efficient

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



Rhythm in Turning the Car

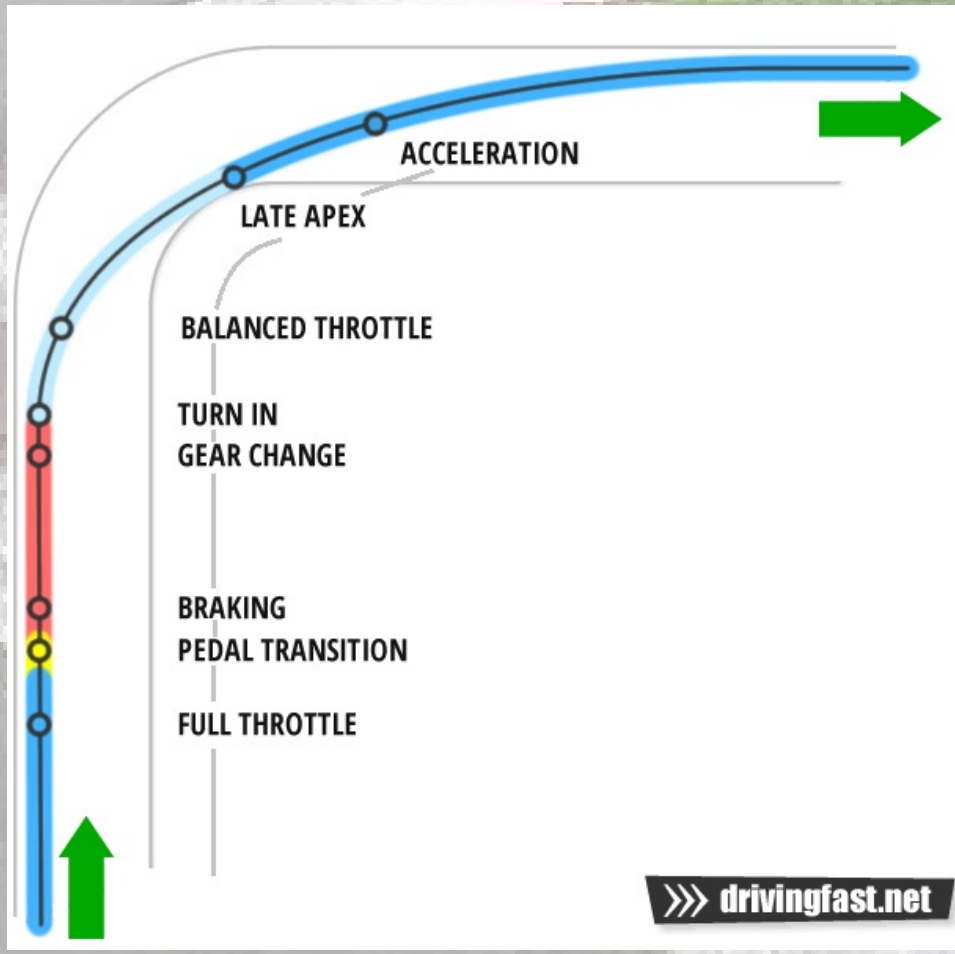
Brake: Threshold but *do not lock up.* Wheels still need to rotate

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



PLANTING SEEDS: *Maintenance Throttle*

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

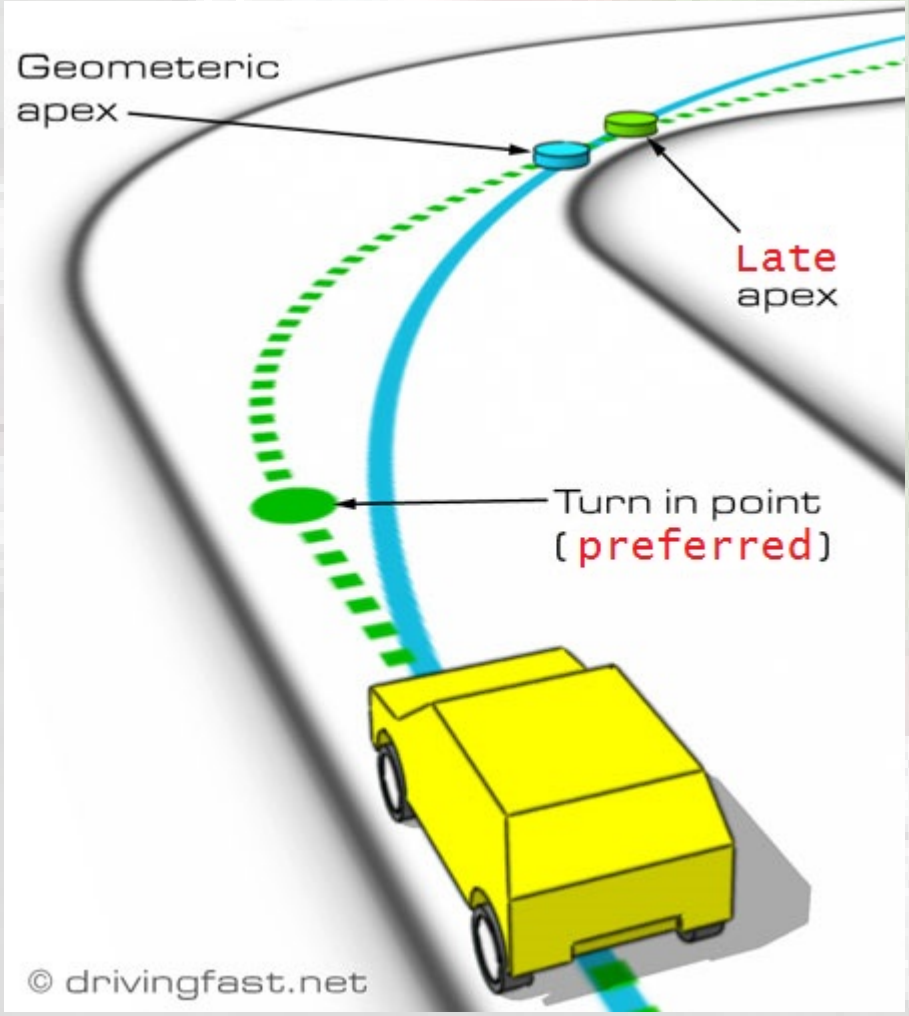
As you advance in your skills, you will refine and adjust the transitions here

THE TURN IN POINT

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

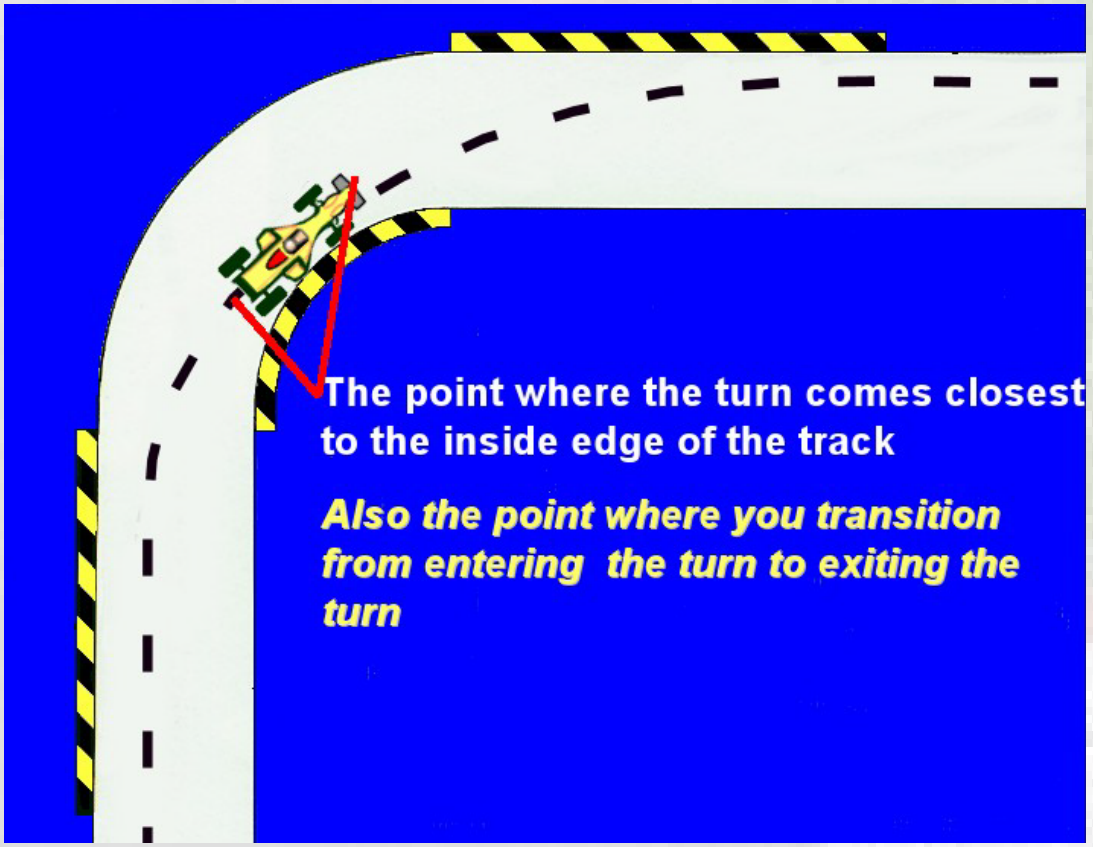
Caution: Most new students turn in too early…



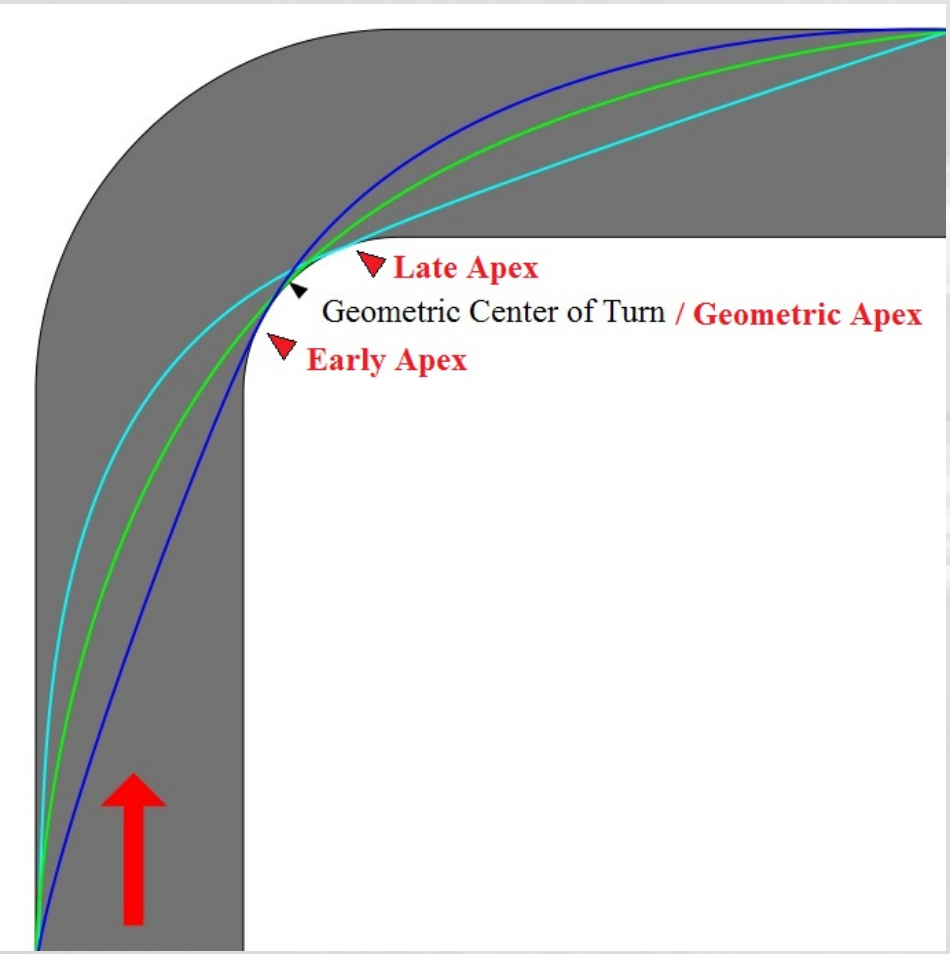
THE APEX

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



Types of Apex

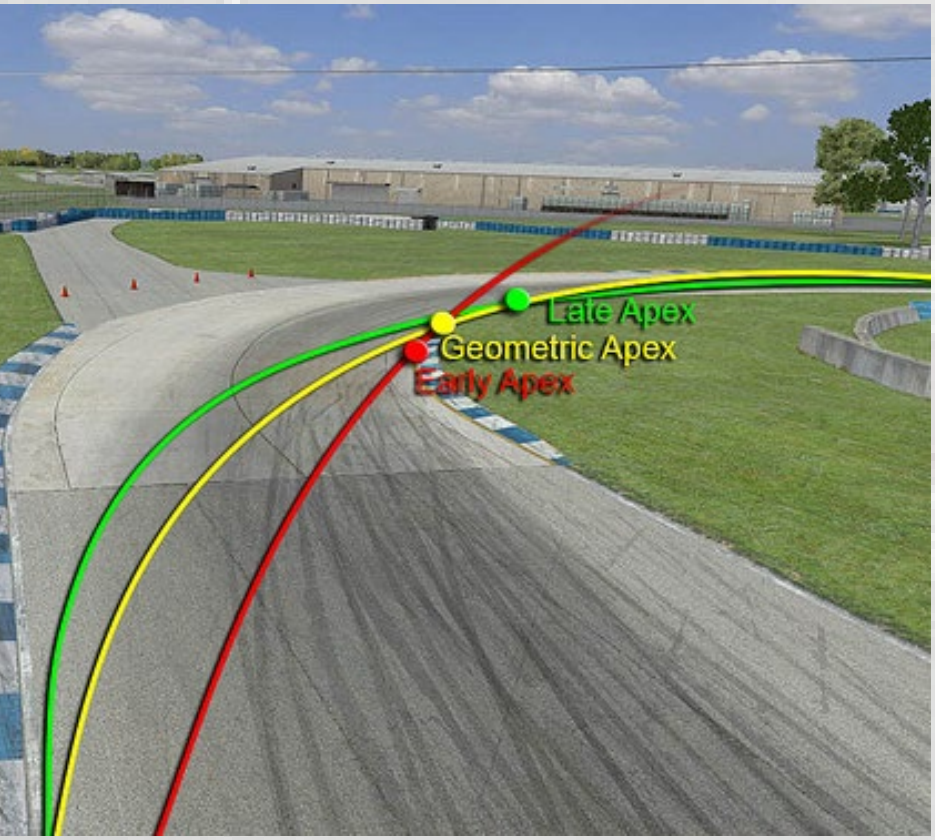


Early Apex: Arriving at the inside edge of track *before* geometric center of turn

