

Porsche Club of America
San Diego Region

Performance Driving School
Driver's Handbook 2002



Art contributions
Scott Carey
Cecelia Knauf
Mike Mulligan

Introduction

Welcome to the Performance Driving School with the San Diego Region of the Porsche Club of America! Just as your Porsche represents excellence, our club strives toward excellence in all its activities. One of the most popular activities is performance driving, whether at an autocross, time trial, performance driving school or driver's education event. If you come to the event with an open mind, a good attitude and a small ego, you will have more fun and learn more about yourself and your Porsche than you ever thought possible. In addition to the wonderful time, the skills you learn could save your life and others. Be assured that you will not be asked, nor expected, to drive any faster than you feel comfortable. We want you to have fun and come back. Remember, an excellent driver uses his superior skills and talents to avoid situations that require them. All of our instructors are looking forward to helping you and your Porsche along the road to excellence. We always stress that safety is first and foremost. Without safety, we can't have fun.

Becoming good at performance driving requires nothing more than education and practice. This manual is a guide for starting your education in getting the most from your Porsche. In this guide you will find a wealth of information on driving techniques, vehicle basics, and an outline of our driving school exercises. At the back of the book I have reprinted a series of articles written by John Hajny, from the Central New York Region. He provides a valuable perspective. A different look can make a new idea easier to understand. The practice part is up to you. No matter how many events that you attend, you will benefit most for a willing-to-learn attitude and an open mind.

We are a club of volunteers. Our driving instructors are the most devoted group of enthusiasts you could find anywhere. Although each can help you build a solid foundation for your driving, there are many different styles. No matter what the skill level of your driving, you can often benefit from another perspective. Feel free to experiment with new ideas, try things out, reason what ought to work and be open-minded. Don't forget that there are many others in the club who can help: an instructor does not necessarily need to be a better driver to offer some valuable insights.

Here's wishing you a lifetime of learning, growing, and grins driving your Porsche! Who knows, someday you could be a Driving Instructor too.

Vince Knauf
Zone 8 Chief Driving Instructor
October 2001

Contents

Chapter

	Introduction	page 2
1	About PCA (read me first)	page 4
2	Preparation	page 7
3	Car Control	page 10
4	Watch Where You Are Going	page 13
5	Driving Basics	page 14
6	Talk Your Way Around the Track	page 22
7	School Exercises	page 23
8	Beyond the Basics (read me much later)	page 36

Appendices

A	Further Reading	page 46
B	Handling Adjustment Chart	page 47
C	Monitoring Your Learning	page 48
D	Wisdom from John Hajny	page 50

Chapter 1: About PCA

This chapter of the handbook is first for a reason. We want you to read it first. Although you may become hooked on driving your Porsche at autocrosses, you need to know that PCA offers many other ways to have fun with your car.

The Porsche Club of America is a national organization of more than 50,000 Porsche owners dedicated to the enjoyment and improvement of their cars. PCA was founded in the Washington, DC area in 1955, with new regions soon forming across the nation. The San Diego Region was the first on the West Coast and was chartered in 1957. Within our region of 1350+ members you will find a tremendous wealth of Porsche knowledge, enthusiasm, and camaraderie. Every month our region offers several events, many geared toward families. There is something for everyone. Check out these great events soon:

Rallies: require teams (driver and navigator) to follow a course of instructions to arrive at a designated location at a proper time.

Tours: day (or longer) trips such as wine, photo, poker & other tours, ski trips, etc. There is usually a beautiful group of Porsches driving on some really fun back roads with a fun destination!

Wash & Shine: show events where you can show off your car. Only the exterior and interior are judged for cleanliness.

Street Concours: the next concours step above wash & shine, where everything is judged except the underside of the car.

Full Concours: judges every part of the car for cleanliness and originality (including the underside). The three concours/show events are often held concurrently. They are fun to enter or attend, with many beautiful and unique Porsches on display.

Tech Sessions: meetings set up at local shops to help members learn more about the systems and components of their cars, as well as how to maintain and repair them.

Social events: brunches, parties, formal dinners, tours, etc. are loads of fun, and perhaps not quite so focused on our Porsches. Here you will meet a great group of people who like to have fun, entertainment, discussion, good food, and good laughs! Owning a Porsche is the entrance exam that lets you get to meet the other tremendous folks in the club.

Goodie Store: sells books, boutique items, clothing, accessories, gift items, pins, decals, and other fun Porsche related items.

PCASD Driving School: are held once or twice a year and are special non-competitive events. These 3-day events include a classroom session, car control exercises, and an instructional autocross. Although the focus is for drivers without a lot of track experience, there is something for all skill levels. A lot of learning for the money!

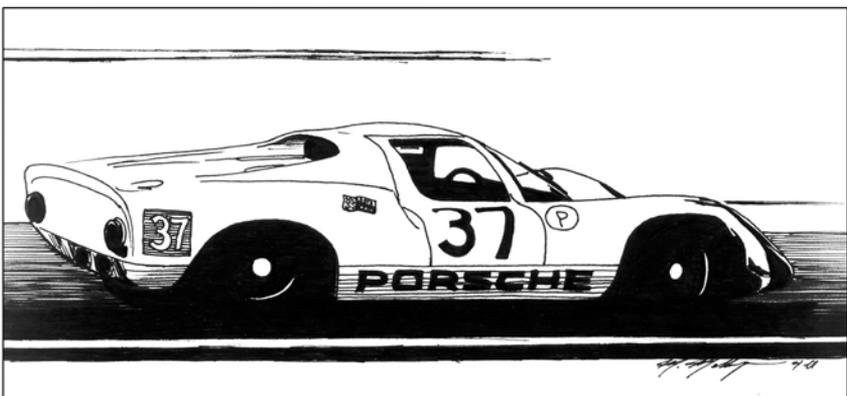
Autocrosses: single lap moderate speed competitive driving events emphasizing handling, driving skill, and education. Cars are separated and no passing allowed. Instruction is provided at every event.

Time Trials: the next step up from autocrossing in the driver training program. These higher speed, timed events require a special permit and instruction. They feature continuous laps with restricted passing on a parking lot course or race track.

Driver's Ed (DE): these events are similar to time trialing with no timing.

Club Racing: PCA nationally sanctioned events with wheel to wheel racing for qualified drivers with specifically prepared cars.

PCA national is divided into 12 zones and 140+ regions. The San Diego Region is in Zone 8, which coordinates zone-wide series in autocross, time trials, con-



Porsche 910 Sebring 1967.
4th overall, 2nd in class behind another 910.
Driven by Hans Herrmann/Jo Siffert

cours and rallies. Each year PCA holds a national convention called the Porsche Parade. This week-long series of events, banquets and parties is held in different cities each year. Thousands of Porsche lovers come from all over the world.

Club members receive two award-winning monthly magazines; *Porsche Panorama*, the PCA national publication, and *The Windblown Witness*, San Diego Regions local newsletter. Many Witness advertisers offer member discounts and contribute to the support of our club in various ways.

Since this is a club of volunteers, there are many opportunities for you to expand your fun by helping at events, writing articles and taking photographs for the Witness or organizing and running events. The behind the scenes folks are no different from you - regular people that share a love for Porsche fun. So come out, participate in the variety of events this great club offers. Get involved, have as much fun as you can stand. We hope you'll soon discover that the magic of the Porsche marque is reflected in PCASD.



1971 overall Le Mans winner, this Martini 917K had a 5.0 liter normally aspirated engine. The factory was supporting both the Gulf and Martini teams this year. The car was driven to victory by Helmut Marco and Gijs van Lennep. The car sported a magnesium frame. Most 917s were aluminum tube frame chassis.

Chapter 2: Preparation

Before charging out there and driving our Porsches at an event, we must be prepared. First, consider the automotive preparation. At the beginning of each driving event (such as our driving school or an autocross), your Porsche will undergo a safety check. You should become familiar with these items (see the checklist at the end of this section). They need to be checked before you arrive at the event. Let your service facility know what you are planning, show them the check list and they should be able to do this for you.

Unless your track experience tells you otherwise, make sure your tire pressures are set to the values specified in the owner's manual. Consider adding up to 4 psi if your Porsche is older than 1978 (due to the higher profile tires typically used). Your fuel tank should be at least 3/4 full.

Check the interior of your car to remove loose items. Having an orange or soda can roll out from under the seat while you're busy negotiating a corner is distracting and dangerous. Empty the glove box, door pockets and trunk. Wear comfortable clothes, and closed toed shoes. Things you will want to consider bringing are: camera and film, folding chair, drinks, snacks, jacket, hat and sun-screen, and maybe a tire gauge. If rain is a threat, an umbrella and appropriate clothing could be useful. That's it! Anything more would probably just be in the way - keep it simple. Use a small bag for your personal stuff. As you gain more experience at the events, you'll tailor this list to suit your own needs.

As far as physical preparation goes, your own body should be in as good working order as your Porsche (all right, I *do* take showers more often than I wash my car!). By being in better physical shape you will drive better, be more alert, better able to concentrate, and won't tire as easily. There are many aspects, and even books, about physical conditioning for driving. The most important for us to consider is adequate rest. A good night sleep will go a long way to improve your physical and mental well-being while driving. As you gain experience with performance driving and your Porsche, you will learn that the driver is the most significant performance item. You can make all kinds of modifications to your car, but if the driver is not operating properly, the performance will suffer regardless. The point is to take care of yourself. If you want to get the most out of your Porsche and the event, take care of the most important part - you.

One more point of preparation: seating position. This is important because if we are not correctly hooked up to our Porsche, we can't do our best. First, adjust the seat front to rear so that your knees are slightly bent when you fully depress the clutch, brake or gas. Next, adjust the seat back. With your shoulders

firmly against the seat back and your elbows straight, rest your arms on top of the wheel. Your wrists about even with the top of the wheel is a good place to start. Your hands should then be moved to their normal position at 9 o'clock/3 o'clock positions on the steering wheel. You should be able to turn the wheel nearly 180 degrees while keeping your elbows slightly bent. Spend some time in your car finding the seat settings that allow you to attain this posture. These positions may not be the way you learned to drive and may take some time to get used to, but they are considered to be the best position for driving at these events and on the street. Please try it our way.



Safety / Tech Inspection Checklist:

- o Good tires, no cord or cuts showing, 2/32 minimum tread depth, no age cracking
- o Brakes properly functioning, adequate pad remaining, system recently bled
- o Fluids at proper levels (brake, coolant, power steering)
- o Fan belts and throttle return spring properly adjusted and not damaged
- o Battery securely mounted
- o No loose items in car or trunk
- o Properly functioning seat belts or harness

Preparation Checklist:

- o Fuel level 3/4 or more
- o Factory tire pressure settings (maybe a bit more)
- o Drinks and snacks (if not provided at the event)
- o Jacket, hat, and sunscreen, folding chair, camera and film
- o Remove all other items from car
- o Snell 95 helmet if you have one (some loaners available)
- o Windshield clean
- o Driver well rested

Chapter 3: Car Control

It has often been said that the best automobiles (like Porsches) are an extension of the driver. You will also notice that the best drivers are an extension of the car. This means that the communication between the driver and car goes both ways. The driver gives commands to the car, and responds to feedback from it. The more we can learn from what our car tells us, the better we will be at controlling it. Performance driving consists of two aspects, what to do (the theory of how to find *the fastest lap*) and how to do it (car control).

We discussed seating position and the importance of being properly and comfortably connected to our Porsche. We send commands to our car through the controls: steering, brakes, accelerator, clutch and gears, and we listen to our car through them.

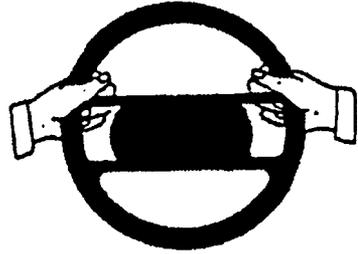


STEERING

Generally, the less you move your hands around on the wheel, the better. Moving them can introduce jerkiness, which isn't good. Most turns can be taken easily with the hands where they started at the 9 and 3 o'clock positions. In sharper turns, when the top hand travels much past the 12 o'clock position, we need to move the hands on the wheel to avoid our arms being crossed up. There are several ways to do this, but we teach just one: shuffle steering. This is done by taking successive grips with each hand, keeping each hand near their 9 and 3 o'clock positions, and then shuffling or feeding the wheel through your hands. It takes a little practice, but is smoother, and more controlled than the *hand over hand* technique. Ask your instructor if you need help deciding when to move your hands on the wheel. As you straighten the wheel out after a turn,

do not let it just slip back through your hands. Rather, feed the wheel back in the same manner you did when making the turn. Be sure to hold the steering wheel firmly enough to control it, but not a panic grip. The wheel is not there to help stabilize you in your seat. That's what the seat belt/harness is for. In addition, there is a *dead pedal* on the left side for you to brace your left foot.

Use that foot to push your butt into the seat and thus control movement of your body. This allows you to have a lighter grip on the wheel, thereby using it to control the automobile and not stabilize you in the seat.



9:00 AND 3:00 O'CLOCK
HAND POSITIONS

SHIFTING

The only time you remove a hand from the wheel is changing gears, and it goes right back onto the wheel when the shift is complete. Don't leave your hand resting on the shift lever waiting for the next shift. Shifting should be done gently and smoothly, like all other parts of performance driving. Upsetting the balance of the car is more likely to slow you down and cause you to lose control. A good exercise to ensure that you are shifting gently is to just use three fingers on the shift lever, not a full hand death grip.