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

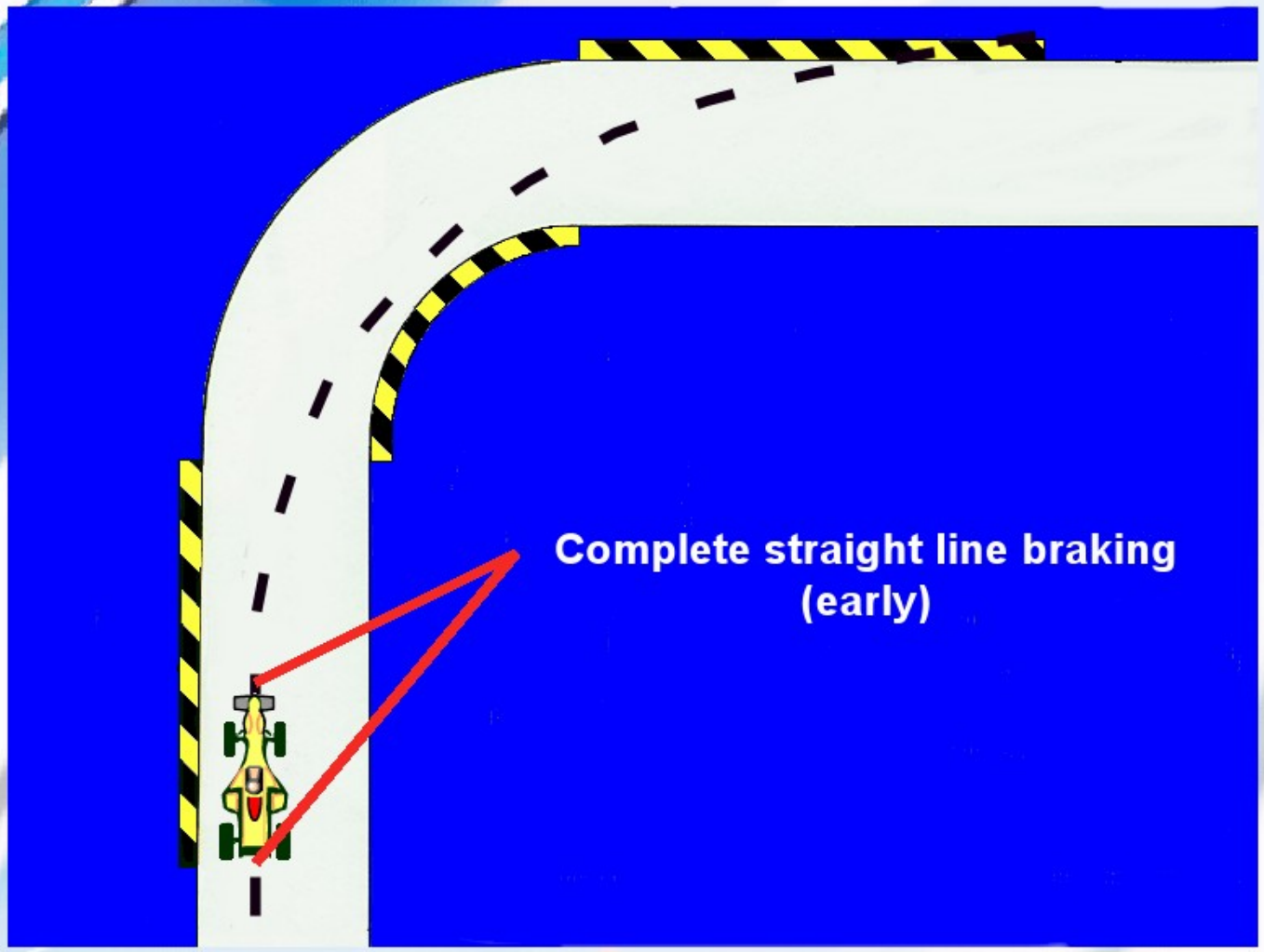


Early Apex: Fastest line INTO a corner – *leaves least amount of room on exit*

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



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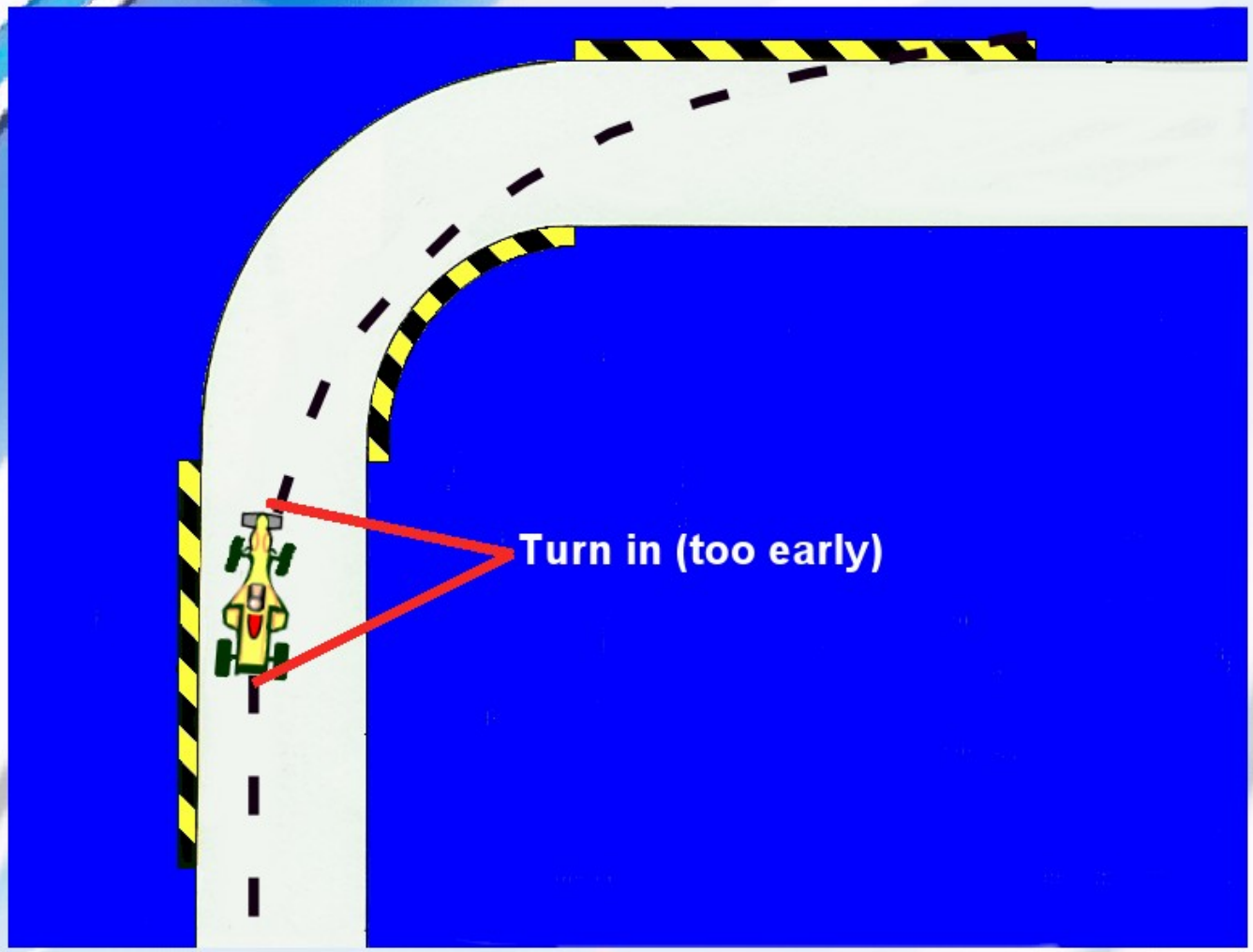

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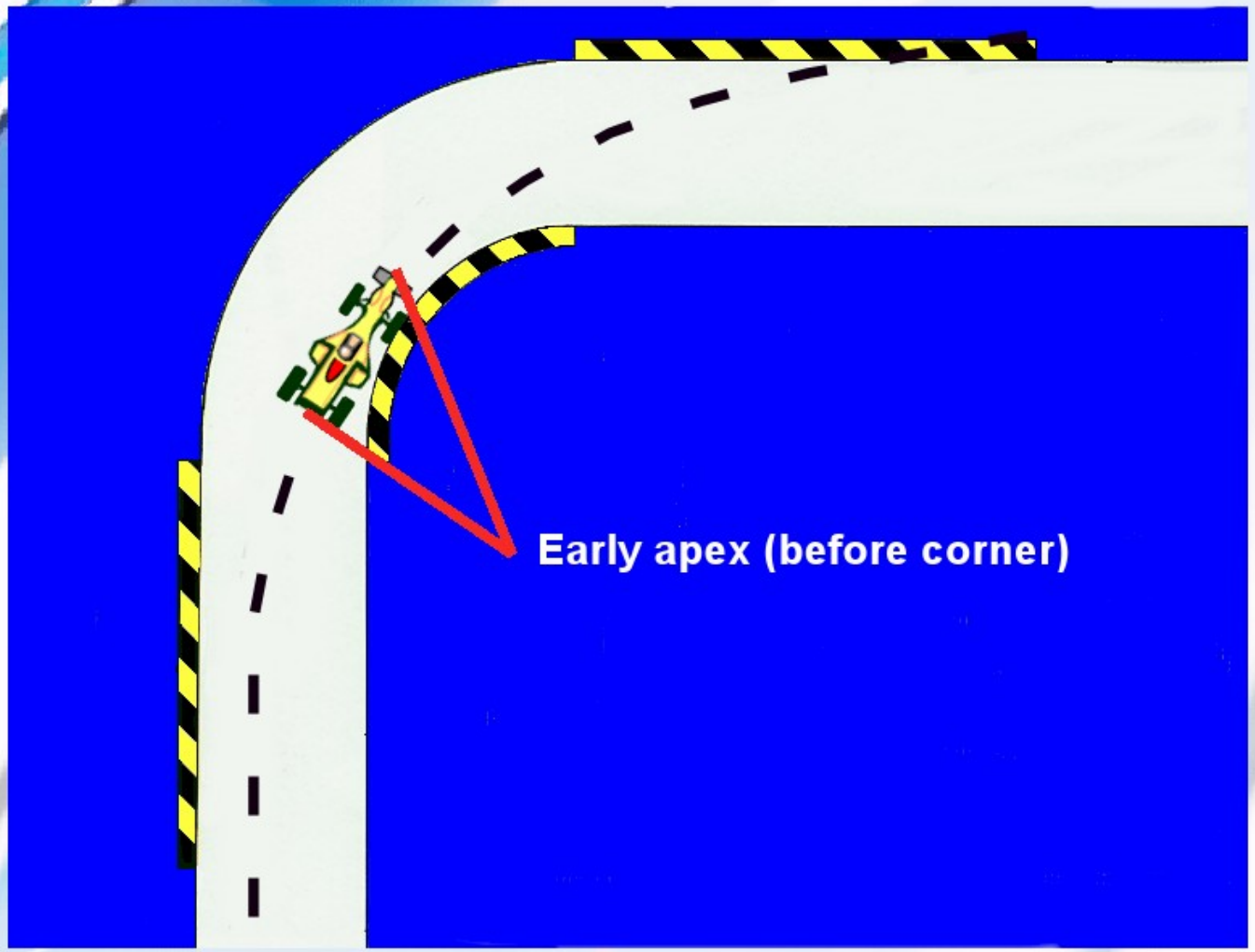

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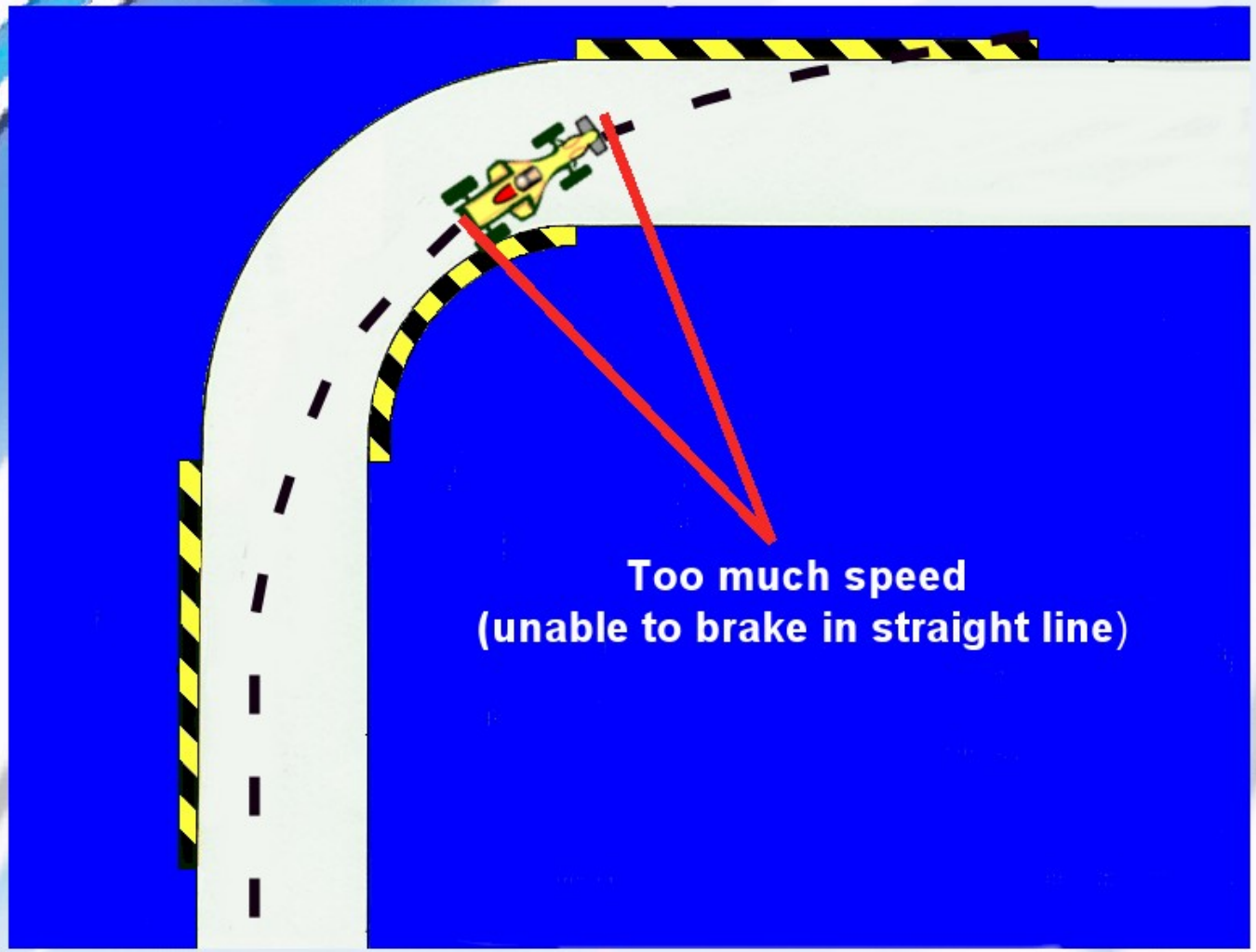

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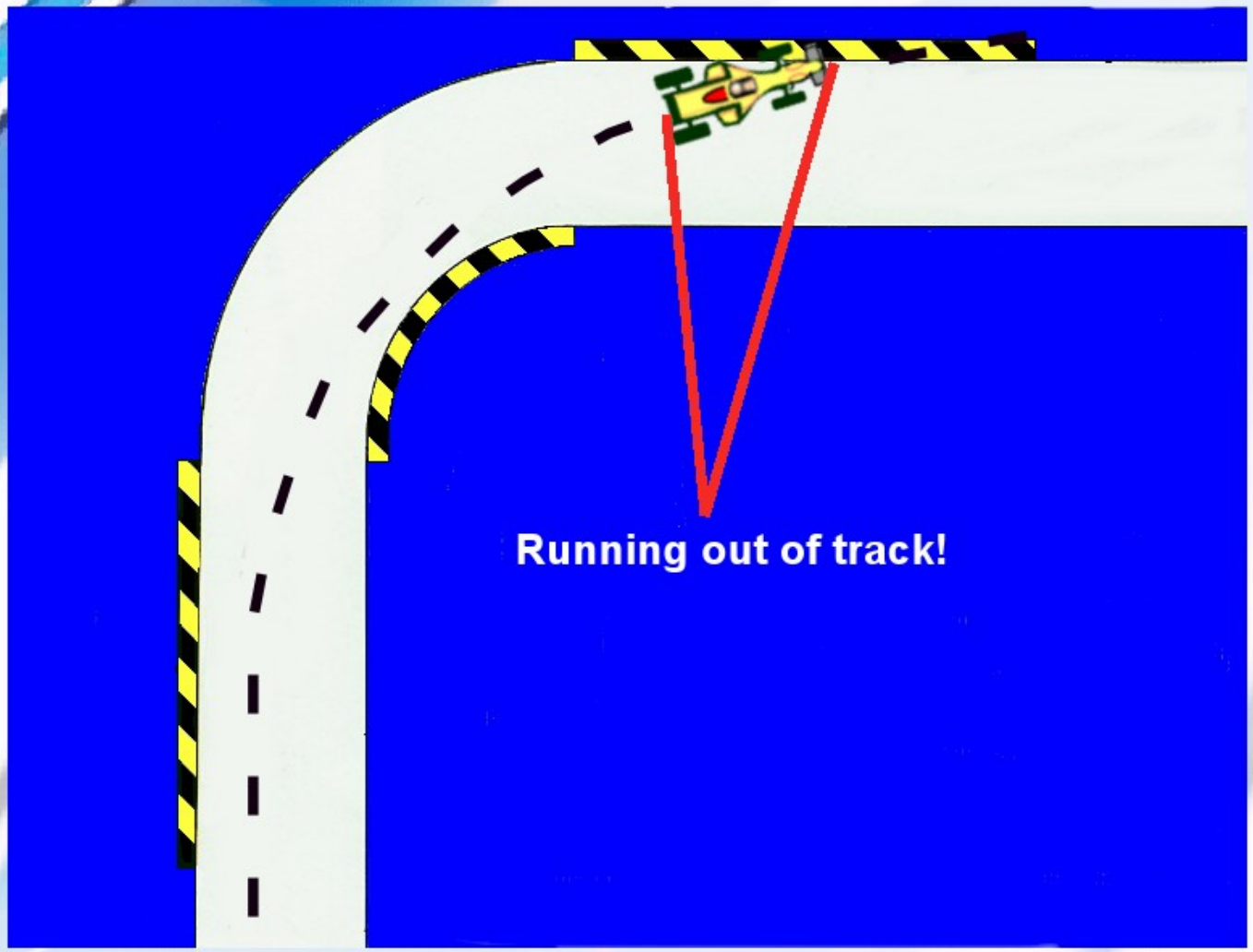

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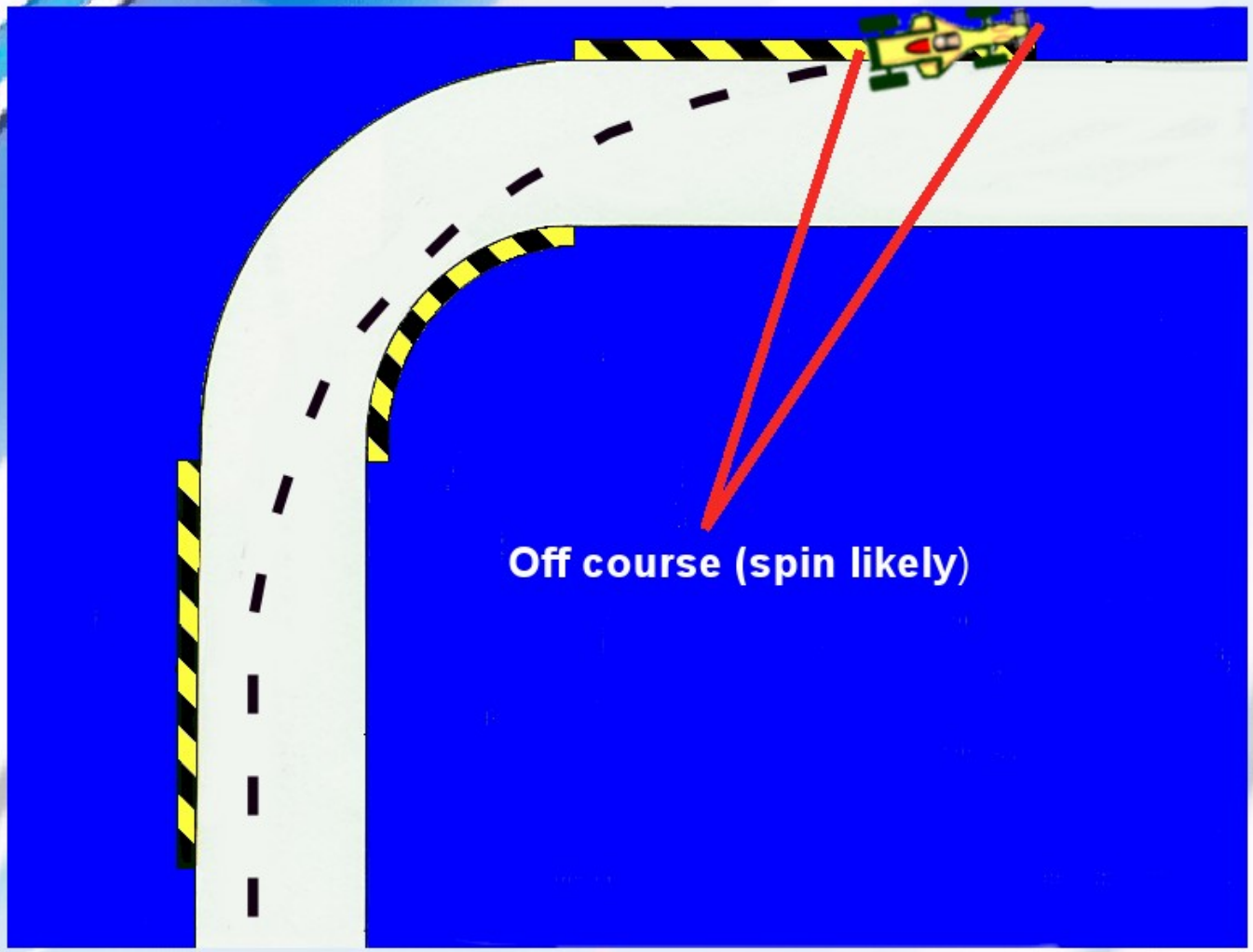
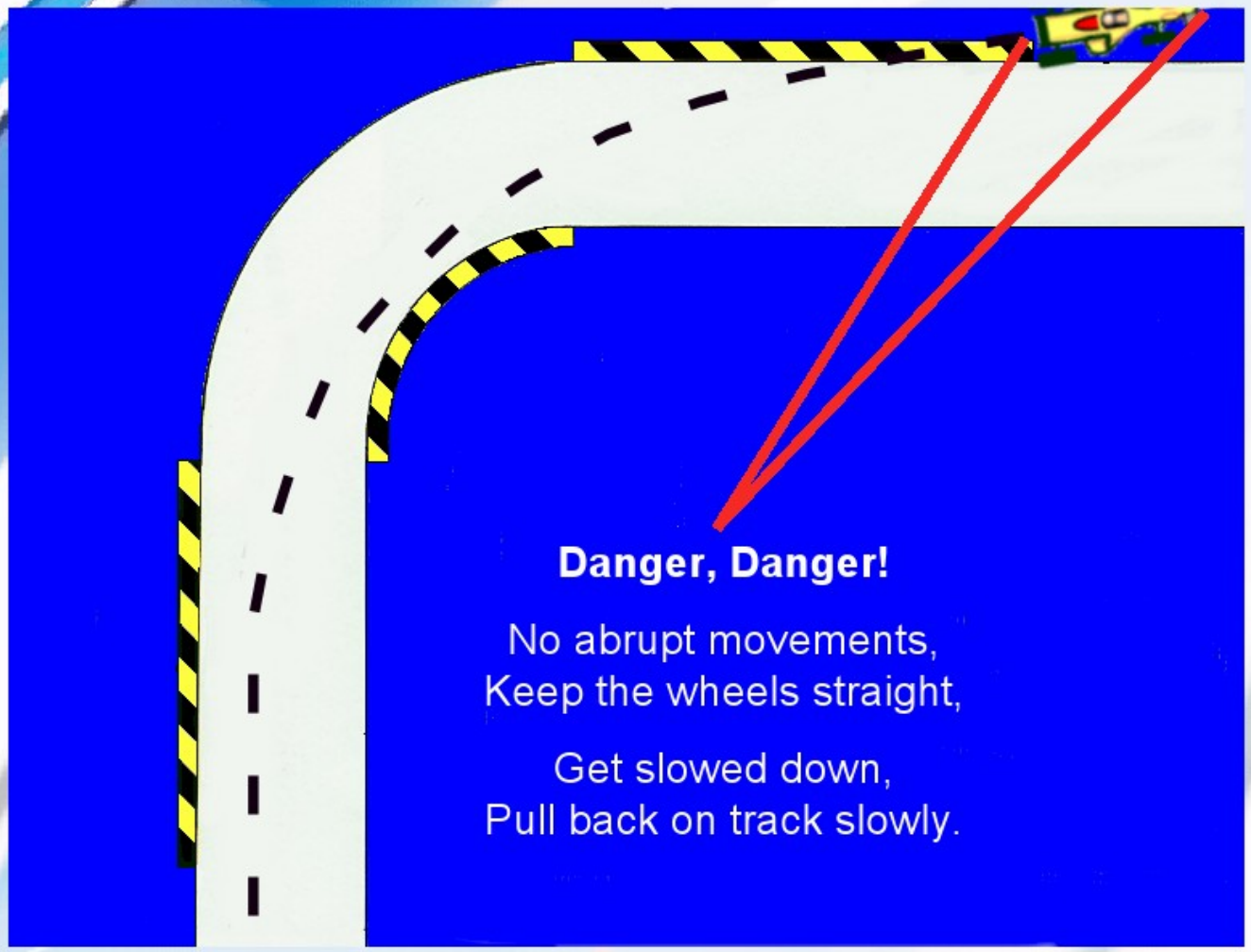
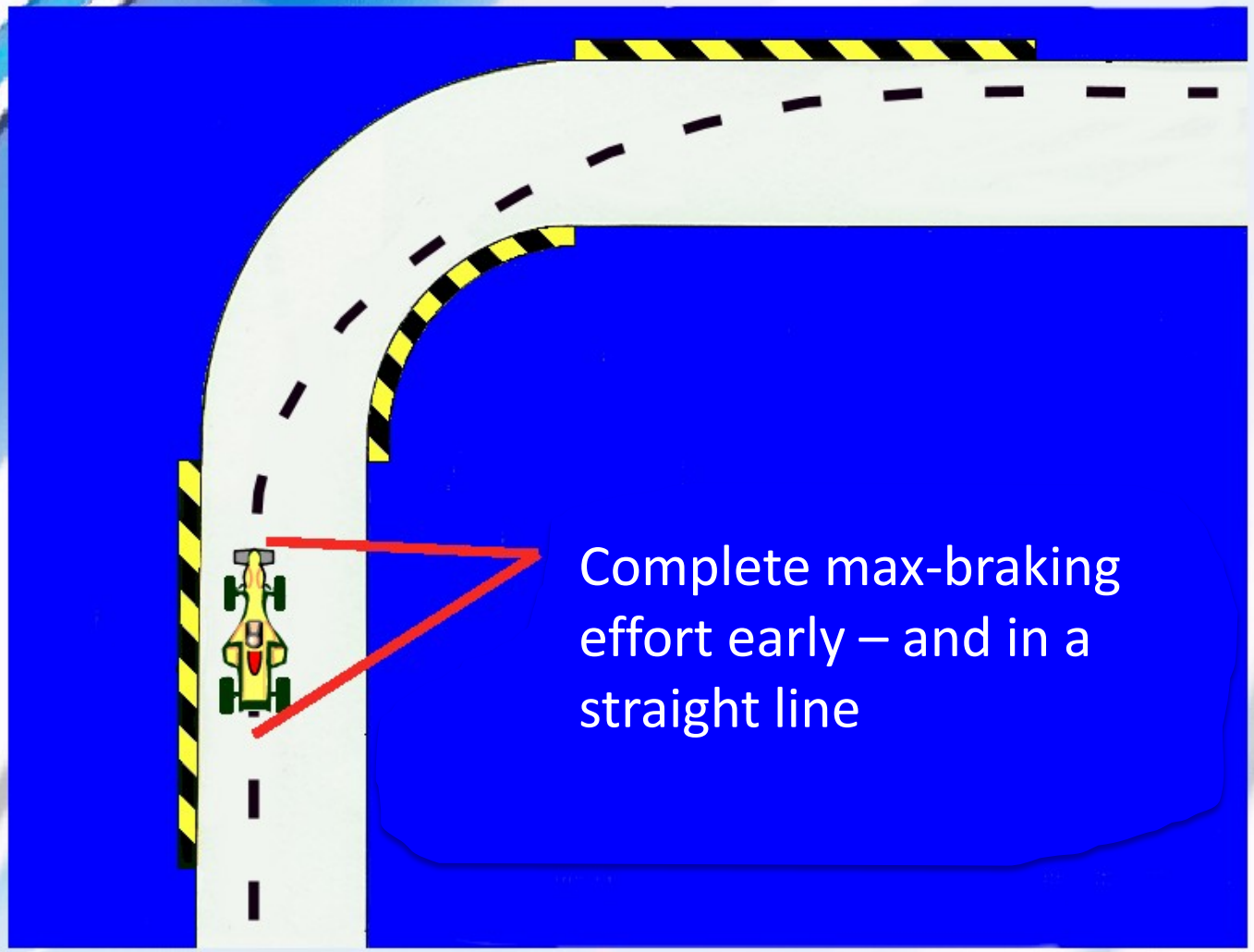