SMOOTH

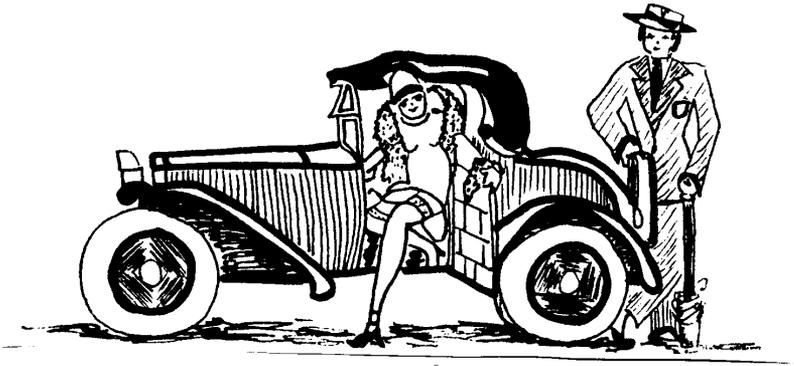
All the control signals you send should be done smoothly: smooth steering, smooth shifting and clutch use, smooth braking, and smooth acceleration. You are capable of jerking the wheel or jabbing the brakes or accelerator much faster than your Porsche can respond. Just because you are driving fast doesn't mean your input should be abrupt. Jerky movements will unsettle the car. When a car gets unsettled and swerves (or even spins), the first thought is that you were driving too fast. More likely it was the steering or pedal input that was too fast, not your speed. Your inputs don't need to be slow, just deliberate and controlled. Use the full braking and accelerating potential of your Porsche, just be smooth with it. There is a difference between mashing on the gas pedal and squeezing it on gradually as you exit a corner. That difference is smoothness, and it will reward you with better car control and faster laps.

FEEDBACK

Part of car control is sensing what your Porsche is doing and what it can do.

You will feel the motion through the seat of your pants and the steering wheel, and get sensory inputs from sights, sounds and occasionally smells. Your Porsche will tell you when it could go a bit faster and when it has reached the limit. If you look back at situations, you can usually figure out what happened and why (with an instructor's help, initially). This process cannot be easily described or taught. It must be experienced and practiced. As you drive your car more and get to know it better, you will learn the signals and recognize what they mean. It's kind of like with people. You don't get to know somebody at the first meeting. It takes time to develop a relationship and build understanding. There will be some spats (spins, etc.), but that is part of the learning process. In either case, listening is more important than giving input, and harder to do.

Remember: with everything you do, do it SMOOTHLY



Chapter 4: Watch Where You Are Going, or Ocular Driving

How many times did your mother tell you that? She was giving good advice. Look where you want your car to go. You do this by looking at the spot where you will make the next control input. For example, while driving on a straight, the next input might be getting on the brakes to prepare for the turn at the end of the straight. So, while driving down the straight, you find that spot and look at it. As you approach that spot, you don't have to look at it directly to know where to apply the brakes. You WILL get to that spot. You WILL brake at that spot. Before you get to that spot you shift your vision, looking for the turn-in point. Before you reach it, your vision has moved to the apex point (the apex is the spot furthest to the inside of the turn). You watch the apex and apply steering input at the turn-in point. You will get to the turn-in point because YOU LOOKED AT and DECIDED WHERE THAT POINT IS. You will see it peripherally while looking at the apex and make the steering input. Before you reach the apex you look for and find the track-out point (the spot at the furthest outside part of the turn).

You learn to quickly look at a progression of different spots, and none of them will be right in front of the car. Some of them will be quite a distance from the car. And your car got that whole distance without you looking at the spot right in front of it. This is a valuable thing to notice, because most drivers start by looking at a spot just in front of the car. This spot is too close to you to provide enough time for you to locate and make the necessary inputs. You need to learn to look further ahead, much further ahead than you ever have before.

Once you get used to looking one spot ahead, it is time to make the leap to one and a half or even two spots ahead. We are all used to looking where we are going through the windshield. Sometimes you need to look out the side window to see where you are going.

When you look ahead (ocular driving), look with your whole head. Turn your head, not just your eyes, toward what you are looking at. It is much more comfortable, more efficient and less tiring.

Vision controls comfort, and comfort controls speed. When you are comfortable looking where you want to be, you will get there quicker.

Please re read this section (perhaps a couple of times), and remember what your mother said: "Watch where you are going."

Chapter 5: Driving Basics

We could describe how our Porsche drives and handles with lots of neat mathematical equations and physics theories. Fortunately, common sense and a few simple rules are all we really need. Just as Isaac Newton (the guy that got conked with the apple) had three laws of motion, we can work with three basic rules of performance driving:

1. A car can go faster in a straight line than on a curve
2. You can drive faster on a larger circle than on a smaller one, but it takes more time because the distance traveled is greater
3. A car brakes better than it accelerates

If you remember only one of these rules, it should be the first one. It seems straightforward enough - obviously a car can't turn a sharp corner at top speed, yet we can turn sharply at low speeds. This is because our tires have only so much grip or cornering force available. As the speed goes up, so does the cornering force for a given turn. This is why you can feel even a slight turn in a jet liner, yet you can pivot around quickly in your office chair without getting motion sickness: high speed versus low speed.

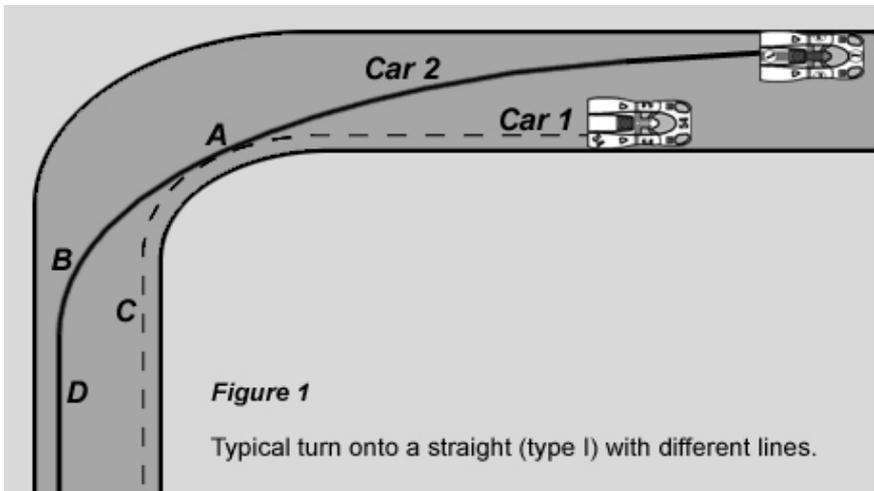
While accelerating, the faster you go the less you will be able to turn the steering wheel. Conversely, the more you turn the steering wheel, the slower you'd better be going. With braking, you can use the full capabilities of Porsche brakes in a straight line. As you turn the steering wheel while braking, you are asking the tires to do double duty with their grip; braking *and* turning. The sharper the turn, the less you can use the brakes. Think of the tire grip like the limit on your credit card. If you spend it all on entertainment, you have no credit left for home improvements. If you spend all your grip on acceleration, there is no grip left for turning. If you spend it all on braking, there is no grip left for turning. Budgeting your grip is important.

The first rule ties in with the second rule, which says that you can go at a faster speed in a larger circle. Makes sense, since a larger circle is more like a straight line, and a small circle is like a sharp corner where you have to go slower. But the smaller circle means we have to travel a shorter distance, and this more than makes up for the lower speed. The smaller circle ends up taking less time overall than a larger one. As we apply this rule to a track, we'll learn when the inside

corner (small circle) is better, and when we should take a larger circle path for more speed.

The third rule simply means that the brakes generally outperform the engine. The sensation of braking always pulls harder on you than acceleration. Even the mighty Porsche Twin Turbo goes from 0 to 100 m.p.h. in about 10 seconds, while the brakes haul it down from 100 back to 0 in only 5 seconds. With most Porsches this difference is greater. This means we should be concerned more with helping our car accelerate, and not worry too much about braking. Let's apply these rules to driving in a corner.

Referring to figure 1 (looking down on a right hand turn), we are driving



through a right-hand corner, or turn, that leads to a straight section.

Car 1 has taken a path or *line* that most drivers would take - the inside line. It is comfortable because if you lose grip or spin, there is room to the left (outside). But we can't start accelerating until we reach point A on the diagram. The corner will seem to be a slow, sharp corner to the driver.

Compare the line for Car 2. Here we start on the left, and by turning in at the correct point, we are able to accelerate from point B all the way *through* the turn. This is because even though we are still turning as we accelerate, we are turning less and less sharply as our speed increases.

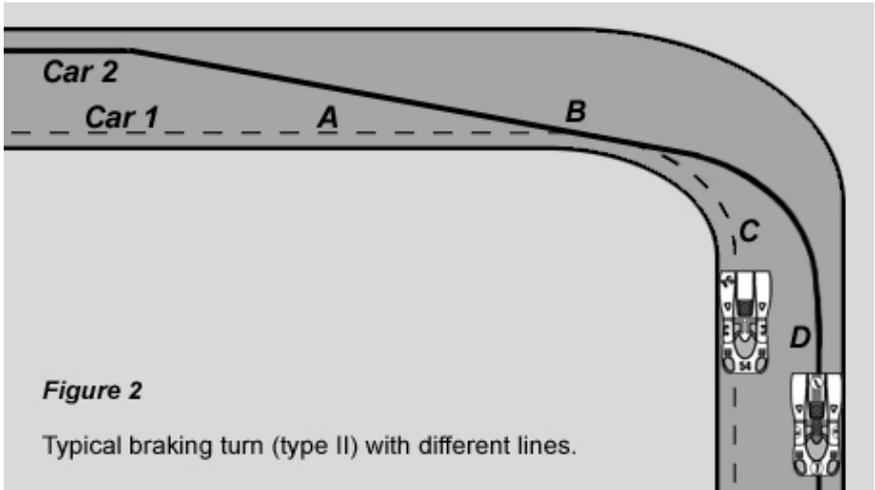
Makes sense: the faster we go, the more straight our steering wheel should be, and in fact, we straighten the wheel as we accelerate through the turn. Now the turn appears to be less tight and faster, and we have extended the straight. By taking this better line, we are spending more time on the straight going fast, and less in the slower turn.

Rule 1: *A car goes faster in a straight line than on a curve.*

What about the fact that Car 2 has to put on the brakes earlier? True, by setting up properly for the exit of this turn, we need to brake at point D instead of the Car 1 point C. But the difference between C and D is much less than that between points A and B. Additionally, our third rule tells us that *A car brakes better than it accelerates*. This means the effect of the difference between the braking points C and D is not very important. The correct line of Car 2 gives our vehicle the assistance it needs with acceleration, while sacrificing very little from braking. The net result is greater speed over the entire straight that follows this turn, and significantly less time. The time lost to earlier braking (D instead of C) is more than made up for by the longer, faster straight we created with the correct line.

Speaking of braking, it is important to finish your braking *before* starting the turn. Remember that if we are using all the tires' grip for braking, there is none left over for turning. If we brake too late before a turn and try to turn while braking, we run a great risk of spinning out, or at least scrambling and losing the correct line. If we brake too early, we lose but a tiny fraction of a second, but we are well prepared for the turn. Rule 3 reminds us that our Porsche can brake very well, so by braking early we lose very little, but by braking late we could lose a lot. The lesson here is to do all your braking in a straight line, and with enough time to set up properly for the turn. When in doubt, brake a little earlier. By the way, every turn that leads onto a straight like this is commonly referred to as a Type I turn. Type I is the highest priority and most important type of turn. If you learn only one kind of turn, make sure it is a Type I. In fact, it would be worth going back and rereading this section. Please do it now.

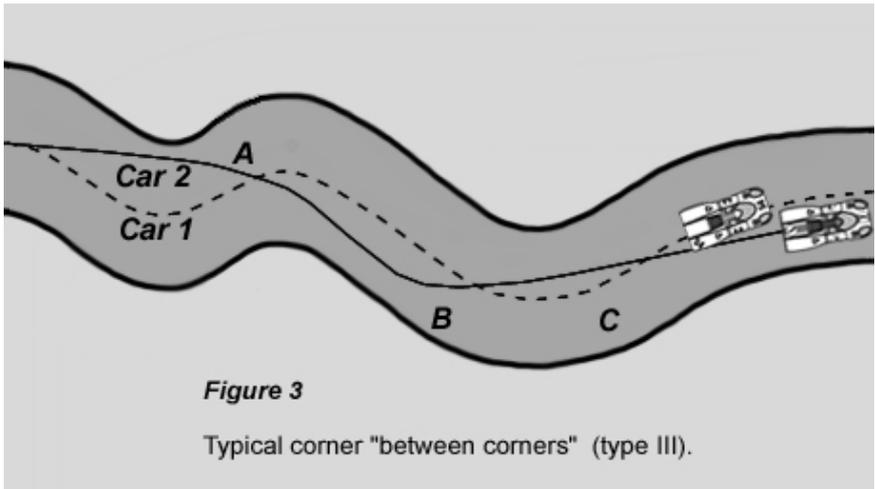
Now let's look at figure 2 and consider a turn at the end of a long straight (but not leading onto another straight), called a Type II turn. Here again, we have two different lines. Car 1 has the comfortable but slow line, hugging the inside of the turn. For this path, braking starts at point A and finishes at B. If we drive the course of Car 2, we don't have to start braking until B and we continue braking until C.



By taking this better line, we have delayed braking and made our straight longer. This again satisfies rule 1 by spending more time on the straight. For Car 1 we can get back on the gas again at point C. For Car 2 we begin accelerating at point D, not that big a difference. Notice with Car 1 how much time we spend in the turn between B and C. With Car 2 the time between braking and accelerating is from C to D - effectively much less time spent in the turn.

What if there is a straight just after this turn? Wouldn't the acceleration points C and D be important? Definitely! The above discussion assumes there was no straight after the turn in figure 2, only before it. If it is a turn between two straights, how do we take it with regards to the line; as a Type I or Type II? Looking at our rule 3, braking isn't as much an issue as accelerating. So, this means we must favor the acceleration side, and treat it as a Type I. Even if the straight after the turn is shorter than the one before it, always take it as a Type I since we need to favor acceleration. This is why a Type I turn has higher priority than a Type II. A turn at the end of a straight will be optimized when taken as a Type II. But if we take it as a Type I, we won't lose all that much because of rule 3. You could take every turn on a track as a Type I and do pretty well. You would do much worse taking them all as Type IIs. .

There is a class of corners designated Type III, and as you might have guessed,



it is even less important than the Type II. Type III is a series of turns which will eventually lead to a Type I. It usually has a Type II before it (the only exception being where a single lap autocross track begins or ends with a Type III). Here again we can apply our rules to see what the best line would be in a Type III turn.

Referring to figure 3, we have a series of turns at the beginning that don't have a straight connected to them. See how the middle of the road line taken by Car 1 involves a good deal of steering wheel turning. Car 2 has a straighter path and will carry more speed through this section (remember rule 1). Most important is the smoothness that comes from the better line taken by Car 2. The most important point of a Type III turn is to prepare for the Type I turn that eventually follows. Sooner or later there will be a straight, and nothing you do for the Type III should interfere with setting up properly for it. For car 2, notice the straight after the last turn. This is a Type I and we need to properly set up for it. Car 2 has sacrificed a bit of speed at point A in order to start accelerating down the straight from point B. You could indeed go a bit faster from A to B, but you would not be able to accelerate fully on the straight until well after point B. It is most important to accelerate from as far back as possible, entering into that straight. Look carefully for that Type I turn at the end of the Type III and focus on doing it correctly. It may involve sacrificing part of the Type III, but it is smoother and faster.

Type III turns are not very fast sections of the track, so there is not a lot to be gained here. The best technique for Type III turns is to take them smoothly and with as straight a line as possible. Above all, do whatever it takes to be optimally

set up for the Type I turn that follows.

There are a few more terms related to performance driving that you should know at this point. The *apex* of a corner describes the part where our car is closest to the inside of the turn. Going back to figure 1, we see that Car 2 has the apex at point A. Another term is *turn-in point*, which describes the place where we begin our turn from the outside of the track toward the apex. For Car 2 this is between points D and B in figure 1. Selecting the correct turn-in point determines whether we will get the apex point that we want. Finally, there is the *track-out point*, which is where our car reaches the outside of the track after passing the apex. For Car 2 in Figure 1 this is shortly before the arrowhead. The goal is to not fight the steering wheel as we drift and accelerate after the turn. Notice that Car 1 in figure 1 doesn't really have apex, turn-in point or track-out points.

Looking at figure 2 (the Type II), we see that Car 2 has a turn-in point near the left side of the drawing, an apex just after point B, and a track-out point near D. We can also see a difference between figures 1 and 2. Figure 1 has what we call a *late apex*, because it occurs *after* the actual midpoint of the turn. The Type II in figure 2 illustrates an *early apex* since the apex is just *before* the midpoint. In general, Type I turns require a late apex and type II use an early apex.

We select our turn-in and apex points based on looking at the turn and practicing the line. If we run out of room on the exit and have to slow down after the apex, then the turn-in and/or apex was probably too early. It's also possible we fed on the gas too soon. Most people tend to turn-in as you approach the turn, which is usually way too early. Don't be surprised if you have to back off the gas after passing the apex. Just make a note of it and turn in later next lap. If you turn in and can't get the car to go to the apex, you were either too fast or turned in too late. Again, make a note of it and adjust.

As you perfect the turns, you will find that you are using all the track and maximizing the straights. You won't have to think about going faster, as taking the correct line will bring up your speed naturally. You will be smoother, safer, and faster. While we can decide where we want the apex to be, our only choice is where to make the turn-in point. The turn-in point determines where the apex will be. This is why the location of the turn-in point is so important. As a general rule, which applies to much more than driving, we can choose our actions (turn-in point), the action determines the consequence (the apex point location).

In summary, the three kinds of turns are (in order of importance):

Type I - leads onto a straight; most important; maximize the straight.

When in doubt, take it this way.

Type II - end of straight; later braking; Type I if followed by straight.

Type III - between corners; smooth line; prepare for Type I after it.

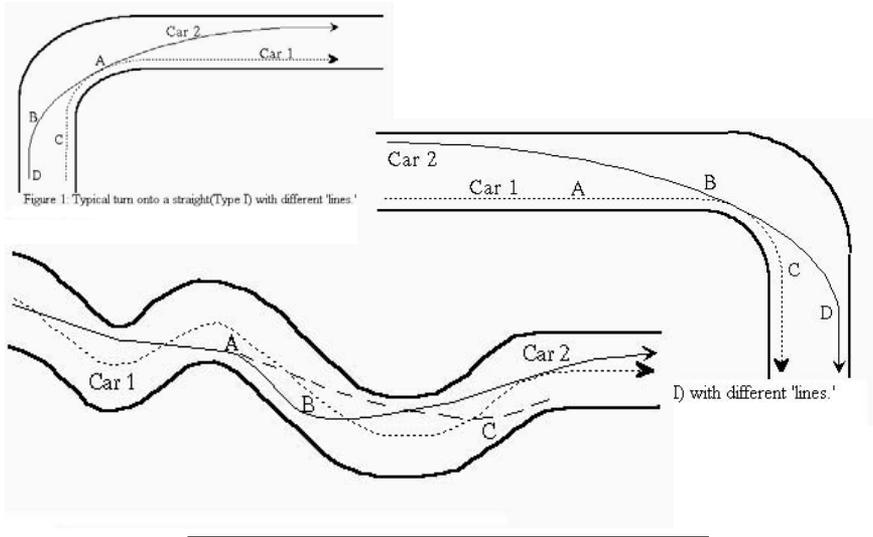
And the three parts of a turn are:

Turn In - beginning the turn from the outside toward the apex.

Apex - you are closest to the inside of the turn. Late for Type I.

Track-Out - where you end up at the outside of the track after the apex.

Please review this summary several times and review this chapter until these concepts and terms are clear. THIS IS IMPORTANT STUFF. Don't hesitate to ask an instructor if you need help with this section.





THE BOYS (FERRY'S FOUR SONS)
YOUNG BUTZI
GERD AND WOLF
WATCH AS PETER BOARDS A 550

Chapter 6: Talk Your Way Around the Track.

Now, let's put some of this together. When you look at an autocross track, it can often look like a sea of cones. There are some steps that you can follow so that it will make more sense. The first thing is to do is:

Find the Track. - This means to get a good idea of what is where. We start this with a *track walk* where an instructor leads a group of students around the track before any driving. At the school, and at most autocrosses, the chief driving instructor will lead this. We look at the track *up close and personal* to figure out what is where, what comes next, and look for landmarks and details that affect where you want to drive on the track. You look for these things when actually driving the track. Riding as a passenger with your instructor driving the first lap or two will reinforce this. The next thing you need to do is:

Find the line - This means putting the car at the correct spot on the track at close to the correct speed. This will only happen after you find the track, so don't rush it or drive too fast. Your instructor will drive the line first to get you started. Watch closely. The information about type I, II and II turns comes heavily into play here. Once you are getting to the right spot most of the time, you need to do the right thing when you are there, which brings us to the third thing.

Drive the line - We have some standard phrases that tell you what to do at each spot. They are fairly simple and will be used often. A good way to learn a track is to talk your self around it using terms like: on the gas, off the gas, brake, down shift, off the brakes, turn-in, apex, track-out point.

So, to *talk yourself around the track* you select the correct phrase and use it in sequence to identify what to do next. Notice what you are doing at different places on the track. Use landmarks.

Another reminder. This learning process is an investment that you are making in yourself. Like investing money, you have to pay for the investment first to get the dividend later. The payment is driving more slowly while you get the basics handled and get the learning done. The dividend comes later in better car control skills, better track times and a feeling of mastery. The two most common mistakes people make are driving too fast too soon, and turning in too soon.

Chapter 7: San Diego Region Driving School Track Exercises

Safety

We cannot enjoy performance driving without safety. This safety consciousness is a habit everyone needs to learn and apply. It should be the first thing that you think about with each new situation. There is a region Safety Chair, but each person needs to be personally responsible for safety. Look for safety concerns. If you see something that worries you, stay away from it and tell the event or safety chair.

An important part of safety is staying within your limits. When you drive beyond your limits you are not in control and not safe. Your limits will increase with experience, but you need to know and stay within them. Another part of safety is keeping yourself functioning well. Be sure that your clothes are comfortable. Be sure you are drinking enough fluids. Dehydration, hypo- or hyper- thermia can happen without you noticing.

You will be required to wear a helmet while autocrossing (but not for the driving school exercises on Saturday). The helmet must have a Snell 95 rating or newer. There is a limited number of loaner helmets available. Bring your own if possible.

There are more stringent safety rules that apply to time trials. If are interested, you can find these requirements in the Zone 8 Competition Driving Rules (available on our region website: www.pcasd.org).

No alcoholic beverages may be consumed by ANYONE, ANYWHERE on the event site until the event is finished for the day. This applies to drivers and spectators alike. You are responsible for your guests. There is a maximum speed limit of 10 m.p.h. when you are not on the track. There are pedestrians (adults, children, bicycles and animals) in the pits.

Attendance at all driving meetings is mandatory. This is where safety considerations and rules are discussed. If you miss a driver's meeting you will not be allowed to drive.

We are serious about safety. You may be asked to leave an event if you violate safety rules.

Driving Exercises (Saturday)

The students will be assigned to groups. Drivers sharing one car will be kept in the same group. You will receive your assignment at or before the morning driver's meeting. Be there early enough to get your car through tech inspection before this meeting. Refreshments will be available. Wear your name tag. Please review the following information, so that you will be able to get the most from the exercises. Each exercise is designed to teach a specific driving skill. Each exercise will start with a short talk from the exercise leader about what you will be doing and learning from that exercise. They will go over the procedures specific to that exercise. Then you will do the exercise.

Each group will move between the exercise areas as a group. Please be prompt about these moves so the meeting can begin on time. You will not be driving continuously during each exercise, so there will be time during the exercises to take a porta-pottie break. There will be plenty of time to watch the other students. This is a great time to watch the student currently driving and discuss what you see. This is not the time to conduct business on your cell phone. Please, keep your mind on the school.

Speed is not stressed in the exercises. The speed will be optimized for maximal learning. Trying to go faster will diminish your learning and could be a safety issue.

Your car will get very dirty on Saturday. There are wet pavement exercises, including a skid pad, which will be messy for your car exterior. These wet pavement exercises allow us to teach the lessons at lower speeds and also reduce wear on tires.



BOHORQUEZ BROTHERS 356

Skid Pad

This will be everyone's first exercise.

DESCRIPTION:

A circle of cones is setup and the pavement surface is kept wet. Each student goes out with an instructor in the passenger seat. The instructor will show you what driving the car at its cornering limit feels like. You also learn how to control your car at the limit. You start by driving around the circle near the limit of how fast your car can go around the cones. You then slowly accelerate until you reach that limit. You need to learn what that feels like. Then you go a little faster. Holding the steering wheel steady, the car will want to drive in a larger circle. If you try to correct this with the steering wheel it won't do much good. If you go faster, the circle gets bigger. As you try to go a little faster the front tires "push." This is called *understeer*. Notice how the steering wheel feels in your hands, and how this changes as the limit is reached. Notice that more gas *will not* make you faster, and more steering wheel input *will not* turn the car more.

Next we get you back to the limit and have you lift off the throttle (or perhaps apply some brake). Your car will want to drive in a smaller circle. You may feel the rear wheels become *loose*. This tendency for the back of the car to swing around is called *oversteer*. Notice what this feels like to your hands, and your butt in the seat. By alternately lifting and applying the throttle (gently), you can make the car drive in an oval instead of a circle even though the steering wheel has not moved. You have learned to control steering with the throttle instead of the steering wheel. To demonstrate this, your instructor may have you cross your arms on your chest while they hold the wheel. You will again move the car out and in with the throttle to prove that you are steering with your right foot.

The instructor will probably guide you to spin your car so you can learn what this feels like. Remember the rule: In a spin; both feet in (This rule applies to cars with standard transmissions. If your car is an automatic, you would push only the brake pedal in). Please reread this section.

GOAL OF THE EXERCISE:

By the end of this exercise you will know what *oversteer* and *understeer* feel like and how to control them. You will learn how to steer your car with the throttle or the brake. These are important basic experiences and skills to build on.

Accident Avoidance

This exercise is combined with the threshold braking exercise. Half of the group

will do each, then switch.

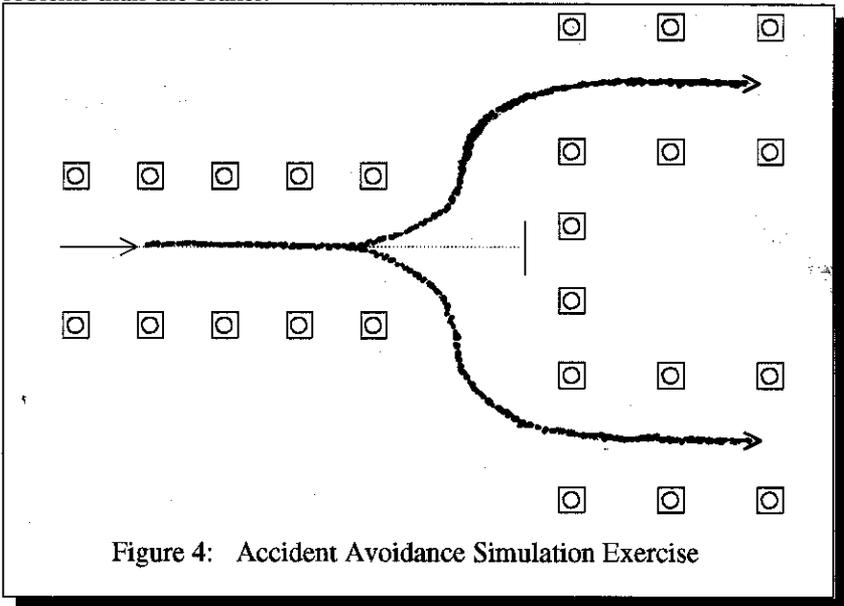
DESCRIPTION (see figure 4):

Each student will drive down a *traffic lane* of cones. You will have an instructor with you. At the end of the lane there are three choices: change lanes to the right, left or make a complete stop. As you drive down the lane, a flagperson will direct you to go right, left, or stop. Do so safely. This last moment decision making requires you to be ready for any action. You will learn that turning to avoid an obstruction generally is safer than slamming on the brakes. When you master this at moderate speed, you will be asked to increase the speed. Note: in older cars without ABS, you will need to modulate the brakes to keep the wheels from locking up..