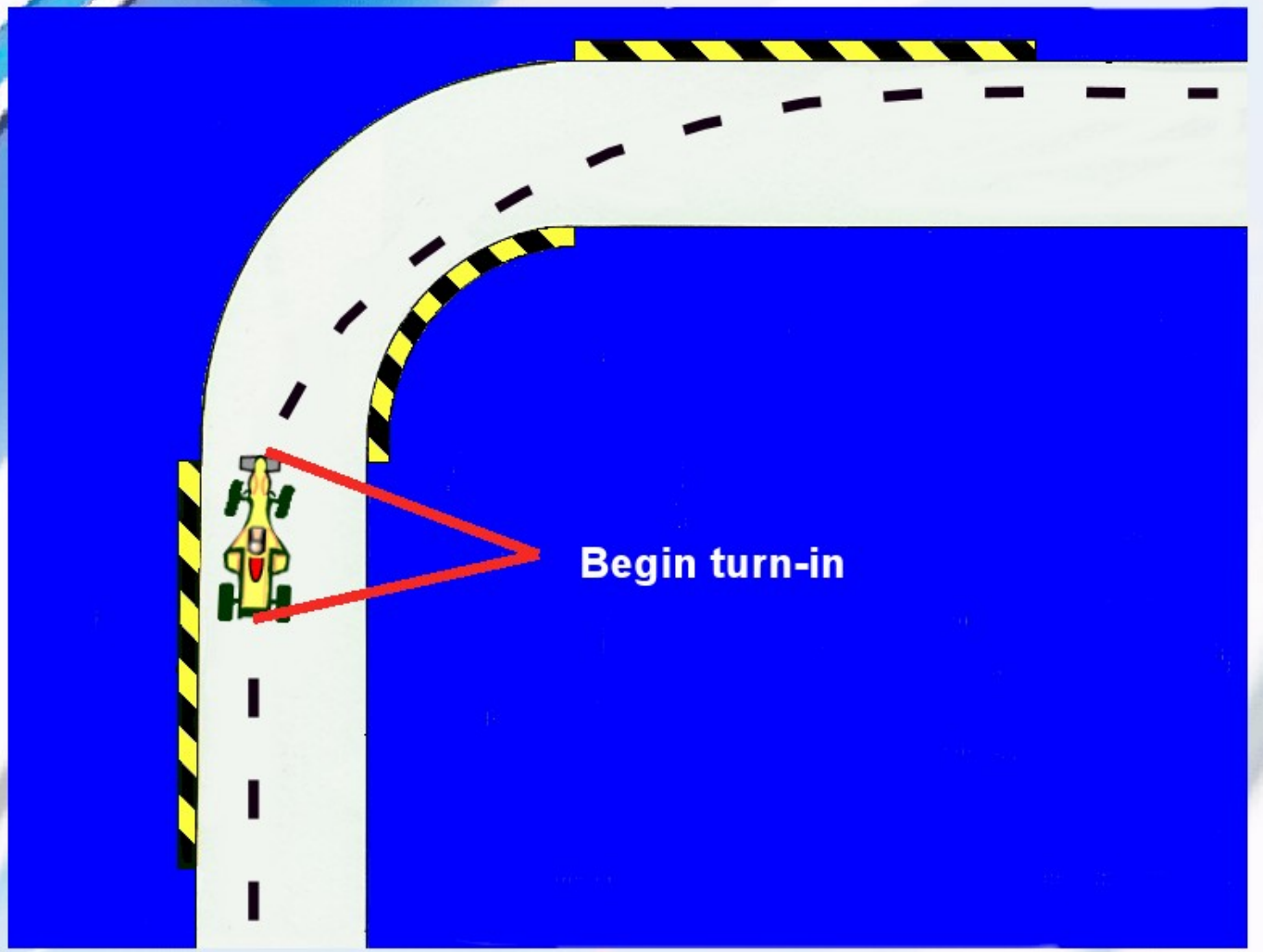
Dangers of an Early Apex



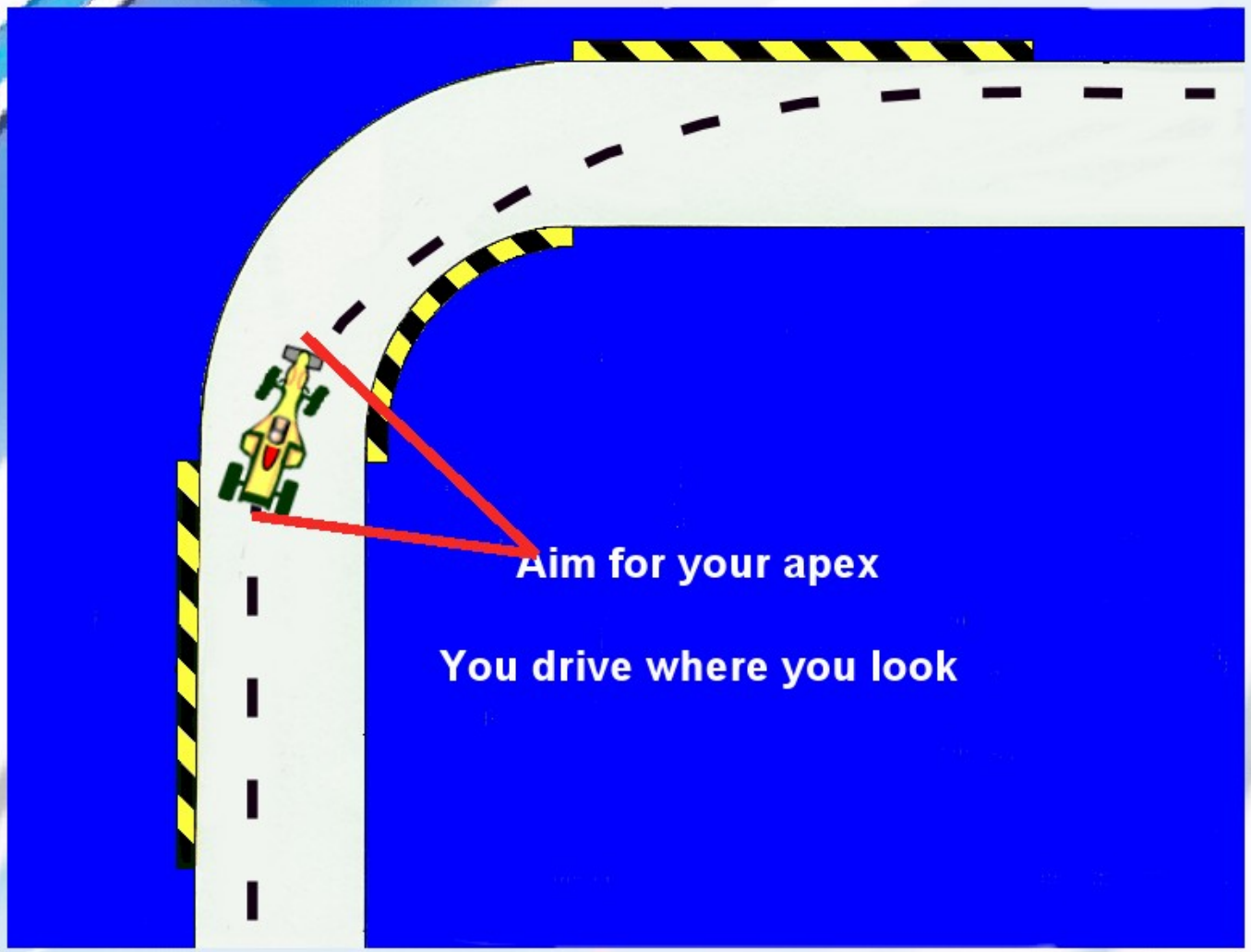
Benefits of a Late Apex



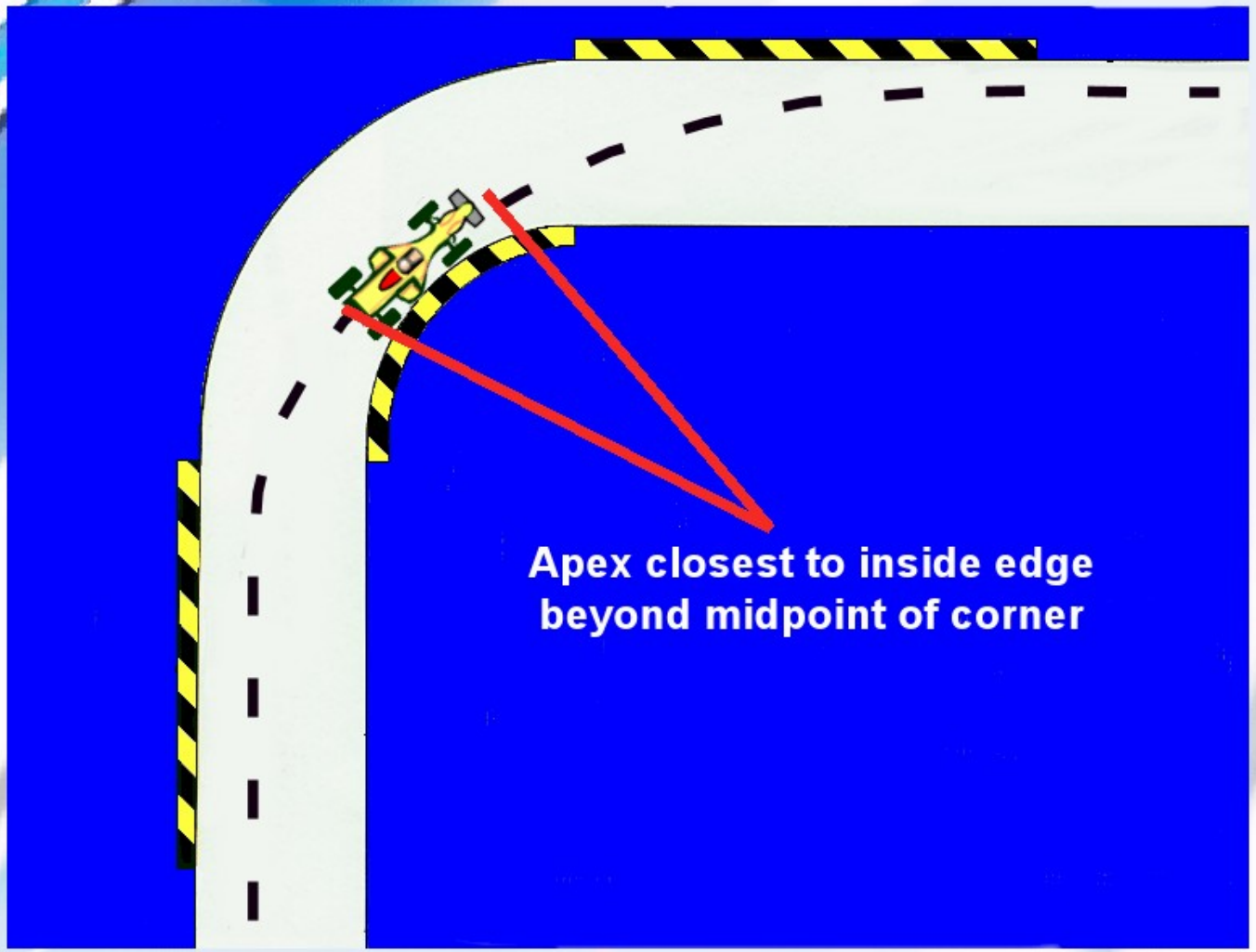
Benefits of a Late Apex



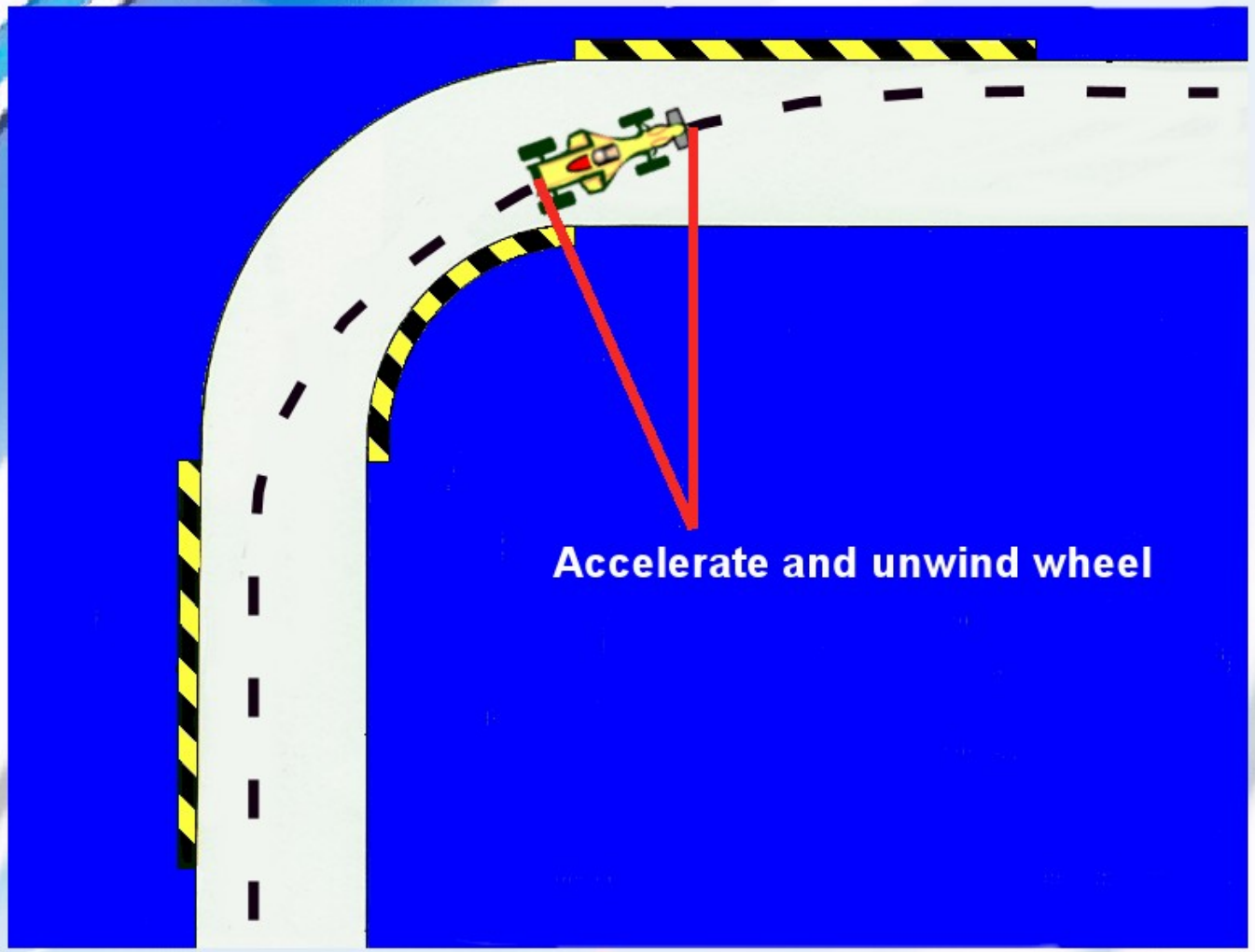
Benefits of a Late Apex



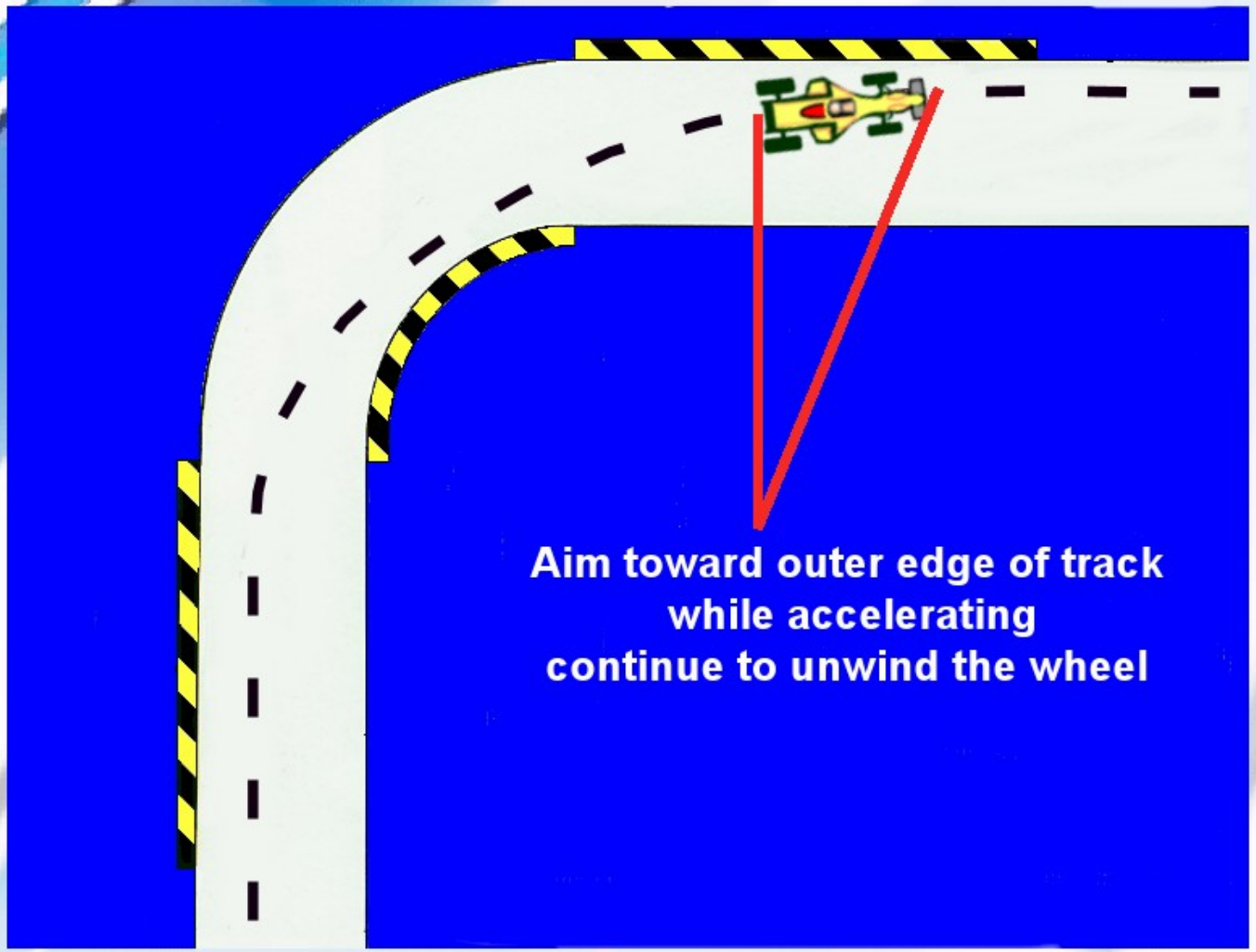
Benefits of a Late Apex



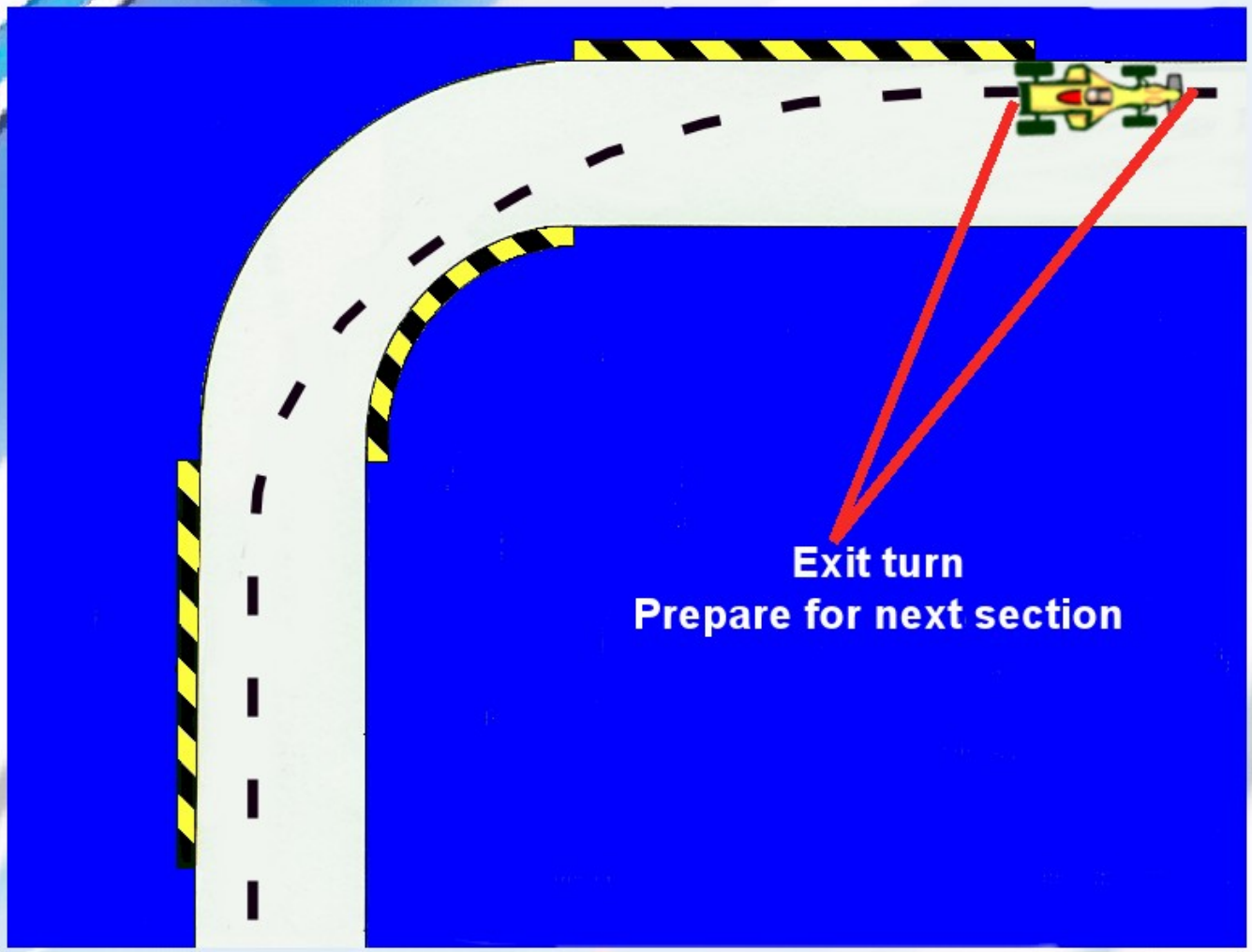
Benefits of a Late Apex



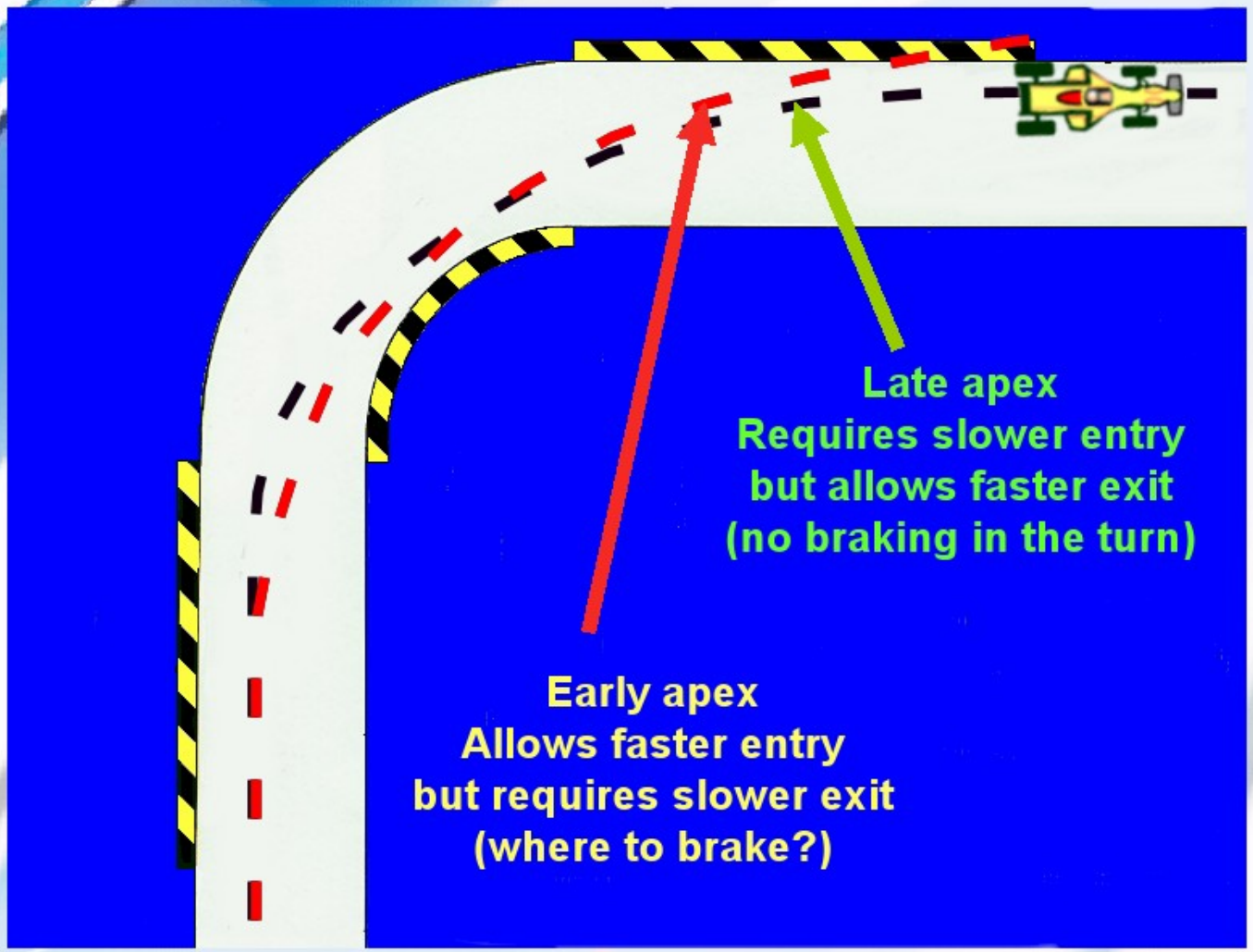
Benefits of a Late Apex



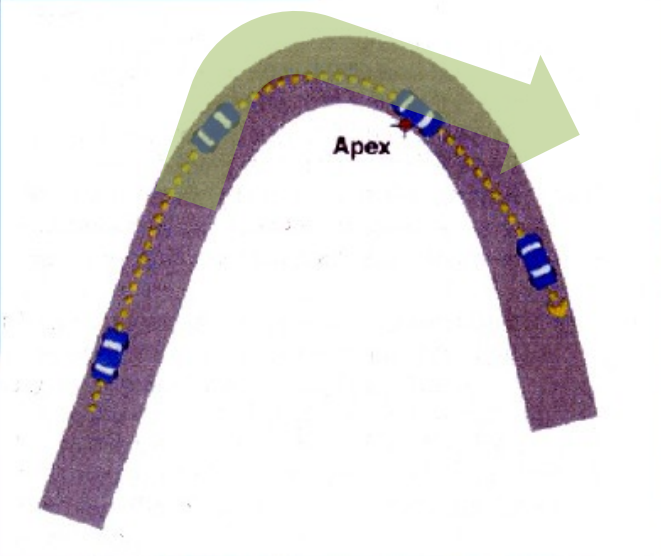
Benefits of a Late Apex



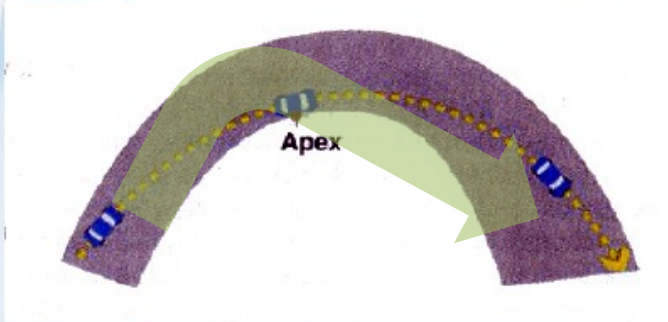
Early vs Late Apex



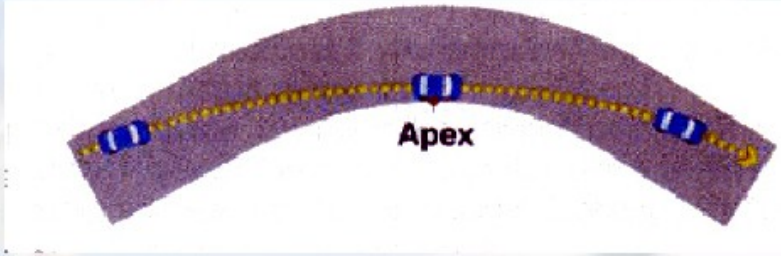
Apex – Typical corner styles