Hints: The quick lane changes reward car balance. There are three turning actions to make: 1) into the next lane, 2) straighten out in that lane, and 3) re-balance the car by another turn opposite to the last one. If you forget this third (and not so obvious) turn, you may very well spin as the speed increases. Also, lifting partly off the throttle as you begin turn 1 and increasing the throttle a little during turn 2 will increase the stability by helping the rear tires *hook up*.

GOAL OF THE EXERCISE:

To prepare you for real traffic emergencies and demonstrate some car control basics. Learn that your gas pedal and steering wheel can help you avoid more problems than the brakes.



Limit Braking

DESCRIPTION:

This is a wet pavement exercise. There will be two parallel driving lanes defined by cones. One lane is straight. The other has several curves. Each will have a large cone to indicate where you start braking. You accelerate down one lane to about 30 m.p.h.. When you reach the large cone, try to stop your car as quickly as you can without locking the wheels. We will place marker cones so that you can see how much distance it took. Try to approach the brake marker at the same speed every time and begin braking exactly at the marker so you can compare your progress. You drive back to the start point and do the exercise in the other lane. The instructor or a starter will tell you when to go. Compare the



feel this in the pedal, the steering wheel will get tight, and the car won't feel the same. You will probably hear noise and smell tire smoke. Reduce the pedal pressure immediately. Tires that stay locked up too long will *flat spot*, significantly reducing their life. With practice you will get the feel of modulating the brake pedal, easy at first and then harder and harder, always keeping the tires from locking up.

One of the lanes gives you the opportunity to turn during the braking. Once you get some speed up, this turning while braking will show you the challenge of this. If you don't modulate the brakes enough, a spin can happen. *Both feet in!* ABS works great here. When you are comfortable with the exercise, ignore the braking cone and try to start braking as late as you can to stop exactly at the end of the lane. Brake as hard as you can. It won't take long to figure out that this is not as easy as it looks.

IF YOU HAVE ABS

If you have ABS, it will prevent the wheels from locking up and will give you close to, if not the best braking potential of your Porsche. It is a good idea to know what the car feels like when the ABS engages so that when it happens, you will know what to expect. Many excellent drivers believe that threshold braking makes ABS work even better, because you get the car to take a set before getting into the ABS. This allows greater braking when the ABS is working. ABS does allow better steering control if you have to steer while braking. When the ABS is doing its thing, you will feel a pulsing in the brake pedal. This is the ABS working by interrupting the braking force enough to keep the wheel turning as it is braking. It tells you that the ABS is needed so that you can adjust your driving knowing that you are very near the edge.

GOAL OF THE EXERCISE:

This will provide experience in braking at the limit. It is a valuable skill for any driving, and can be very useful in an emergency on the street

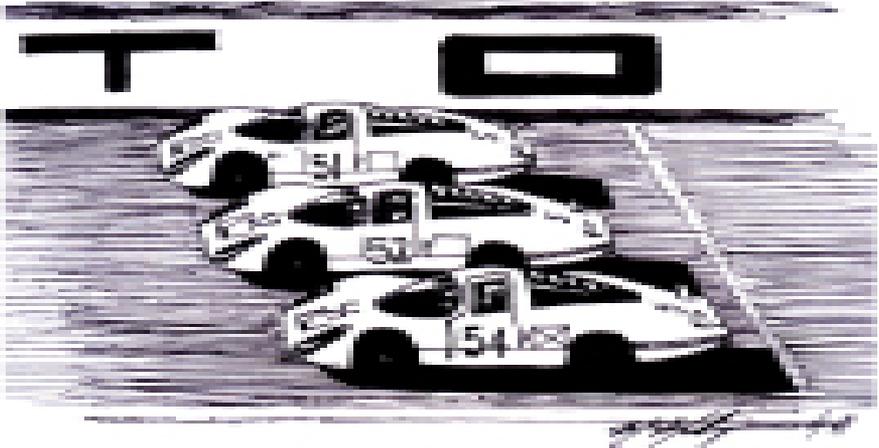
Slalom Loop or Linked Turns

DESCRIPTION:

You will drive through two different kinds of linked turns. The slalom cones are a line of three or more very large cones that you must weave through. You may start on either the right or the left of the first cone and then alternate as you drive through them. Going between the slalom cones will force a large amount of side to side weight transfer in your car. This upsets the car balance and limits your maximum speed. By correctly using the steering wheel and the throttle together, you will learn to minimize this weight transfer and increase speed. You will also see the difference between turning at the cone or before it. Rhythm and smoothness are rewarded. The second part of this exercise is several closely linked "S" turns. This shows the importance of *sacrificing* speed and line in one turn to improve the speed in a more important turn. It also demonstrates how to take several turns as a single unit (lots of Type III turns here). Please review the section on Type III turns now.

GOAL OF THE EXERCISE:

Another car control skill is stressed. You will see that some corners are more important than others. It helps develop balance and rhythm.



Porsche 907s finish 1st through 3rd at Daytona 24hr. race, 1968.

Car 54 - 1st place, drivers: Vic Elford/Jochen Neerpasch

Car 52 - 2nd place, drivers: Jo Siffert/Hans Herrmann

Car 51 - 3rd place, drivers: Joe Buzzetta/Jo Schlesser

Increasing Radius Turn

DESCRIPTION:

You will drive in a loop that has two corners. The one that we stress becomes more open as you progress through it, or has an increasing radius. This is the classic Type 1 turn: it leads onto a straight. This means that your priority is to take a late apex, and get on the gas again as early as you can. Treat the remainder of the loop as a transit section just to get you back to the corner that we are focusing on. You will have brake cones as you approach THE CORNER, as well as turn in cones (several to choose from) and a track out cone. This is our version of the corner in Figure 1 in chapter 5. Please go back and reread this section now.

To drive this exercise, brake a bit before the turn in cone. Turn in at the turn-in cone; the instructor with you will tell you which one to use. Then aim for the apex cone. Begin squeezing on the gas well before the apex. Be sure to unwind the steering wheel as you pass the apex. Use the whole track. Go all the way out to the track-out cone at the outside edge. Look where you are going. The description seems so simple, but getting it right takes work. To see how you are doing, we will set up the timing lights at the track out cone. This will give you instant feedback on how you took the corner. Don't worry about this for the first few laps. You are still finding the corner. When you are comfortable with the corner, with the turn in cone that your instructor selected, then try turning in at the other turn in cones. Notice how some of these turn in points keep you from getting to the apex, and some cause you to run out of room in the track out area. Either of these will cause a lower speed than when you find the turn in point between these two extremes.



Doug Briggs 944

Pitch and Catch

DESCRIPTION:

We set up a triangle of cones about 75 feet on each side. Each corner of the triangle represents the inside of a very tight turn. These turns present a car control challenge. It is possible to slowly drive through each of these corners, but we want to teach you a something different here. At a relatively slow speed you will learn how to pitch your car into the corner in a controlled way. This will get the back end around quickly, which is effective in very tight turns. Next you learn how to catch the back end, keeping the car under perfect control at all times. Remember, as long as the wheels are turning, you are driving. We keep the surface wet so speeds are lower for this exercise. With some gas on, you gently turn into the corner at a reasonable speed Then you lift off the gas abruptly. This will pitch the back of the car out. Then you get gently back on the gas to catch the pitch and get the car back on line. You will practice this skill at one of the corners at first, then progress to all three corners until you do it comfortably and in control. This is also known as throttle steering. The sequence is: gas, turn, lift, gas (some gas on before starting to turn, turn the wheel and hold it in a constant position, lift off the gas enough to pitch the back end out and gently get back on the gas to stop the pitch).

TO SAY IT ANOTHER WAY:

The Pitch: Approach the corner under even throttle. After you start to turn the wheel, lift off the throttle abruptly. The rear of the car will loose grip and start to rotate.

The Catch: When the car has rotated as far as you want, gently apply enough throttle and maybe straighten the steering wheel. Done properly, this will cause the car to stop rotating.

An instructor will demonstrate this in your car. When we teach this skill, we use exaggerated motions of the gas pedal to make the effect more obvious. As you learn the skill, you will become more gentle with the gas pedal and produce a more subtle pitch. You will also get a feel of where in the corner to begin the pitch, how much to pitch, and where to catch. The 993, 996 and Boxsters have very sophisticated suspensions that make the cars more predictable to drive but harder to pitch & catch. They require more aggressive throttle motions to make the exercise work. The four-wheel drive models may not be able to make this work at all. If your car has traction control, turn it off for this exercise.

GOAL OF THE EXERCISE:

We want you to learn the importance of keeping inputs to the steering wheel

and throttle coordinated. Otherwise, it doesn't work. This exercise provides another format for practicing car control skills.

Mini-autocross

DESCRIPTION:

This puts together many of the skills learned and is a preview of a regular autocross. After a driver's meeting and a track walk, each car lines up in pre-grid with the instructor driving and the student as passenger for a few laps. The instructor will show you the line at moderate speed. There will be Type I, II and III turns. He will demonstrate how to drive them. Then it's your turn. The first few laps, just find the track. Do not try to go too fast. Once you understand the track and know the line, gradually pick up speed. Your instructor will offer suggestions and instruction. If you don't think the communication is working (i.e.: too much or too little input) talk to the instructor or to the event director. We can easily make an adjustment. Remember, be smooth and slow down at the exit. Talk to the instructor between laps for more input.

GOAL OF THE EXERCISE:

To give the student a taste of what it's like to put all the skills together in one exercise. And an opportunity to learn the lines of several turns, looking for and using landmarks, as well as practice in deciding which corners are more or less important.

Corner Worker Instruction

DESCRIPTION:

During this exercise, you will learn how to be a corner worker and function as part of the corner worker team for the mini-autocross. You are the *local safety officer* during an autocross and are responsible for the safety of that portion of the track assigned to you. Important parts are (in order of importance): 1) keep yourself safe, 2) keep the car driving near you safe, 3) keep the next car coming down the track safe, 4) communicate with the start/finish person, and 5) reset cones that get knocked down when necessary and safe. Your safety is most important. Putting cones back is the least important. If you can't reset the track safely you can always call the start/finish person to stop the cars for a few

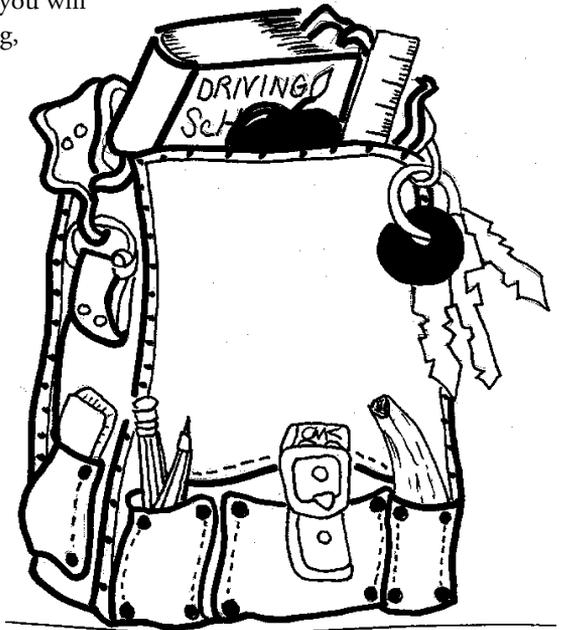
minutes.

SOME DETAILS:

We mark corner worker stations in a safe spot in the area you are monitoring. You can move around in that area, as long as you make sure you take care of your personal safety. Think about where a car would go if it were to spin or leave the track. Make sure you do not stand there. Watch the cars coming by you for signs of a problem. If you notice something (excessive smoke, loose body part, fluid leak, etc.) immediately call this information in to the start/finish person. If a car spins, look for the next car coming. Your job is to wave the yellow flag to slow down or stop oncoming traffic; use the radio to alert the other corner workers (identify yourself by the number of your corner worker station), and to direct the car that spun back onto the track only when it is safe to do so. Point the flag at that car to get their attention. If the spun car has come to a stop, the driver is to wait there until directed back onto the track.

SPINS:

As you explore driving limits, you will probably spin the car. Spinning, in itself, is not dangerous, but it can be frightening and disorienting. If you think you are going too fast for a particular area and are going to spin, it is usually best to look ahead and just drive straight off the track, slowing as you go. In a stadium course, there is no “edge” to drive off of. On a road or track with a pronounced edge, it is important to be driving straight across that edge to maintain control. If you do spin: 1) Get both feet in (again, this applies to



standard transmission cars; cars with automatic transmissions only apply the brake). You push the clutch to the floor to prevent transmission/engine damage and to prevent a stall. Apply firm braking. 2) If the car comes to a stop, signal the corner worker whether you are okay or if you need help. 3) If you are still on the track, get your car off the driving line. 4) Watch the corner worker for instruction. Don't try to get back onto the track until the corner worker has cleared you. If you have a mechanical problem and are unable to continue, 1) get well off the track if you can, 2) stay in your car, 3) signal the corner worker and 4) wait for instruction.

If a car becomes disabled in your corner working area, be sure it is safely off the track and notify the other corner workers and start/finish with your radio. The starter may wish to dispatch help immediately or wait until the end of the run session. If the disabled car is in danger, use your flag and radio to stop the track immediately. The corner worker needs to make sure other cars are warned and kept out of danger.

A corner worker's two most important safety tools are the radio and the yellow flag. Always keep them with you. Communicate with start/finish and other corner workers if you have a problem that they need to know about, or if you need help.

Part of the safety precautions you need to attend to are preventing dehydration and sunburn. Have sunscreen on, and take water or other drink to the corner worker station with you.

We hope you never need the fire extinguisher, but don't be afraid to use it if necessary. It is Halon, and will not damage a car. Pull the pin, point the extinguisher at the base of the fire and squeeze the handle. Don't be stingy with the extinguisher. It will need to be serviced anyway.

The radios are ~~simple to use~~. ~~The volume dial should be turned~~ all the way up. The squelch knob should be disabled. If there is a choice of channels, it should be on channel 1. To talk: grab the radio, firmly depress the button on the side and talk into the front of the radio. Release the button to hear others. Be sure you only press the talk button when you want to speak. Leave the corner worker equipment at the corner worker station when you are relieved. Do not turn off the radio.

A side benefit of working a corner is that you can watch other drivers at work and you may learn something. Generally, the car that gets on the gas earliest in a Type I corner is doing the best job. Figure out how they do it.

VIII Beyond the Basics

This chapter discusses driving techniques to be attempted only after you have a thorough and practiced understanding of the principals discussed in chapters 2 through 7. This booklet is designed to assist your first year of autocross after the PCASD driving school. Once these basics have become a standard part of your driving skill, including finding and driving the line and demonstrating consistent car control, you can explore the advanced techniques discussed here.

More on Vehicle Dynamics

We avoided an in depth discussion of vehicle dynamics earlier. We did not want to overwhelm the beginner, but a more indepth look at these dynamics will be helpful for the more advanced topics discussed below.

Your Porsche has suspension at each wheel. This suspension consists of a spring (a torsion bar is a type of spring), a shock absorber, suspension bushings, the wheel and, most importantly, the tire. The shock absorber is merely a damper and usually does not add any spring force itself. This combination of suspension components can be tuned by alignment settings, tire pressures, changing springs, different bushings, and a host of other influences. There is a finite response time for the suspension to settle (catch up) to your control inputs. At slow speeds, the suspension has no trouble keeping up with your control inputs. As speeds increase and control inputs become more vigorous, the suspension may have trouble keeping up. This is why, if you jerk the steering wheel sharply, the car will become unsettled and your car may spin. You need to develop a feel for your car's response time and not try to make it work faster than it is capable of. Jabbing on the brakes (or jerking your foot off of them) is another abrupt transition that needs to be smoothed out to match what the car you are driving is capable of handling. The skill of giving fast but smooth inputs to your Porsche takes sensitivity and experience.

When you did the skid pad exercise, you drove faster and faster until the car started to describe a larger circle. This is *understeer*. All cars will eventually understeer if you hold the steering wheel in a constant turn and the accelerator is increased. When you lifted on the throttle suddenly, the car transitioned to *oversteer*. This may have been as subtle as a reduction in the circle diameter to as abrupt as a severe spin. All cars have *lift-throttle oversteer* to some extent. Some Porsches are more abrupt with oversteer (especially early 911s). All Porsches can be made to understeer or oversteer by suspension setting changes or, more to the point, driver inputs.

Understeer or oversteer can occur without necessarily having the tires slide or skid on the pavement. Tires have a characteristic called *slip angle*. Slip angle

describes the amount of twisting flex between the tire sidewall and tread. With hard cornering, there is more slip angle. If the front tires have more slip angle than the rear, the result is understeer. With more slip angle in the rear, you have oversteer. A sliding tire can also produce understeer or oversteer, and the effect is usually more pronounced.

Each of the four tires has a certain amount of cornering force it can handle. When you accelerate in a turn (like on the skid pad), you transfer weight from the front of the car to the rear. With the front tires lighter and more load on the rear, the front tires will have less traction and more slip angle, hence understeer. Turning the wheel further will only aggravate the situation, perhaps making the front tires slide. When you lift off the accelerator (or apply brakes) you transfer vehicle weight from the rear to the front. This decreases the traction and increases the relative slip angle in the rear causing oversteer. As you accelerate out of a corner, you find the car is relatively stable, perhaps understeering a bit. It may also drift, where all four wheels slide a bit as the car clears the apex. Do not fight the steering wheel. This will cause more understeer and scrub off speed. Let the car seek its own line as it exits the corner; steer more by using the throttle. This is the time for subtle throttle adjustment.

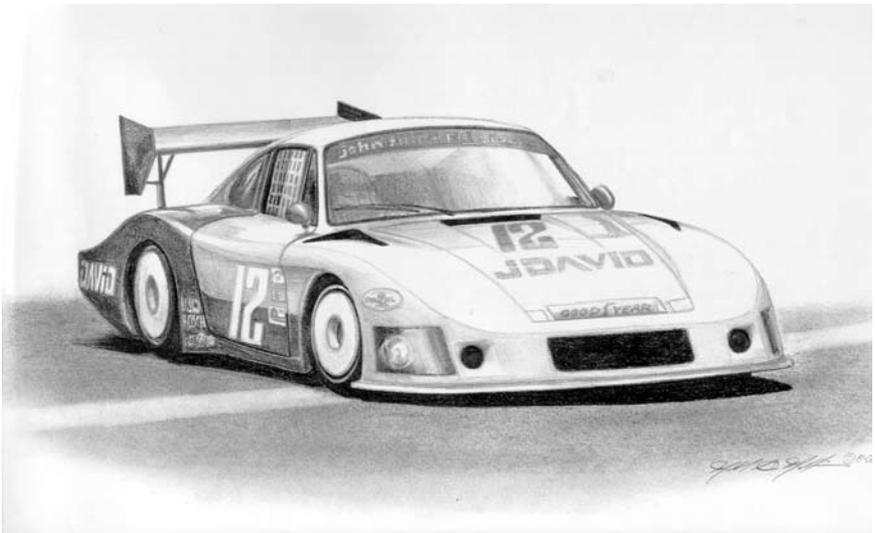
Within reason, understeer is a more stable attitude for a vehicle; you may not have much steering control in severe understeer, but the vehicle points relatively straight ahead. Oversteer is less stable, so most car manufacturers design their suspensions with a good deal of understeer.

By controlled use of oversteer, you can pivot the car around tight, slow corners where the car would otherwise understeer. The technique involves a slight lift off the throttle (just enough to kick the rear end around), then get back on the gas until you are pointing in the right direction. In many instances, this is the fastest way through a turn. Do not mistake controlled oversteer with lack of smoothness. Done correctly, this is still a relatively smooth maneuver. Do not try this if you have not learned to control oversteer in the earlier exercises. This maneuver is what the pitch and catch exercise was all about.

The act of turning the steering wheel slows the car. When your car is moving and the front wheels are pointed straight ahead, they have the least resistance to the forward movement of the car. As you turn the front wheels, you create slip angle and this increases the resistance to forward movement. This slows you down. The more you turn them, the more your front wheels are driving sideways and acting as brakes. For this reason, it is important to turn the steering wheel no more than absolutely necessary, and to straighten it out as soon as you can. An important place to attend to this detail is when you are accelerating onto a straight. Once you have passed the apex, unwind the steering wheel. Since you are going faster than you were going before the apex, you don't need

as much steering effort. This helps you go even faster.

Attending to this detail is less important than some other priorities, such as being sure to take a turn as a Type 1, avoid entering a turn too fast, and make your control inputs smooth. It is just another detail that will improve your driving and deserves your attention after other details become second nature.



The San Diego based J DAVID Company sponsored this 935/78 was driven by John Fitzpatrick and David Hobbs in the 1982 Le Mans 24 hour race, finishing 1st in IMSA class, and 4th overall.

Using All of the Track

Try to take advantage of, and use the whole track. By adjusting the track line properly, you give yourself the smoothest path with the least amount of turning, and longer straights. These contribute to an easier drive, more safety, and lower lap times. The key to successfully refining this technique is consistency - we must be able to put our car where we want on the track at the speed we want - on every lap. The *level* of this consistency determines the level of refinement we can work on. It would be worthless to try an earlier apex point on a turn if we can't keep from blowing away the cones there!

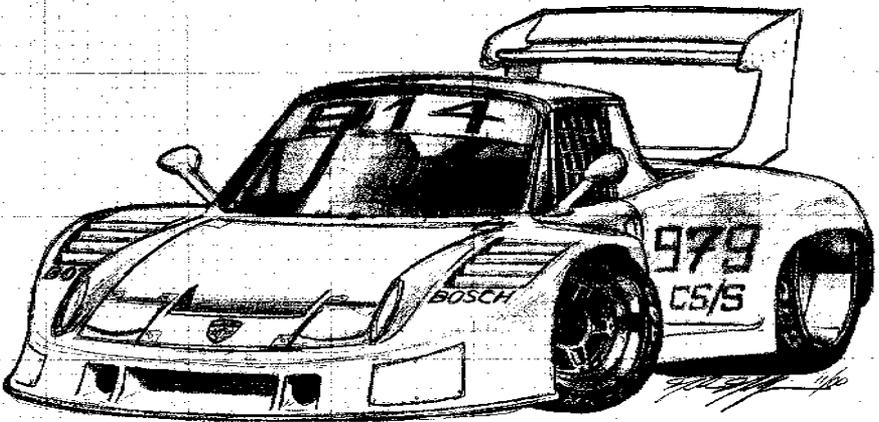
Don't panic or give up if you don't have precise car control. You should not be driving a faster line than you can consistently drive with control.

Physical reference points are important. We must look for and use landmarks that allow us to reference our driving to these locations. Once a landmark is picked out, you can refer to it as a turn-in or apex point, and try differing lines referencing that point (i.e. we might try a turn in just before the triple white stripe instead of right at it). Find a fixed reference (not necessarily a cone, which may move) and work with it.

When optimizing sections of the course, our goal is to use all of the track while still leaving some margin. This margin allows for variations from lap to lap due to our inconsistency. We all develop different levels of accuracy and repeatability. We should allow for an appropriate safety margin based on that particular place and time. If we don't use all the track, we may lose a very small fraction of a second. If we don't leave enough safety margin, the loss of time can be much greater due to scrambling, having to slow down, hitting cones, spinning out, or worse. Obviously, if we can drive more consistently overall, we can safely reduce the margin and use more of the track.

Recall rule 1 from chapter 5: *A car goes faster in a straight line than on a curve.* A similar adage is *Don't make a turn where there doesn't need to be one.* Another way of think of this is to look for *non-turns*. A driver will often make a turn out of a simple bend in a straight and end up struggling with the turn. We can look for ways of making a turn nonexistent by simply setting up for it properly and using all the track. Sometimes, by looking carefully at a corner, you can find a line that allows you to take it flat out, thus making it part of the straight (a non-corner). Resist the temptation to use all the track if it doesn't help you. It is wise not to fight the steering wheel while exiting the corner, but it is also counterproductive to purposely steer the car to the outside of a turn, lengthening the course and artificially using all of the track. There are some corners where your Porsche won't need to drift all the way out to have the best line. If you can shorten the course, you shorten your times. In other words, don't make a turn

more than it needs to be. The secret is to look for as straight and short a path as possible through the section of the course. Sometimes a turn can be eliminated completely; other times it can be reduced to a lane change. Don't forget to keep in mind the importance of setting up for the straights. Type I turns are always the most important, and nothing we do to minimize Type III turns should sacrifice the Type I.



FANTASY 914 RACER

Braking and Shifting

We didn't want you to worry too much about shifting when you first started. Shifting can make a difference, although the correct line, for example, is much more important. As you get better, you will want to pay particular attention to downshifting. The most common mistake is the idea that we use downshifting to slow the car. Wrong! The purpose of downshifting is to be in the gear offering the best torque when we are able to get on the gas coming out of a turn. Brake pads are much cheaper than transmissions and much more balanced and effective at slowing the car down.

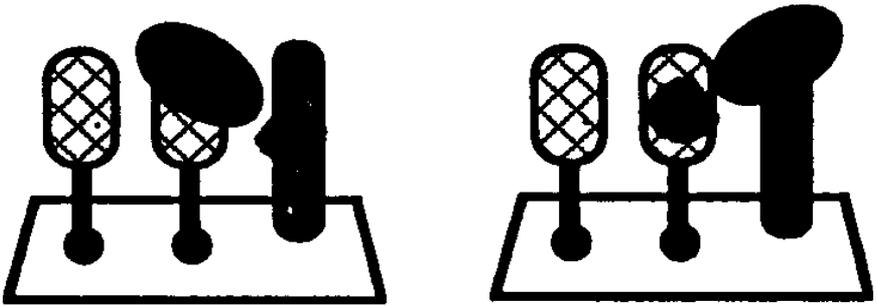
A useful downshifting technique is the **heel-and-toe** downshift. Here you activate the clutch with your left foot in the conventional manner, while using the right foot on both the brake *and* accelerator pedals. It usually works best with the sides of the foot (left side on brake, right side on gas), rather than the actual heel and toe. While braking into a turn where you want a lower gear to accelerate out of, you use the left side of your right foot to brake. While braking, you activate the clutch with your left foot in the conventional manner and start your gear change. The idea is to use the right side of your right foot on the throttle (while still braking with the left side) to raise the engine rpm up to where they should be in this new gear. The reason for doing this is that if we simply let out the clutch in the new gear while the engine is at idle, it can cause the rear tires to skid. If you are already braking as much as you can, this extra jerking force could cause the car to spin.

The heel-and-toe downshift is not easy. It takes practice, but can result in a smoother lap. To repeat, the reason for downshifting is to be in the gear offering the best torque when we are again able to apply the throttle out of the turn. Brake pads are much cheaper than transmissions and are more efficient at slowing the car down.

Another advanced braking technique is **trail braking**. When first learning performance driving, it is best to do all of your braking *before* a turn and in a straight line. The car is more stable this way. When you have sufficiently mastered car control, you can try trail braking. You will then brake into a turn, as well as before it. You will still have to do some of the braking before the turn, but the braking can start later. Then, as you enter a Type II turn (at the end of a straight), you brake more lightly as your front wheels begin turning. Since your tires have only so much adhesion, if you are using some of that grip for turning, then less than 100% of it is available for braking. As you turn more and more, you must brake less and less to keep the combined traction forces close to, but less than 100%.