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)
  - 1st Lap: Take a very *early apex* on every corner
  - 2nd Lap: Take a very *late apex* on every corner
  - Keep pace at around 70% normal pace
  - Focus on *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?

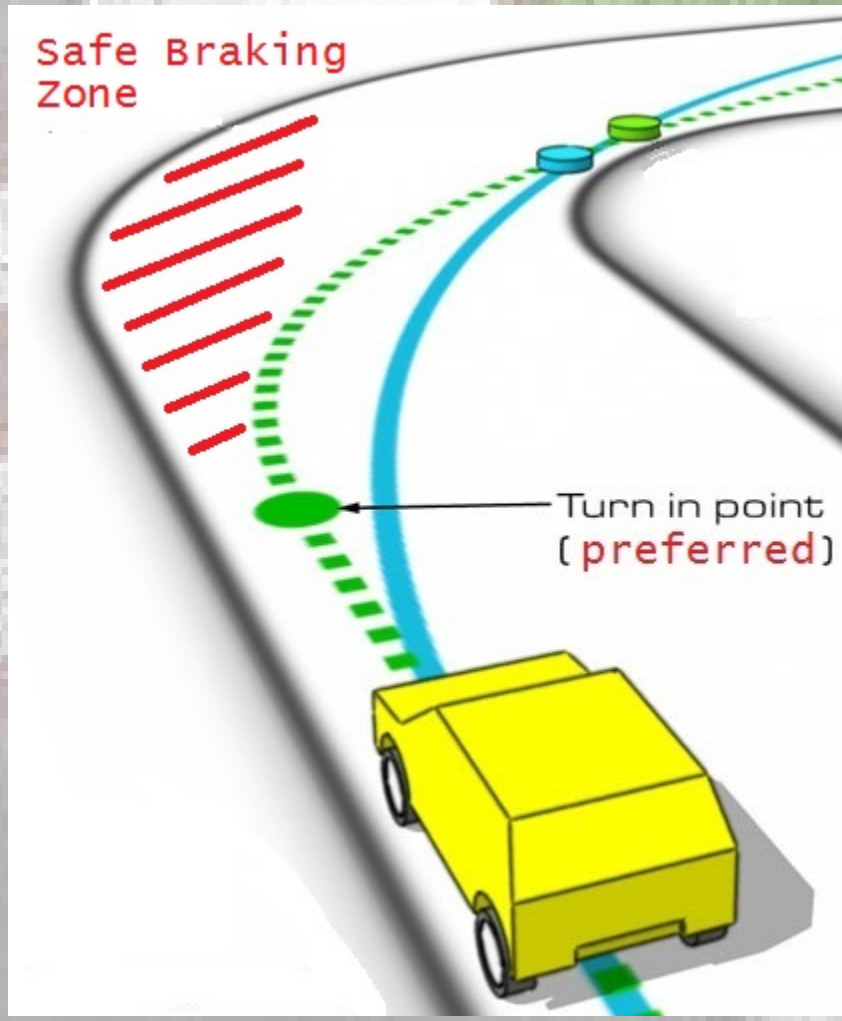
Trouble Scenarios – *We're Going In Hot!*

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 *up* & look *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!

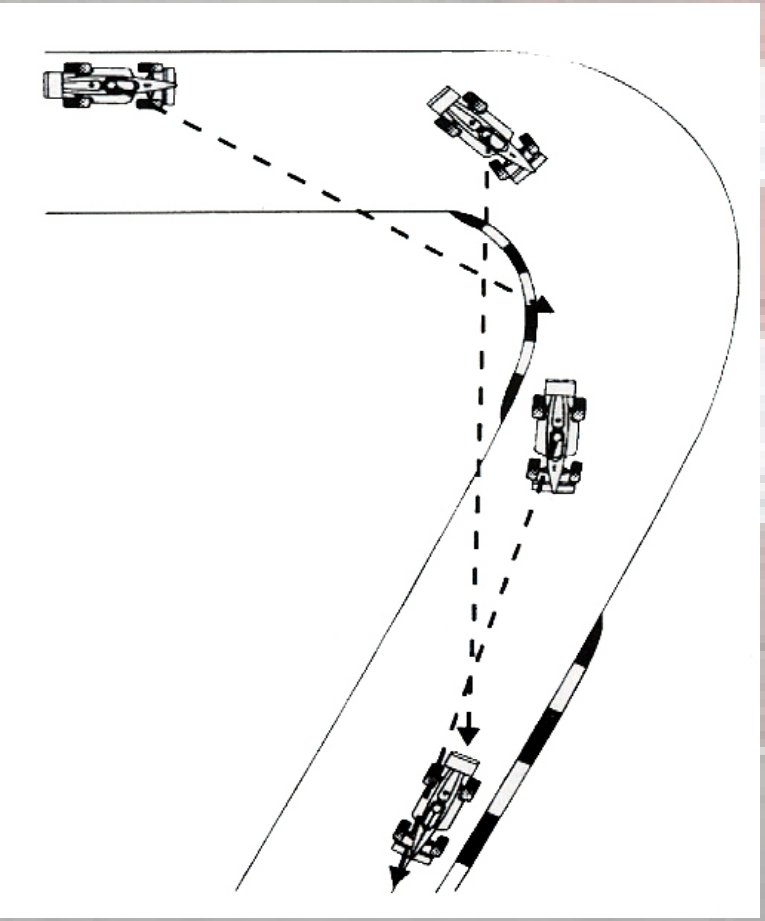
The Focus of Vision

- 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**
- **Down Track**
  - (and flag stand)

KEEP YOUR *MIND* AHEAD

3-Points Define an Arc

Point #1:

Where you are **Right Now**

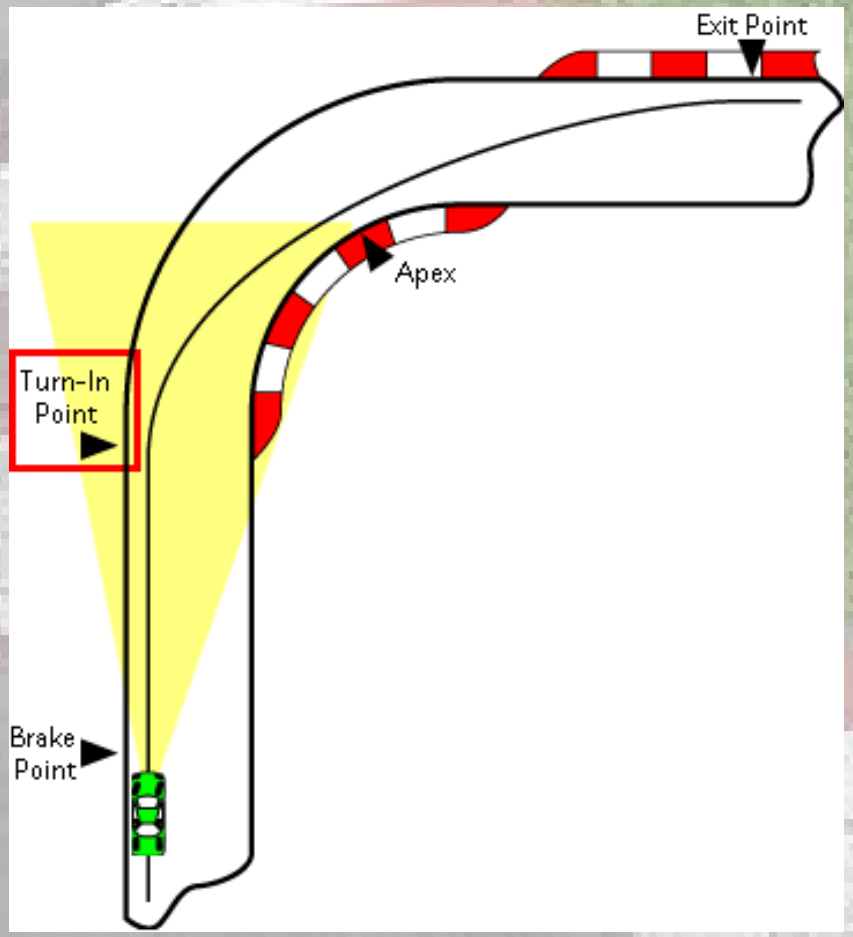
Point #2:

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

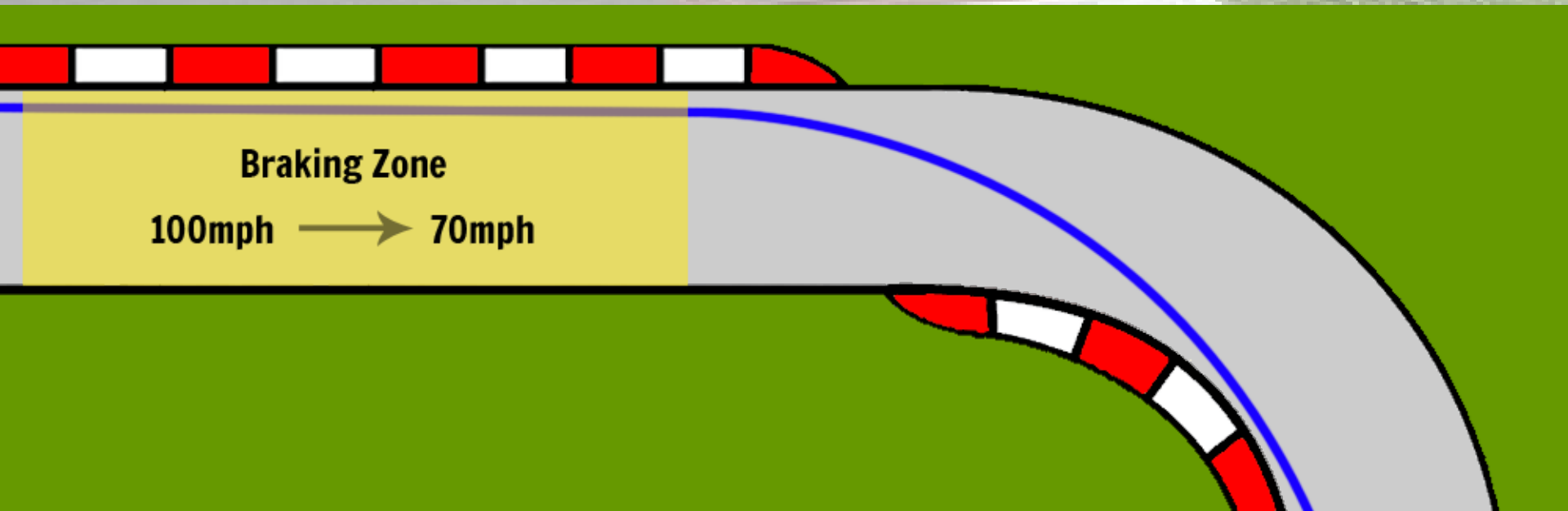
- Classroom 1 – Braking & Turn-In Target Speed
- Classroom 2 – Weight Transfer, Understeer & Oversteer
- Classroom 3 – Using Track Time, Car Modifications

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

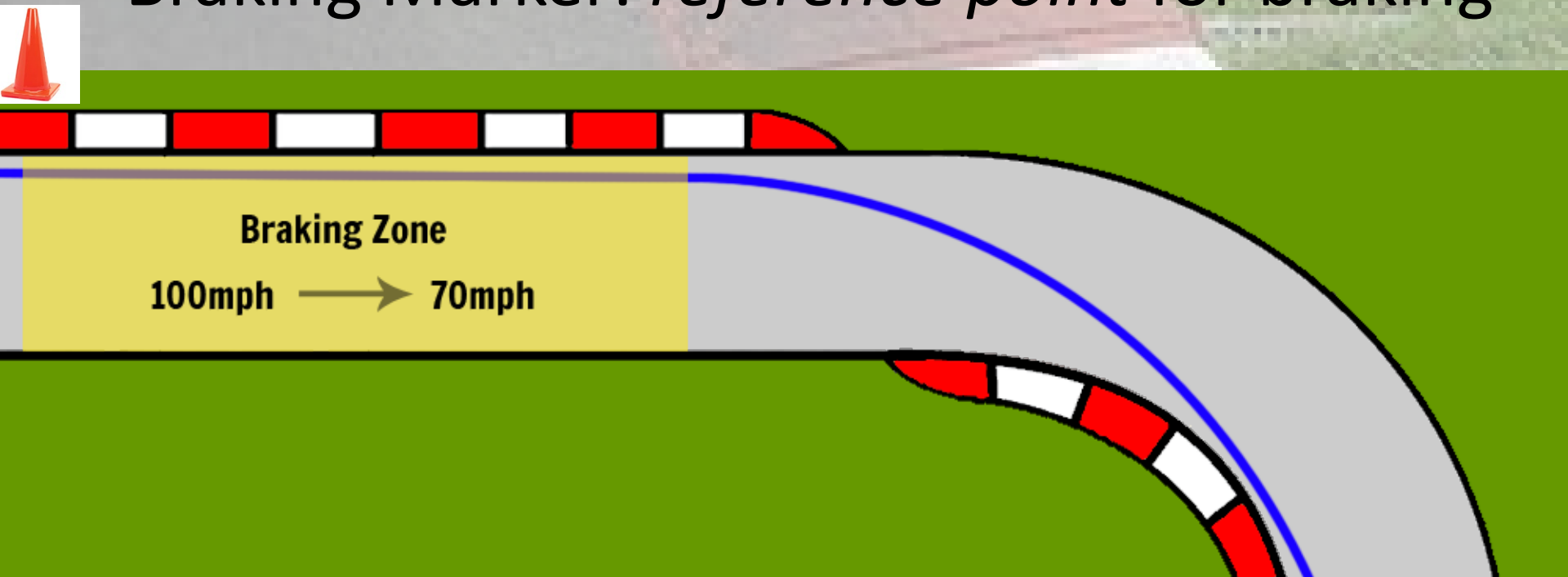
The Braking Zone

- 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



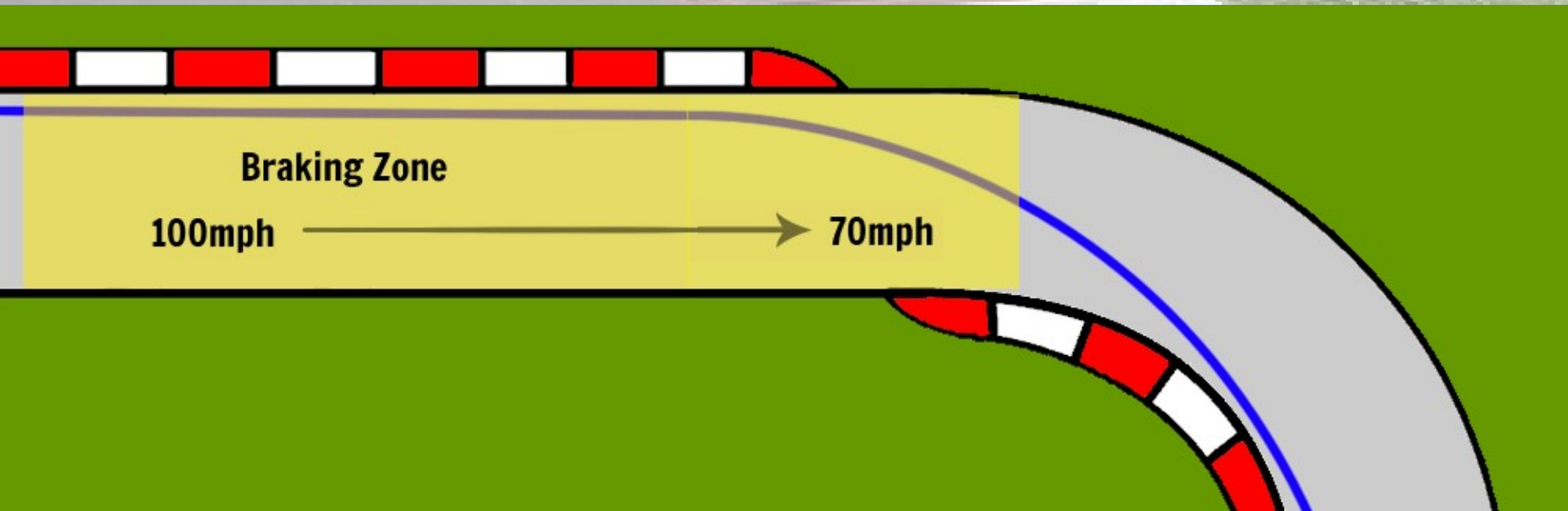
BoB: The Beginning of Braking

- 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")



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

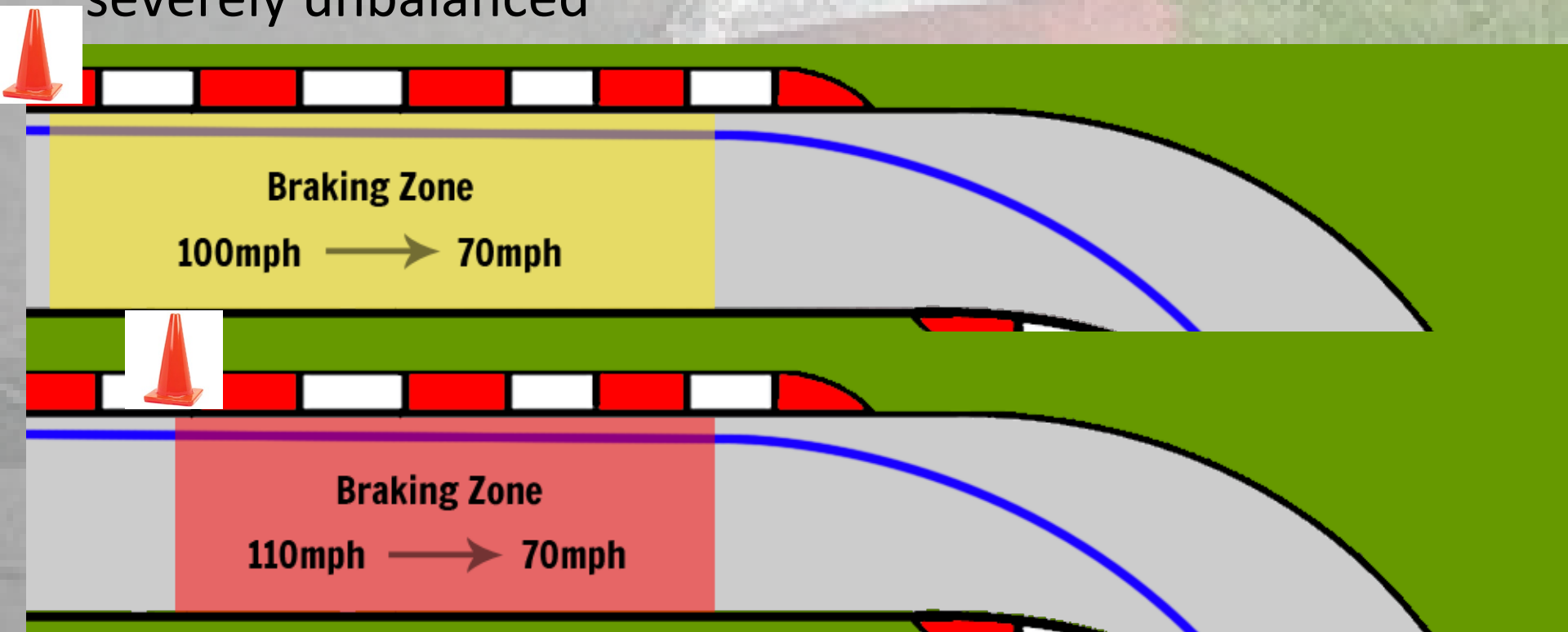
Q: How do you know this is achieved?

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…*shhhh*…
  - 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

SUNDAY CLASSROOM SESSION 2

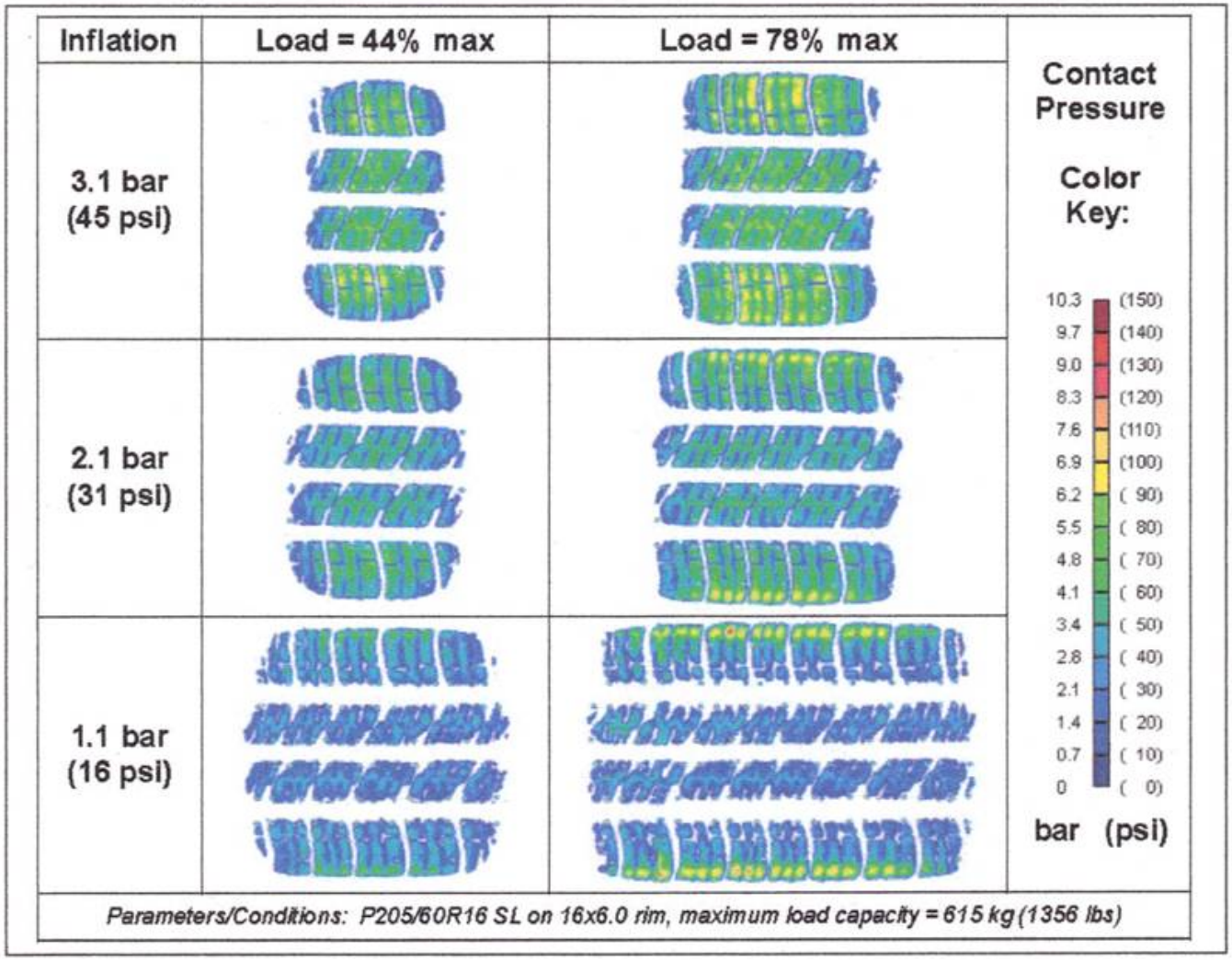
Track Session Download

WHAT WERE YOU LOOKING AT ON TRACK?