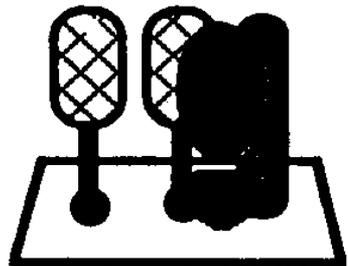
If you are close to the limit you need to be smooth with all controls, otherwise the car will probably spin. If done correctly, trail braking can lengthen a straight by delaying braking. Longer straights and less corner is always a good thing. Don't be discouraged. This is awkward at first. Another big advantage of trail braking is that the braking part transfers weight to the front wheels which reduces the understeer that might otherwise occur as you turn. It makes the turn-in easier.

Finally, there is **left foot braking**, an even more advanced but useful technique. When your Porsche accelerates, the front end tends to lift or lighten and the rear squats down. In braking, the opposite occurs with the rear end losing some grip and the front end digging in. If we simultaneously brake and accelerate, the suspension hunkers down with both the front and rear wheels firmly planted to the pavement. This is a stable situation with the braking forces balancing the acceleration. You use this technique in a turn where you do not have to downshift, but do need to bleed off some speed. With your right foot on the accelerator pedal, you bring your left foot over to the brake. Very smoothly, you gently apply enough brake to reduce your speed. As you exit the turn, you smoothly let up on the brake with your left foot, allowing full throttle acceleration to carry you down the straight. This technique requires doing about four things at once; definitely an advanced skill. Your other skills need to be almost automatic so you can concentrate on what your left foot is doing.



THREE FOOT POSITIONS USED FOR
HEEL-TOE DOWNSHIFTING.

DECIDE WHICH TECHNIQUE WORKS
BEST FOR YOU IN SPECIFIC SITUA-
TIONS

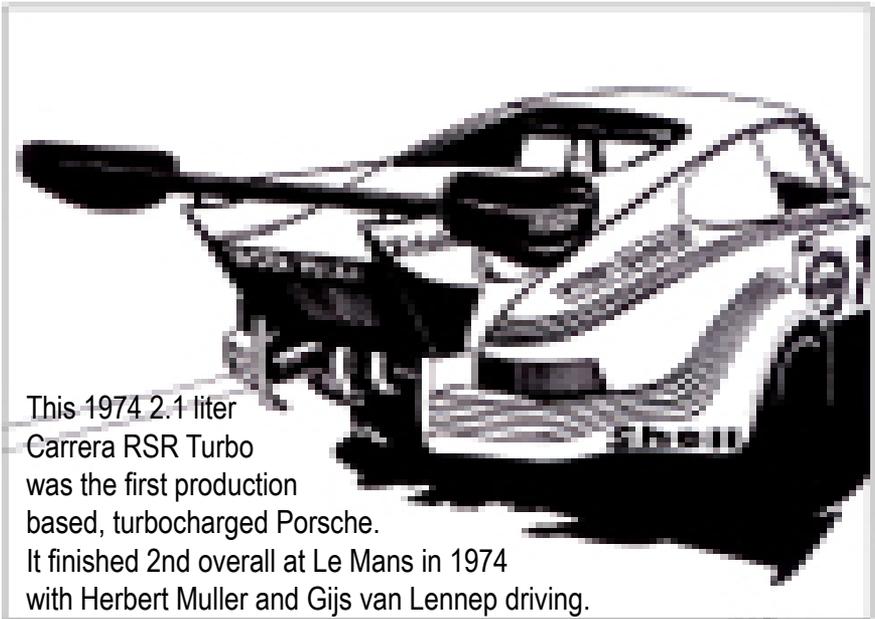


There are several advantages to left foot braking. First, the squatting down of the suspension lowers the center of gravity and allows the car to corner faster. Second, you have smoothly applied braking transitions, rather than more abrupt transitions from braking to accelerating. There may be turns where you need only to lift and not brake, but you can achieve the same effect with left foot braking without the upsetting transitions associated with lifting and accelerating. Finally, most turbocharged cars have turbo lag, where the car must build up boost from periods of no load or letting up on the throttle. Left foot braking can keep the car up on boost and thus reduce turbo lag and its accompanying, and sometimes disastrous, oversteer.

Be careful when you first try left foot braking. You will feel very uncoordinated and the car will probably jerk and be very unsettled. Your left foot needs to be trained for the delicate task of operating the brake pedal. The street is the best place to practice this. Make sure you have plenty of room with no cars around you. You don't want to hit anything or scare anyone. Let the car coast in neutral (leave it in drive if it's an automatic). Then simply try slowing the car using your left foot. With practice, you will soon learn to brake smoothly using your left foot. After you get comfortable, practice left foot braking on an easy corner with the gas kept at neutral throttle. Again, be sure no other cars are near you.

Extra Practice Time

Practicing on the street. The street is no place to speed or drive recklessly. *Road*



This 1974 2.1 liter Carrera RSR Turbo was the first production based, turbocharged Porsche. It finished 2nd overall at Le Mans in 1974 with Herbert Muller and Gijs van Lennep driving.

time is not a perfect substitute for *track time*, but, done prudently, it does allow us to get additional practice. We spend many hours street driving, so you may want to take advantage of this opportunity. The *only* element of performance driving that requires being at the extremes is finding a particular vehicle's handling limits, and this should only be done on the track. Every other aspect of performance driving can be done at safe, legal speeds.

Since the fundamentals are essential to learning better driving techniques, we should ensure that the correct basic habits are included in our everyday driving. This starts with your driving position in the car. Your seat position should be the same as when you drive on the track (not withstanding possible helmet clearance adjustments). This position is also the most comfortable for long trips. You develop correct habits so you don't have to remember and adjust when you are driving on a track. Turns at intersections offer good hand position practice for shuffle steering and other techniques that promote smoothness. As you straighten out again after the turn, be sure to feed the wheel back smoothly. Don't let it spin or snap back on its own. The goal is to develop smooth flowing, fluid steering wheel control with a minimum of hand motion and exertion. With enough practice this becomes so automatic that you can concentrate on other things (like watching where you are going).

While behind the wheel, think about your driving. You should be focused on what you are doing. Check hand position, seating, and controls. Scan the gauges and mirrors. Look for the correct line on the track, the track being the road on which you're traveling. It is not necessary to actually *drive* the line, but you can make finding it a matter of habit. Analyze turns. Is this one a Type I, II or III? Okay, so what would be the best line through this turn? Drive the line if it is safe to do so. This all happens at normal, safe, legal speeds. Remember, you are not learning the limits of handling, just practicing to read the track. This helps exercise our minds to look for the line. This process helps you think about what you should be thinking about - driving. It's safer that way.

In summary, you must have car control. You gain this skill with practice. Things like heel-and-toe downshifting, left foot braking, general smoothness, pedal sensitivity, reading the track and looking for the line can all be practiced safely on the street.

Attitudes

There is a correlation between a driver's attitude about driving and learning. Some drivers are absolutely merciless on themselves. They can overreact to a

simple mistake and blow it out of proportion (and the rest of the lap or day can be blown too!). Granted, to be competitive requires a certain amount of discipline and self-correction. You do want to recognize a mistake and somehow make an impression on yourself. But severely beating oneself over the head for something like getting on the brakes too late is counterproductive. The same sort of attitude can treat successes inappropriately also. A simple feat done correctly should be acknowledged. Yes, pat yourself on the back, but don't overreact and lose focus on the rest of the lap. Some people tend to be more animated and emotional. That's fine. Just keep your focus. Do not become emotionally dependent on what happens on a lap. A more moderate attitude is the key. Be aware of the effects that your attitudes and perspective have on your driving, and to modify them as appropriate. A good underlying theme should be the willingness to learn, to experiment and to rationally look at what works and what doesn't. Develop an attitude of sensible self-critique, of keeping a reasonable perspective on mistakes. Recognize and reward yourself for success. Allow yourself to experience your emotions, but don't let them dominate or distract you. Above all, don't let your attitude or emotions get in the way of safety. Work on building an attitude that supports and enhances the learning experience.

Credits

The efforts of many PCA members have inspired the Performance Driving School teaching materials. I am unable to credit them all, but I do want to recognize the contributions of former San Diego Region Chief Driving Instructors Steve Dente and Paul Young. Doug Adams of the Northeast Region contributed valuable material from their instruction program. John Hajny, of the Central New York Region, contributed the Appendix F articles. I want to thank Skip Carter for urging me to take on the job of Chief Driving Instructor. But mostly I want to thank and acknowledge the contributions of my wife, Cecelia Knauf, who has had a tireless presence in this club, and for making so many contributions to the club.

APPENDIX A:

Further Reading

There are many fine books to take you beyond what this manual can offer. Strongly recommended is *Driving in Competition* by Alan Johnson. This SCCA Champion is still a San Diego Region member. His book is delightfully well written.

You might also want to look for *Competition Driving* by Alain Prost. It is co-written by Pierre-François Rousselot, himself a F3 champion and for 10 years an instructor at Magny-Cours racing school in France.

Think to Win by Don Alexander is a book that addresses the psychological and physiological parts of being a successful performance driver.

Performance Handling, also by Don Alexander offers a good description of what handling is and some of the ways to make modifications to the handling. This is directed at those interested in the whys of handling, and the physics involved. Rather technical.

Books also worth checking out are *Bob Bondurant on High Performance Driving*, *Speed Secrets* by Ross Bentley, and Vic Elford's *Porsche High-Performance Driving Handbook*.

Most of these books will suggest other good sources..

APPENDIX B:

Suspension Settings

Once you have gained some experience, you may want to change some of your Porsche's handling characteristics. The factory settings are actually quite close to ideal, and some of these changes may result in increased tire wear and other problems. Also, some adjustments are quite easy to do at the track (like tire pressure), where others are more difficult (like spoilers). Talking to other drivers to see what they are do can also be very useful.

SUSPENSION COMPONENT	LESS UNDERSTEER MORE OVERSTEER	MORE UNDERSTEER LESS OVERSTEER
Front Spring Rate	Lighter (smaller diameter torsion bar or spring wire)	Heavier (larger diameter torsion bar or spring wire)
Rear Spring Rate	Heavier (larger diameter torsion bar or spring wire)	Lighter (smaller diameter torsion bar or spring wire)
Front Sway Bar	Lighter or lengthen arm	Heavier or shorten arm
Rear Sway Bar	Heavier or shorten arm	Lighter or lengthen arm
Weight Distribution	More rearward	More Forward
Front Shock Setting	Softer	Harder
Rear Shock Setting	Harder	Softer
Front Wheel Camber More positive	More negative	
Rear Wheel Camber More negative	More positive	
Front Tire Width Narrower	Wider	
Rear Tire Width Wider	Narrower	
Front Tire Pressure Lower	Higher	
Rear Tire Pressure Higher	Lower	
Front Track Narrower	Wider	
Rear Track	Narrower	Wider
Front Spoiler	Larger or more angle	Smaller or less angle
Rear Spoiler	Smaller or less angle	Larger or more angle



APPENDIX C:

Monitoring your learning

There are at least two approaches to learning. You can work on whatever occurs to you (and your instructor) at the moment, or you can have some kind of plan. Both seem to work in the long run, although the plan idea seems more appealing to most. It is valuable to review what you have learned and feel comfortable with and identify what you are not yet comfortable with. Plan to concentrate on some of these things. Or, you can let the instructor evaluate your performance and identify a few things that you should work on that day. The student work sheet that follows can help identify specific areas that may need work or review so that you can plan ahead and talk with your instructor about. Or, your instructor can review this list during and at the end of the day to identify progress and areas needing more work. Either way works.

Be safe. Have fun.

Student / Instructor Checklist:

Event _____ Date _____

	Student input			Instructor input			
	Needs work	Okay with	Got it	Needs work	Better	Okay with	Got it
The driver in the car							
Seating position							
Hand position							
Shuffle steering							
Pedal use							
Shifting							
Looking ahead							
Where to go							
<i>Part 1-Work on these first</i>							
Course walk							
Start out slow							
Use the whole track							
Type 1 turn							
Find & use landmarks							
Brake in straight line							
Increasing radius turns							
Select turn in point							
<i>Part 2-Work on these after Part 1 skills are solid</i>							
Linked turns							
Type 2 turns							
Type 3 turns							
Decreasing radius							
How to get there							
Smooth use of							
Steering wheel							
Throttle							
Brakes							
Shifting							
Smooth transitions							
Unwind steering wheel							
Threshold braking							
Throttle steering							
Consistency							

Driver's Ed. Education - A Series of Specifics for Success

by John Hajny

www.redlinerennsport.com

This is an ordered series of articles I prepared for the *Redline Report* - the official newsletter of the Central New York Region of the Porsche Club of America - of which I had been the Editor for several years. They have been widely reprinted by permission by numerous other regions of the club throughout the country. The text is obviously slanted toward Porsche owners, but the information therein is universal.

Their main purpose is two-fold. For the driver, they are intended to give a good foundation and smooth the transition you will be making as you enter into this exciting pastime. For instructors, they are intended to give you some specific solutions to some of the trickier and more subtle aspects of teaching the art of performance driving.

Through my efforts as an instructor, I have identified these topics as rather universal, and at times particularly vexing to the students (and the instructors who must help solve them!). Through careful analysis, I hope to help those involved with these subjects in solving the little mysteries of the performance driving riddle, and make it a little easier and less confusing to attain success.

Article #1 - Mission Statement

You may be wondering what application or purpose this Driver's Ed thing has for you? If you've been around the club for long, and you haven't yet become a *trackie*, you have likely been approached by some very enthusiastic folks who have a tendency to be rather persistent in trying to persuade you that this Driver's Ed thing is just what you are looking for. If they seem a tad overzealous, don't fault them; they simply have a hard time believing that anyone would not want to discover the great fun and reward of performance driving.

They will offer all kinds of reasons to illustrate why you should take the plunge, and truthfully, they are probably right! Let's explore why. First; the purpose of Driver's Ed (what I termed the *Mission Statement* when I wrote the handbook for the Zone 1 48 hours of Watkins Glen - the granddaddy of PCA Driver's Ed events). The following passage has been adopted by Zone 1 as the credo of Driver's Ed to describe to all what the intent of our Driver's Education pro-

grams is: *It is not the intention of this... event to turn you into a racer. The purpose of Driver's Ed is to teach you the rudiments of performance driving in the safe, controlled, and noncompetitive environment of a racing circuit so that you may use this knowledge to further enhance your driving pleasure and safety, both on the track, and in everyday street driving.*

What we can take from this is, no; we don't expect you to go faster than you feel comfortable. We don't expect you to drive like a maniac, either on the track or when you get home. What we know will happen is that you will attain a level of driving confidence and skill that you have never known before - even if you are already a "good" driver - and will not only be able to enjoy your leisure-time driving more, but do it with more skill and consequently more safety. A most worthy goal... no?

The document goes on to say: *The ideas offered here are meant to be a conservative and consistent starting point to your performance driving career. Make no mistake, this is serious business, and there is no room for anything less than a serious attitude on the track. At the same time, this is also serious fun, and should certainly lead to a lifetime of heightened driving enjoyment.*

As you can see, we mean business. No fooling around, no wild behavior; nothing less than your best effort to learn and improve will be tolerated. This is not to say that it is like boot camp. It is a lot of fun and you will likely find it addictive as heck, just don't think we're a bunch of speed-crazed maniacs hurling our cars around the track with reckless abandon!

"What is there to learn that is so important and that will help me every day" you might ask? Think of anything that you do well. What sets you apart from someone less proficient? Practice and repetition. If you pay attention and learn to do something correctly, you develop a feel for that task, and can almost do it with your eyes closed. From using a computer mouse to playing video games to playing tennis; you develop the anticipation and reflexive skills necessary to excel. Driving is no different.

When you find yourself in a sticky situation behind the wheel, you likely will not have time to stop and think, and so must rely on instinct and reaction time to get out of a jam. If you have practiced the art of performance driving, your skill level will be far higher than someone who has not, and you will have not only the knowledge, but the ingrained reflexive reactions necessary to improve your chances of escaping unscathed. Further, you will almost surely develop a heightened sense of awareness and anticipation, and may be able to avoid altogether the common situations that catch many others unaware. Everyone

should have this training! Many people are afraid to track their cars because of perceived cosmetic or mechanical danger. I addressed these issues in the “Common Misconceptions” portion of the handbook:

I WILL HARM MY CAR MECHANICALLY - Obviously, increased stress means increased wear. If your car is in shabby condition, you likely won't pass pre-tech anyway. Unless you are really driving fast and hard (unlikely if you are a novice), the added stress on traditionally over-engineered Porsche components will be negligible. Driver's Ed can be a good thing. It demands that you maintain your car to a higher level and it will be treated to things it normally may not receive, like fresh, annual brake fluid, brake pads and water hoses, wheel bearings repacked or replaced, etc. You'll get to know more about your car, and the fun is definitely worth the maintenance!

I WILL HARM MY CAR COSMETICALLY - This is the only category of tangible concern. However, with some preparation - such as a fresh coat of wax, nose mask, racer's tape, mud flaps, etc. - cosmetic injury can be virtually eliminated. There are many track driven cars that also provide stiff competition on the concours field. And anyway, Porsches were built to fly free. What would you rather have; a garage queen that deteriorates just sitting there, or a seductress that excites you?

If you are afraid of a stone chip or two, Driver's Ed may not be for you. You might reassess why you own the car. If it is original and pristine, you may have a point. If it is average or refurbished, it can be again, so don't worry. The saying, *Every Porsche Built is a Race Car* is fairly accurate. They were built to be driven. Otherwise, they're just another car.

So, there you have it. Driver's Education will teach you invaluable lessons in car control and safety that you will not get on your own. This is something that all drivers should aspire to. It will also provide you with a heightened sense of awareness, both of everyday driving conditions, and of your cars personality and capabilities; of why Porsches are such amazing automobiles. You will never know that until you drive your Porsche the way it was engineered to be driven. And... it's all great fun!

If you have been active in the club, you have likely realized this for yourself, but here is perhaps the best part of Driver's Ed: *Surely, you will be discovering something else; a whole new group of incredibly friendly and enthusiastic Porsche-philes who share your interest in the marque. You may soon find that the people are what it's really all about: serious fun with good friends and great cars!*

So... what are you waiting for? Life is short... Drive well!

Article #2 - The Language of Driving

The main interface between Instructor and Student is Language. What should it sound like?

Let's Talk Semantics. Communication between a Driver's Ed instructor and the student is obviously critical to the student's ultimate success. Verbal commands are the only effective means of signaling when a task needs to be undertaken, when there is a pending problem, or an adjustment to be made.

In the early stages, information overload is a common problem for students, and experienced instructors will attempt to filter this flood of sensory input by using very simple terms to lead the student through the initial maze of confusion. Trying to elucidate complicated theories on car control dynamics is useless at this point, and both the student and the instructor will be better served if the student feels a sense of calm and control emanating from the right-hand seat. Therefore, success is usually to be found by employing the KISS method: "Keep It Simple, Stupid!"

If words are the best tools, what words to use? Hey, the dictionary is full of them, but if the student has to stop and think or ask what the instructor means, they may be distracted from doing something more important... like braking for a turn! One of the first steps toward Driver's Ed success would then logically be to define and distill a list of terms to be applied consistently to the task at hand. This should be done before any driving takes place.

OK, after you position the car, the first thing you will have to do when preparing for a corner is to back off the gas. For this purpose, we will use a word that is definitely a two edged sword, but as long as it is done before a turn - and not during it - the result should be favorable. That word is LIFT (you likely will never hear your instructor say this in the middle of a turn!).

The next task on the list is to reduce speed in a straight line. That function can obviously be described clearly and succinctly by using the word BRAKE. Through experimentation and practice with braking, you will then reach a point where you have decelerated sufficiently to turn in safely. At this point, I use the term OFF BRAKE (or later, simply OFF) to signal the student that the brakes should be released smoothly in preparation for the anticipated steering motion.

This steering motion is quite effectively described by using the word TURN. After turning in, I like to encourage my students to move back to the throttle as early as possible and begin applying it progressively after the turn-in to help set their cornering arc and suspension balance. This is achieved by using the term

THROTTLE. Later, when we are more experienced and accomplished in driving “the Line,” we will combine these last two steps, but for now... yeah, you got it... KISS!

The next spot you will be heading for on the track is the epicenter of the turn’s inside radius. This most critical point of reference that we are shooting for is the APEX. As we pass the apex, we are continuing to add throttle as we exit the turn. As our speed increases, it is time to UNWIND the wheel and head for the end of our arc. It is now time to use the full track width as we accelerate out of the turn and TRACK-OUT.

We now have our basic list of terms to get us through the cornering sequence with minimal confusion: LIFT - BRAKE - OFF BRAKE - THROTTLE - APEX - UNWIND - TRACK-OUT.

There are more terms that can be useful in certain situations. One such moment is when the instructor senses (likely before the student) that centrifugal force is causing the car to fight for grip. The tires are working harder than they should or could be, and if the situation is allowed to continue, an unsavory result is possible. The instructor should ask the student to UNWIND or RELEASE the steering wheel slightly and allow the car to become more balanced and flow more smoothly.

Another situation the instructor is likely to sense before the student is the car traveling too fast (or on the wrong line) for a truly successful cornering experience. When this happens, the student must resist the temptation to modify any control inputs abruptly, and the instructor will ask the student to MODULATE or FEATHER the throttle, to HOLD the current settings and ride it out, and not make the situation worse by entering erroneous inputs.

So, if we do it right, our distilled verbal cornering sequence will sound like this: LIFT off the gas, BRAKE, OFF BRAKE, TURN, ease progressively into the THROTTLE, clip a tight APEX, UNWIND the wheel, and TRACK-OUT. The use and understanding of a like sequence of terms will greatly assist your learning experience... and your instructors peace of mind!

Article #3 - Car Feel

Tires and the Seat of your Pants

Learning the old "Toss & Catch"

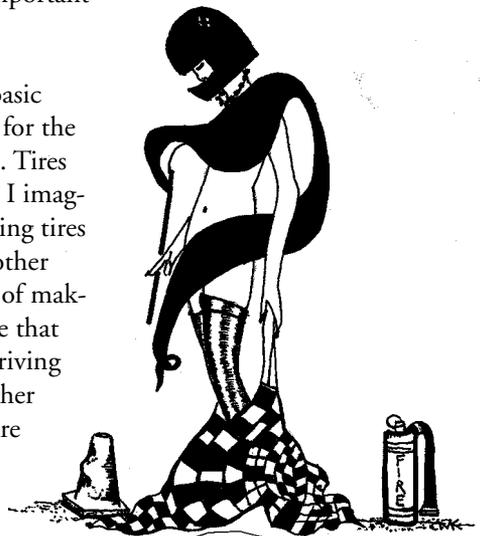
Let's talk about the ultimate characteristic that sets a really skilled driver apart from the norm.

The fastest drivers all share certain attributes to one degree or another: fearlessness, natural ability, concentration, experience, good equipment, etc. But there is one characteristic that sets the Schumacher's and the Senna's of this world apart: FEEL. This is not an exclusive trait, and it can be learned by anyone; the level of one's drive and goals notwithstanding. This is the trait we are ultimately trying to develop in ourselves. Without it, a driver will never be one with his or her means of conveyance and the stretch of road in question.

Do some people inherently have a better sense of feel than others? Good question. Perhaps it would be more accurate to state that certain individuals possess a higher innate sensibility where the dynamics of road feel are concerned. In the end, anyone can improve in this regard. Some just have to try harder. Improved feel for the road also generally leads to a heightened sense of overall awareness. That's really what Driver's Ed is all about.

You might have heard it said that the most sensitive organ must be the driver's backside. This is not a flippant comment. One's nether regions, in conjunction with the ears, eyes, hands, and a healthy dose of intuition born of experience, make up the proverbial *seat of the pants* feel that we are striving for. Without it, one can never progress beyond merely driving well mechanically. How can we accelerate our acquisition of this all-important sense?

At this juncture, I want to focus on one basic component of feel, and lend some advice for the novice Driver's Ed student. Let's talk tires. Tires are a big part of what we do on the track. I imagine some drivers spend more time discussing tires and their effective deployment than any other topic. This has the unfortunate tendency of making people, particularly the novice, believe that tires are the most important part of the driving equation. If one has progressed to the higher levels of performance driving, then tires are indeed a valid concern. However, to start thinking about *the fastest tire* before one has learned the how and why of their



usage will actually retard ones learning of the most important lessons; mainly that of feel and car control.

As previously stated, the goal of Driver's Ed is to teach you car control. You will coincidentally develop a greater sense of feel, and a heightened sense of what the car is doing and what it needs in order to go faster in a smoother and safer fashion. There are many things that contribute to the learning of feel; how deeply padded your seats are, how stiff the suspension, whether your tires squeal a lot, etc. However, how much cornering grip your tires have is the biggest factor.

Unless one is Idiot Savant, one cannot play Chopin without learning where the notes are on the keyboard. You can't learn to drive well by going fast first! You need to learn what to do, and what the car will do, gradually, and the easiest most effective way to accomplish this is to do it at a speed that will allow you to access your and your car's limits repeatedly. A speed where you reach the abyss... and learn through experience how to return from it safely. A speed that won't land you in deep do-do without your knowing how to wield the shovel first! It's in the tires, you know?

R-compound tires are great fun and allow you to really fly, but you have to earn those wings. Below the R-tire's limits, they will lull you into a false sense of security and make up for many inappropriate driving habits. When you push it, the super high grip of these tires is accompanied by a more sudden loss of that grip; they are far less forgiving than street tires. On top of that, if you've got the tires without the talent, you won't have the ingrained instinctual reactions available to help you deal with sudden cornering distress.

Think of some of the great drivers: A.J Foyt, Mario Andretti, Jeff Gordon. They cut their teeth on dirt tracks where sliding is control. Most every F-1 and C.A.R.T. pilôte has at least some karting experience, the better the driver, likely the more karting he's done. Learning with a car that moves around a lot will speed your ascension into the ranks of the skilled drivers. Street tires allow a car to slide around a lot compared to their R-compound siblings. The lessons learned while sliding about are as important to the equation as making sure the car has gas! If you've been coveting a set of R1s... wait. Learn how to boil water before you try your hand at real cooking!

Article #4 - Taking Care of Business

Remember when you first got started in Driver's Ed.? There sure was a lot to learn, eh? Come to think of it, while in some respects it gets easier the more you know, it also gets that much harder to improve as the gains get more infinitesimal. Geez, this isn't really very easy at all!

Everyone reaches various defining moments in their *driving career*. One such moment may materialize as the sudden realization that you don't seem to have enough time to get everything done before a corner. This particular moment may be accompanied and also defined by the sound of a nervous person in the right seat strenuously insisting that you *BRAKE!*

Such occurrences usually follow the period of intense trial and error in learning *the Line*. You begin to realize that your past instructors have been ever so right: To go FAST, you must first learn *the Line* while going relatively SLOW, and then eventually the speed more or less takes care of itself. Unfortunately, this being an entirely fluid exercise, meaning things are constantly changing, you can rest assured they will be again... very soon.

At the point where you have learned "the Line" and can drive it with some consistency, you may notice that this has allowed you to go a lot faster. This has the coincident effect of bringing you to the corners much sooner. Suddenly, it seems the real race is in getting positioning, braking, and downshifting completed early enough before you have to turn. Here's a trick to help you sort through these frustrating and potentially ruinous moments.