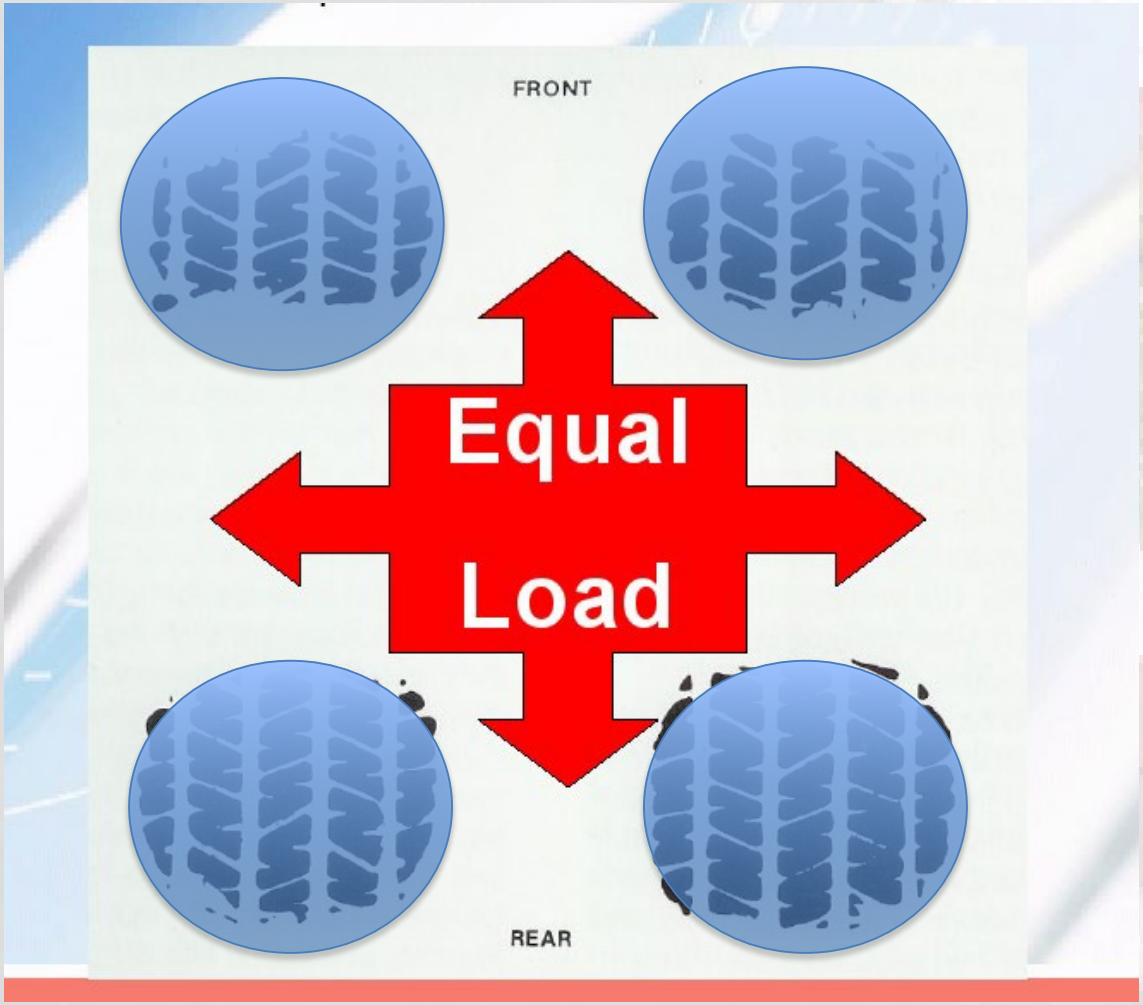
Instructional Attitude, Knows Problem Procedures

LOAD & TIRE CONTACT PATCH

Figure 15.4: Flat surface contact conditions of a passenger tire

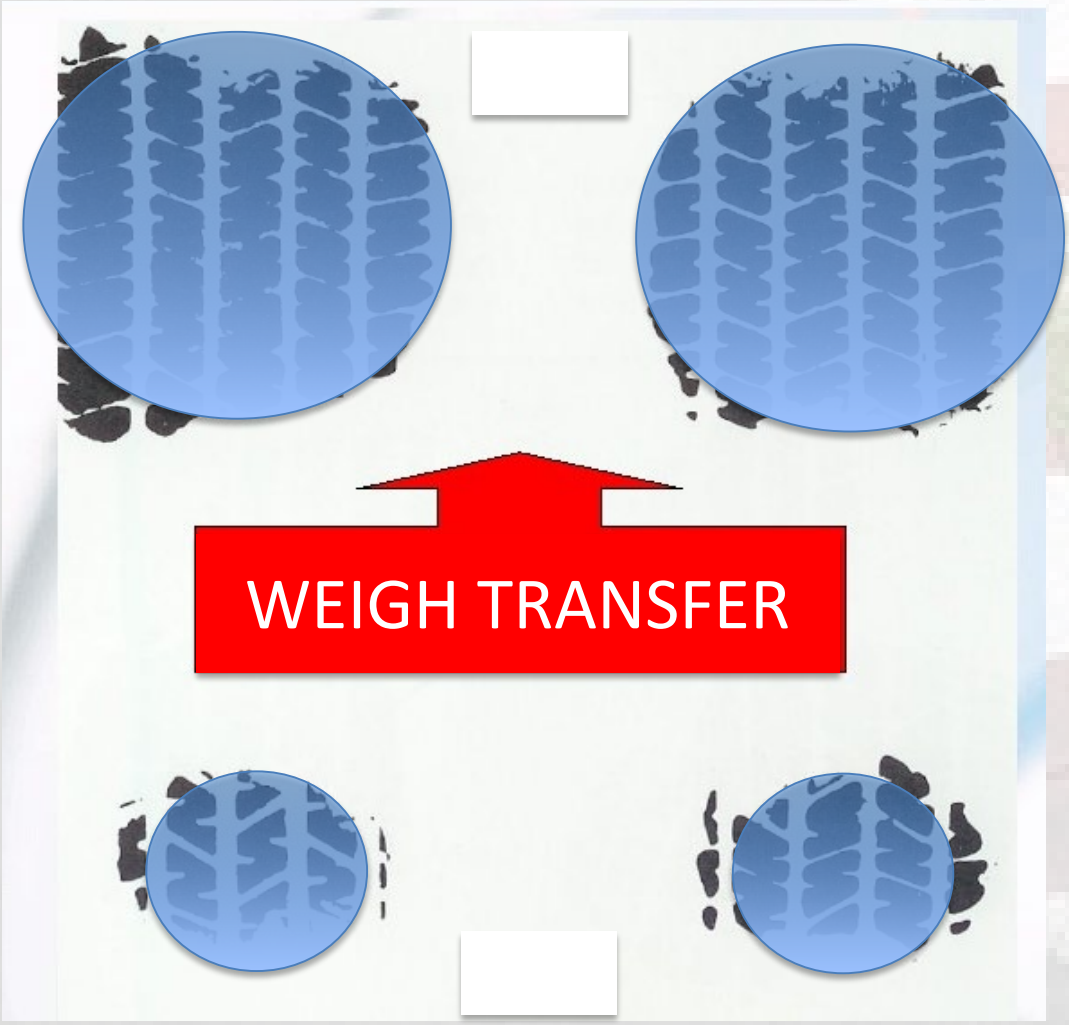


HPDE 1

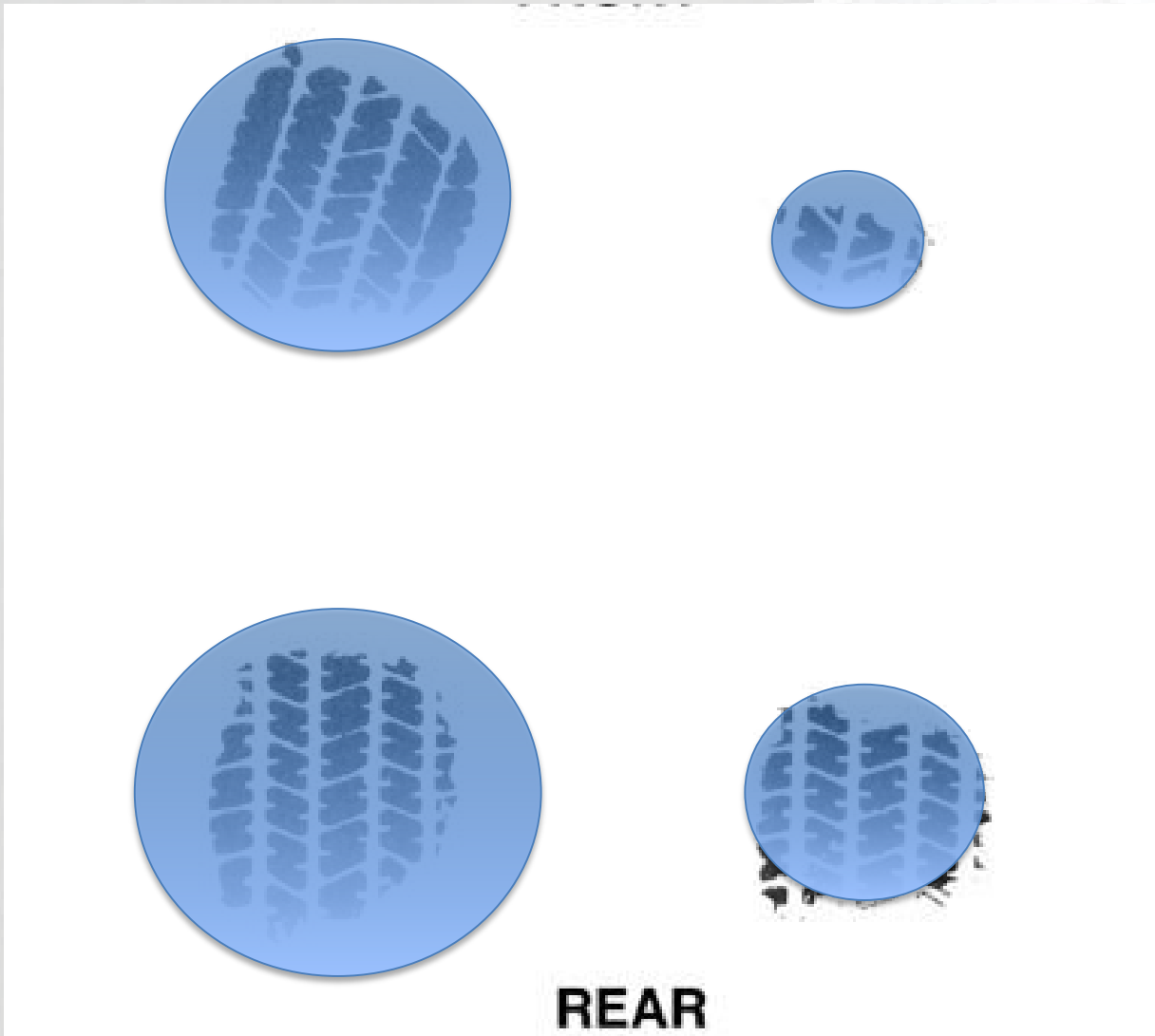


HPDE 1

HPDE 1

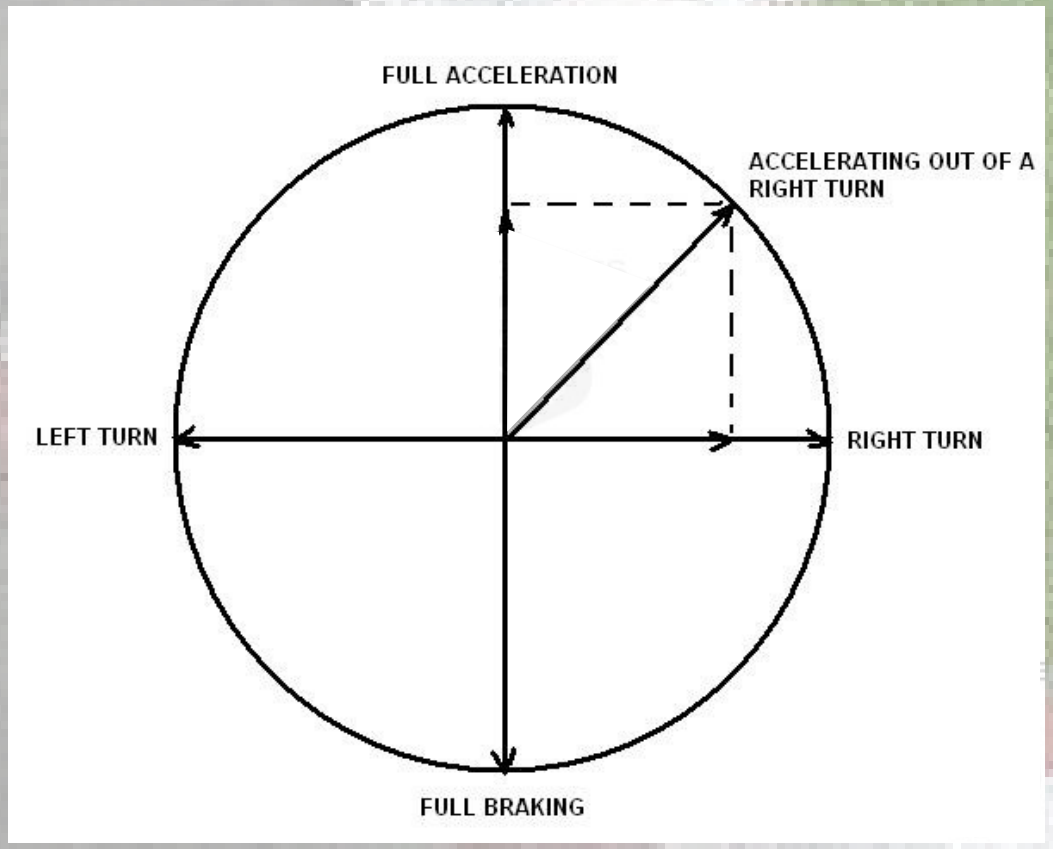


WEIGHT TRANSFER WHILE TURNING



Theoretical Traction Circle

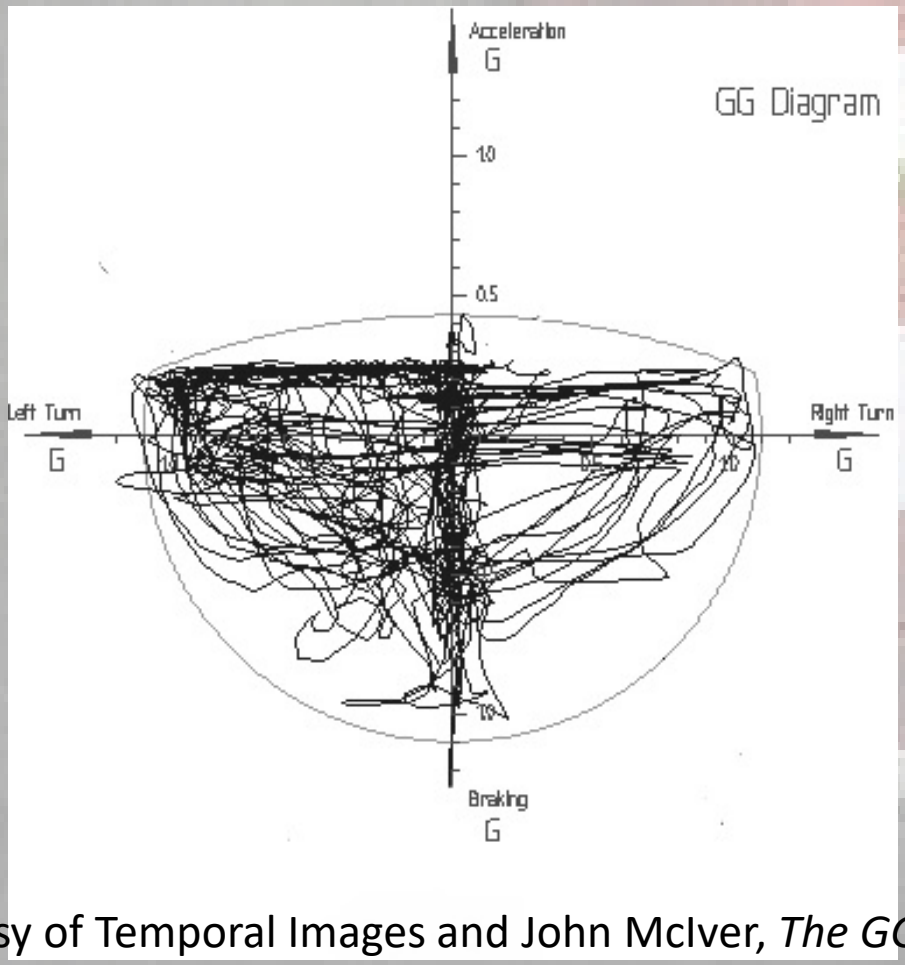
- For a given load on a tire, there is only so much grip it can give
- You can use that grip to Accelerate, Brake, or Corner
- Spending Your Grip Budget Wisely – spend on one area, leaves less to spend on another



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

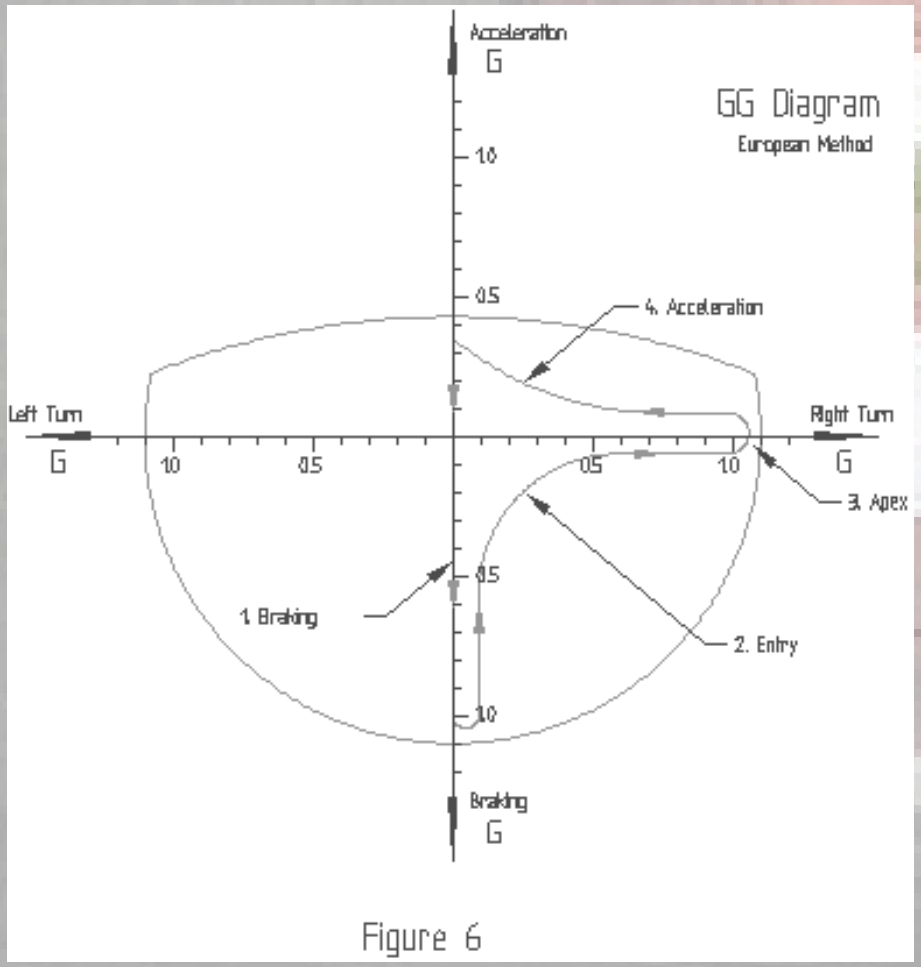


Figure 6

Traction Circle: *very* advanced

- Blended accelerations record *maximum* tire use

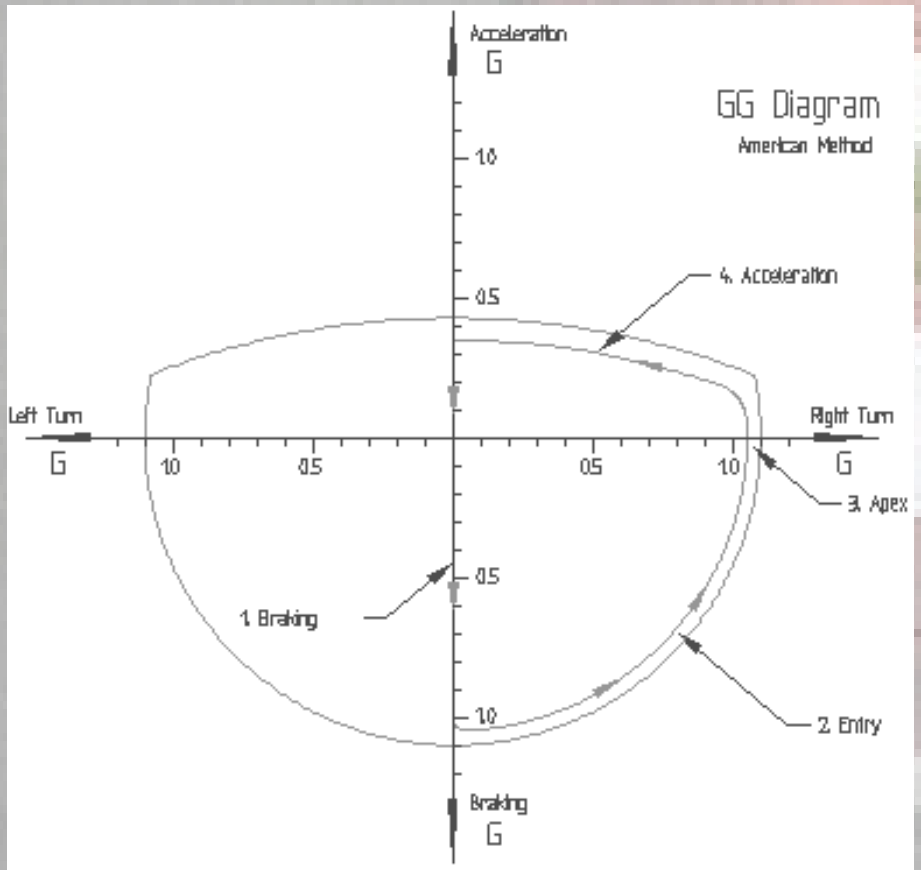
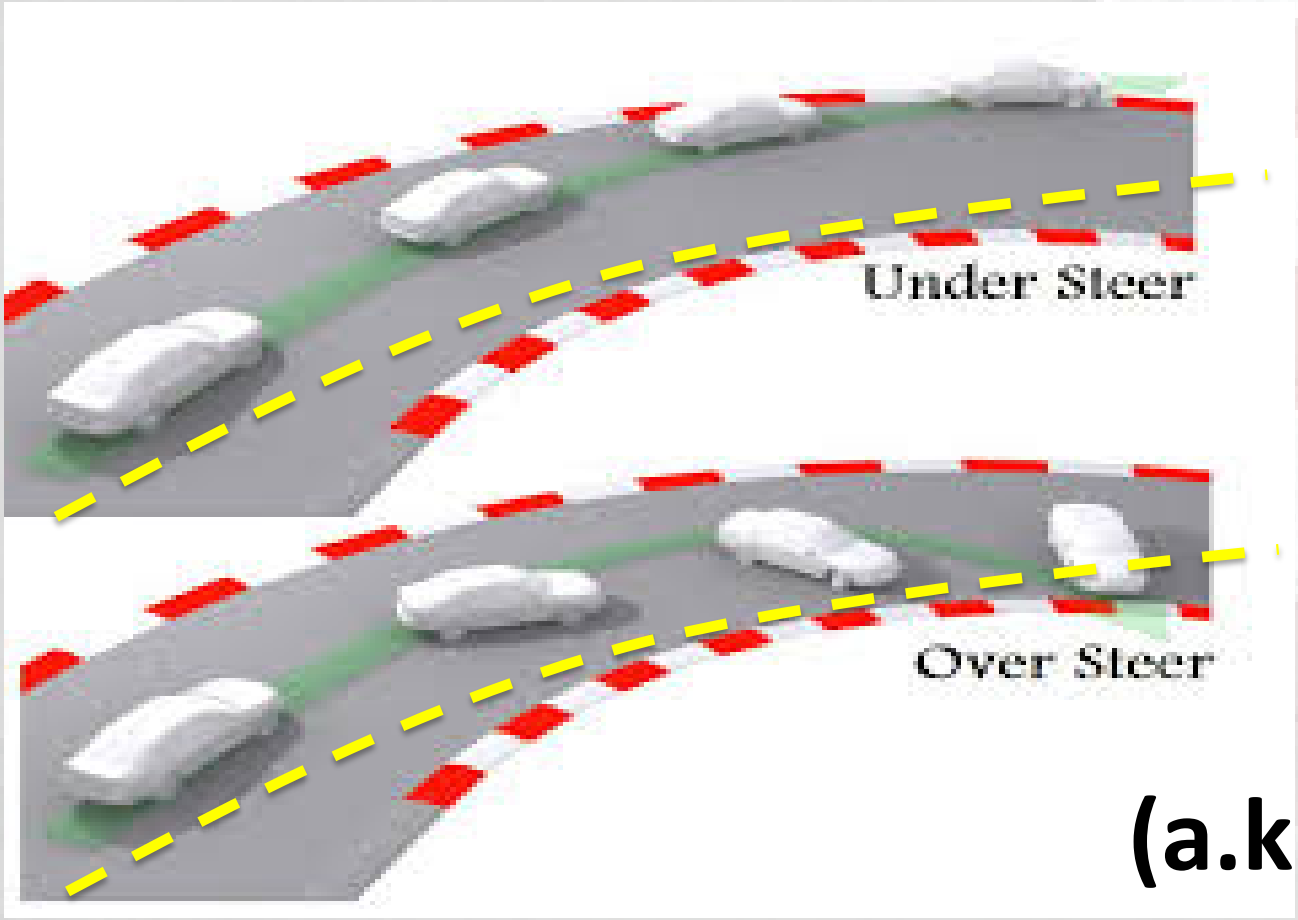


Figure 7

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-taxed 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

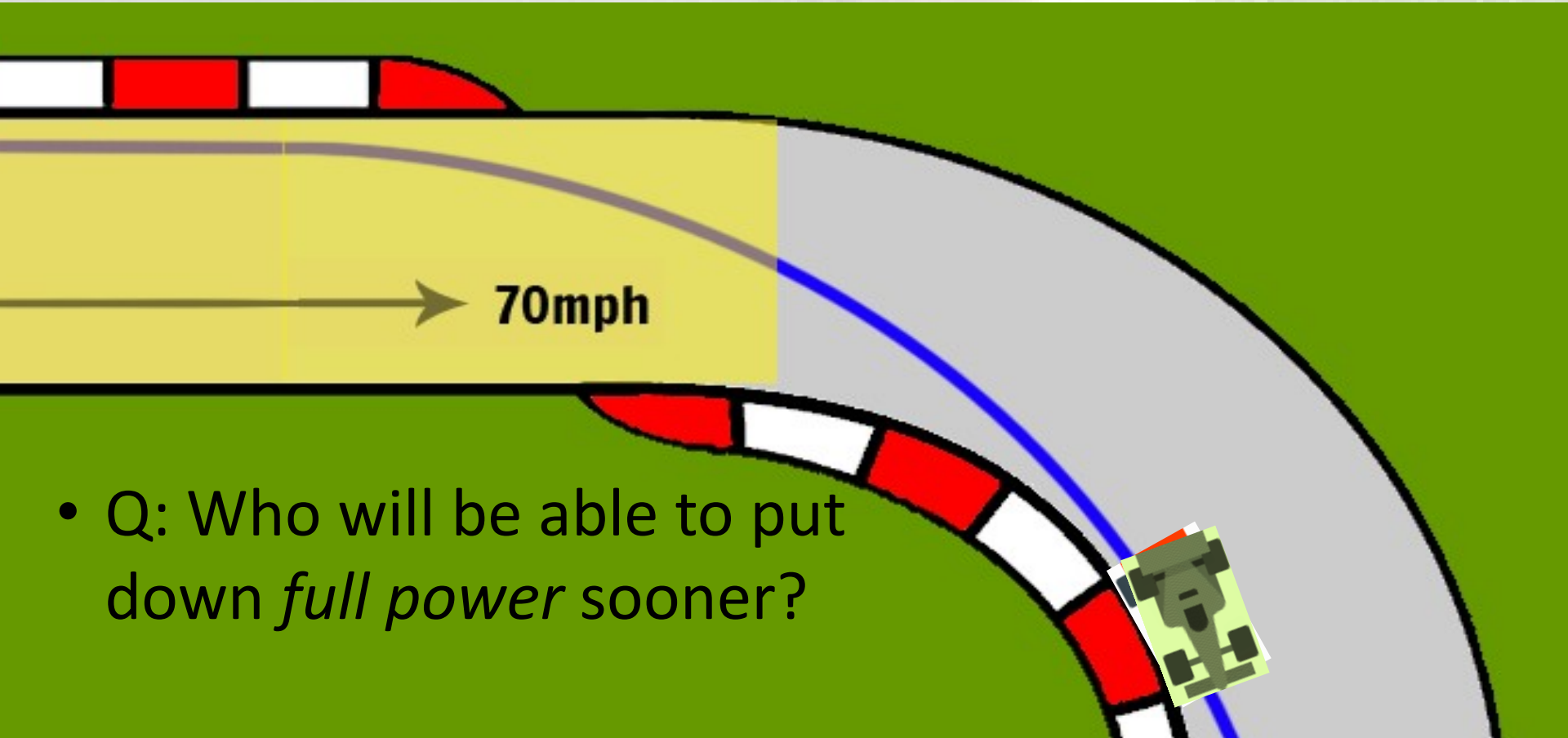
PLANTING SEEDS:

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…

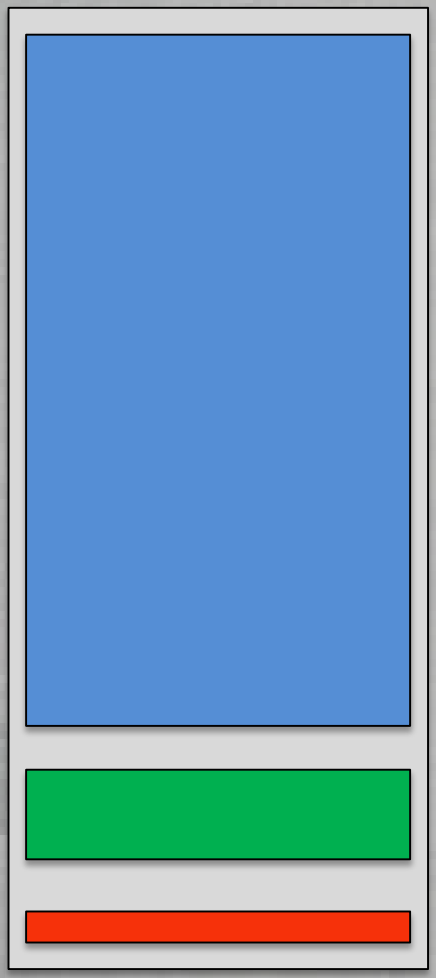
TIGHTEN THE NUT BEHIND THE WHEEL

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!

SPEED SECRETS
SpeedSecrets.com

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!