As you begin going faster, you will need to reevaluate your braking and turning points constantly. The first step might be to not *Brake Backwards*. Distilled, this means braking hard early and then easing up as you reach the turn-in point. Now, that turn-in point will change depending on the circumstance, but there's lots to do before we get there. Let's play a little game that I play with my students when they become corner chargers and look at that turn-in cone in a different light.

OK. Let's temporarily rename that turn-in cone as the *Business Cone*. Passing, Braking, Shifting, Positioning... There's lots of *Business* to take care of before a turn. It stands to reason that one cannot turn in effectively if one is still busy trying to get positioned, shifted, and slowed. This is a common overload situation; both for the driver and the car. It is more than likely that the student is charging into many of the turns with suspect control, and if they can indeed complete the corners in question without going off, this will then result in the inability to accelerate as soon as someone who has entered the turn more prudently. Since turns are followed by either straightaways or more turns, you

have obviously fouled up the ensuing sequence, for which you will pay dearly in terms of flow and overall lap efficiency. What to do?

The goal of this lesson will be to learn by trial and error a combination of positioning, shifting, and braking points that allows you to consistently complete All of your Business before that *Business Cone*. Don't get frustrated if you're having difficulty in doing this. No one does it right the first time. If it rains or you make changes to your car or whatever, you will be redoing all of this again and again. The process of discovery is what is important here. It boils down to patience, concentration, and perseverance. Keep at it and it will come eventually, and you will then have a system that you can use for any combination of circumstances.

By completing your business before you turn in, you are helping your likely overloaded brain do as few things as possible simultaneously. You will also allow your car's suspension to unwind and return to full readiness before it has to cope with cornering loads. Balance in both driver and car is the goal here, and it is critical. With more seat time you will eventually be able to condense this process to a shorter track distance, but don't rush it. Remember, Slow In, Fast Out. It's not only safer, you'll really learn, and go, faster!

So, you've learned *the Line* and can repeat it with some degree of consistency. You are now attempting to systematically reverse the negative side effects of the extra speed this has given you by completing All of Your Business before you reach the *Business Cone*. Remember how I said this driving thing was a fluid exercise? Well, now that you can do *the Line* and *Take Care of Business* consistently, we're gonna rename that turn-in cone again!

Henceforth, it will be known as... the *ACCELERATION CONE*

Article #5 - Throttle Balance: the Key to Smoothness & Survival

Last time, we talked about the *Business Cone*. Then, just when we got used to that, I renamed it ...again!

I told you that Performance Driving was going to be a fluid exercise, so you might as well get used to it! Speaking of fluidity; that is what we are attempting to achieve in our driving style. Unfortunately, as we increase our knowledge and speed, fluidity can begin to suffer somewhat. When one begins to approach the limits of the car's suspension and the tire's adhesion, one must be careful and very specific with control inputs. Sudden moves are not likely to achieve the desired result; which is making the corner. How do we control the delicate dance that we have engaged in?

One key to high speed cornering success is *Throttle Balance*. Forget about acceleration for now. Just as much as the steering wheel, the Throttle is an important tool in assuring that the car stays planted and will maintain the proper line through a turn. If you have one without the other, you only have half the mix!

Let's say you have mastered *the Line* (at least the theory of it), and have recently become proficient at completing all of your *Business* before the *Business Cone*. Most students will be applying the throttle as they pass the apex as instructed because it is safe and relatively easy. When the student learns *the Line*, it is then time to start accelerating sooner for increased suspension balance, exit speed, and terminal straightaway velocity.

At this point, many of my students notice throttle application becomes problematic because it often seems to alter their intended cornering arc and has a tendency to cause them to miss their apex in many instances. They may also experience moments of high anxiety where the tail wants to jump out in a turn as they cruise along with minimal throttle readiness. For these reasons, and more, we will now rename that turn-in cone once again.

Now that the student has graduated with a degree in "Business Cone Administration," we will henceforth refer to it as the *Acceleration Cone*. Cornering velocity has now increased to the point that steering alone does not achieve the desired result. If the tail jumps out, simply steering out takes you away from your apex and closer to an off-track excursion. It also does nothing to increase what you really need: *Rear Wheel Traction*. Also, if the front end pushes wide, steering tighter will likely exacerbate the situation, or may cause the front to bite and the rear to jump out. What to do?

Proper and timely application of the throttle can help mitigate these maladies

and smooth out your cornering attitude. With any car, and particularly in the case of the rear or mid-engined cars, it transfers all-important weight - and therefore traction - where it is needed most; to the rear wheels. Also, the earlier you get on the throttle, the more time you will have to correct any alterations that this may enter into your intended cornering arc well before you reach the all-important apex.

Now, if you have gotten *All of your Business Done*, and have a good feel for the Line, it is time to put these items together with the final ingredient: Throttle Balance. As you turn in, you simultaneously apply the throttle! You will, of course, have to experiment with how much and how soon depending on the corner, but by using the *Acceleration Cone* method, you will have eliminated any variations in line that mid-turn throttle application is likely to cause, and are now ready to correct for any surprises that the track surface or your car's idiosyncrasies may have to offer.

With enough seat time, you will learn to reflexively counter those nasty moments when the tail steps out with just the right amount of counter steer... without lifting! If you maintain *Throttle Balance*, you also maintain the rearward weight shift that you need for traction. Concurrently, if the front starts pushing wide at any moment, and you have your foot on the throttle already, a slight and momentary lift - perhaps in combination with a slight steer out of the turn - will shift weight forward and increase front traction. In addition, this method of cornering not only allows you to build the momentum that will help you swing around the apex cleanly, but also adds that momentum to whatever velocity you are able to create with simple stand-on-the-gas acceleration in the straight.

If you've learned *the Line* and can *Take Care of Business*, it's Throttle and Steer, Throttle and Steer. They are as important to each other as engines and oil. Foul the ratio up, and your gonna spin something. Put them together right, and the car simply sets once, and sails!

Article #6 - Momentum

We're down to the nitty gritty now. *Big Mo* is your Friend!

Last time we talked about getting that good, clean, tight late apex that will increase your acceleration zone. Let's assume you've learned the line and drive it pretty consistently at a good pace. You've learned to finish all of your business before that *Business Cone*, have a good grasp of where that turn-in point is (or at least how to find it!), and have now converted it to the *Acceleration Cone*. This next theme is going to become increasingly important as your speed continues to build. *Trust is a Must!*

Eventually, most of my students reach a point where real consistency and speed are just a breath away. They know the line and are beginning to notice what effect their inputs have on the car as it corners. They now notice what jumping on the throttle to begin cornering acceleration is doing to their line (it throws the front end away from the apex!) and they feel those minute twitches in the tail-end that they didn't before. When the student starts to correctly critique their own driving, I know we are really close. But once again, just when you thought you had it down, I'm going to throw another curve ball at you.

When you've reached a certain point in your driving, that deep, late turn-in we've been pounding into your brain may not be the best line to take into a corner. It was designed to keep you on the track surface and out of the weeds until you learned the basics, but it is not the be-all and end-all of cornering theory. Ultimately, you need to learn to drive the way that works best for you and your car.

If you are beginning to carry more speed into that late turn-in area, you may likely find that this is making it difficult to reach a tight apex. The car is drifting wide and you find yourself really cranking the steering wheel trying to get over there, and the result is a lot of front end push and that old *I'm run-ning out of track-out* feeling. It's likely time to modify that late turn-in a bit, and to develop *Trust*. At this point, I instruct students to start turning in a little earlier so they can reach that tight apex that is so important. ~~It becomes a~~ balance between the point where they turn and the amount of *Momentum* they are willing to carry. At first, the earlier turn-in will cause a perceived early apex situation, which obviously is very unnerving, and will entice you to steer away from your apex. But, you do not want to do that, do you? Now is the ultimate moment... when *Trust is a Must*, and *Momentum is our Friend!*

Now that we've begun to turn in a little earlier to tighten our apexes, we need once again to fight that improper reflex; to turn away from that apex! This is a potentially dangerous time in your "driving career," because you have learned

enough to begin driving with some decent pace, you've learned that the car is much more capable than you, but you have not necessarily developed confidence in the amount of momentum you can safely carry through the turns. With that extra speed you've developed, this is the time to really concentrate hard and use those car-feel senses to the max.

Assuming smooth technique (as always!), virtually every car will initially understeer mildly in a turn. We have learned to mitigate that "push" by turning decisively, and to quell any chance of sudden oversteer by accelerating smoothly. This sets the car on its suspension evenly. When one reaches about 85% of the car's capability, if one has been tactful, the car will gradually ease into a four-wheel-drift, and ultimately begin to oversteer slightly. How much oversteer is a matter of how well you've combined the ingredients. Believe it or not, this is the point we are trying to reach... Trust me!

By driving the car past initial push, through drift, and on to mild oversteer, we have now begun to rotate the back of the car around that apex and to effectively point the car up the next straightaway earlier than if the car were drifting or understeering. This is the principal that has made the 911 so effective in racing, and that makes the 914 such a dynamite autocrosser, but it can be done with any car that is properly set up and driven. You may have heard it said that, *a Loose Car is a Fast Car*, and this is true, but now is not the time to realize that you should have already developed that sensitive throttle foot! Incidentally, if you are having difficulty tuning your car to this slightly loose state, it's time for an adjustable rear sway bar to tighten the rear of the car to the right degree for comfortable and manageable oversteer.

So, if you have a good fix on how much speed to enter a turn with, know where and how much to steer, how much throttle to add, and how to maintain that cornering balance you've set, hang on and enjoy the ride! If you've set all these things up properly, simple minute throttle and steering inputs will arc you by that apex like you were driving on rails.

Guess what... you are!

Article #7 - Apex

Here's a tricky topic that always comes to the fore when a student naturally begins to pick up the pace. Late Apex Ya Say...?

One of the key concepts in performance driving is the Corner Apex, that innermost point of a driver's cornering arc that we are all striving to nail so accurately. If you can remember back to physics and geometry in school, you can see that what corner dissection really boils down to is a cross between the physics of a mass in motion, and billiards. We're attempting to play the forces and angles in a fashion such that we effectively reduce the time that our front wheels are turned, and lengthen the ensuing acceleration zone (straightaway), while maintaining maximum momentum through the turn.

You may remember that your early instructors were asking you to take corners in a way that felt very unnatural to you. They were always squawking at you to *stay out, go deep... don't turn in so soon!* It seemed as though they were having you go absurdly deep into the corners before turning. It just felt so dang awkward, didn't it? But you got used to it, and eventually could go deep smoothly and consistently, right? I'll let you in on a little secret; even though you didn't realize it, your instructors were simply protecting their backsides... and yours! Their wisdom will soon become evident.

As a novice driver, once you begin to master the driving line, you notice that everything begins to change yet again. You seem to be missing braking and turn-in points, charging the turns, sliding wide of your apexes, running out of room at the track-out point, and generally driving like you've forgotten everything you ever learned. Why? What happened?

Speed happened! Those wise old instructors know that speed is a function of proper mechanics and learning the line, not simply of bravado. When a student begins to master the correct driving line, the speed just happens all by itself, and it generally takes the student by surprise because now all those references you struggled so long and hard to establish are out the window! Geez... this is still hard work, isn't it?!

First of all, if you have learned the line correctly, and have not totally forgotten it as your speed has increased, all is not lost... yet. That *awkward line* you learned was meant to give you a foundation. If it was solid, even if the upper layers begin to crumble a tad (which they inevitably will!), it will still be there to build on. The deep entry and late turn in point were designed to keep you both safe while you learned the dynamics of performance driving. And, as you can see, it is plenty dynamic!

At this point you need to become aware as a driver of your instinct to turn in

too soon, and resist it. You also need to become aware of the laws of physics fighting you for control of the car. What you need to do is take control. You see, speed is, in our case, a hallucinogen; it alters and distorts ones perceptions, and throws off ones timing. When drivers begin to pick up the speed, that old early-turn-in bugaboo creeps back into things and causes the student to get impatient and nervy. Suddenly it becomes a fight to make that apex again, that hallowed ground that you'd begun to visit with regularity. Worse yet, now you're not only missing your apexes, but are seeming to find extreme distress lurking at the track out point as well. Here's the deal.

You need to reestablish your control by fighting the temptation to turn in too soon. By turning in too soon, you almost certainly will apex too soon. If you run wide of, or arrive early at, your apex by as little as three feet, that can translate into a track out point that is 10-20 feet earlier than if you'd hit a tight, late apex. It didn't matter much when you were first learning, but now you can't afford to give up that much track-out when you're going faster! Also, you need to turn the car in decisively in all but the gentle sweeping turns to set the car's suspension and balance early, and to get it to rotate toward the apex, and you need to then listen to and feel what the car is asking of you. If the tires are screaming or centrifugal force is really pulling the tail around, unwind the wheel a touch and let the car run a little freer. As we've discussed in previous installments of this series, you have to develop a feel for what the physical situation is, and what the car needs to perform optimally.

Because your speed has risen substantially, you've suddenly lost that comfort zone that seemed to come so gradually. So let's get it back! By using the late turn in approach your instructors drilled into you, you will again be able to establish that sweet, safe late apex that everyone always strives for. It was drilled into your subconscious because it is safe and comforting, and will never let you down. By using that late turn in, you can more easily attain that safe late apex you need to survive as you continue to put all the ever changing dynamics of performance driving together into a cohesive package.

You may have heard it said that, *Friends don't let Friends Early Apex*. Neither do Instructors their Students! It's a rule you can live by.

Article #8 - Throttle Balance II: the Soft Shoe Shuffle... on Egg Shells!

Your instructors have likely always harped on the need for smooth, well timed inputs to the car. As I've mentioned previously, when speed happens, things change, and your timing and input levels need to change with them in relation to the speed you are going. It's a witch's brew folks. But the bottom line remains; your inputs should never unduly unsettle the car.

Now, you may go out with your instructor or other drivers as a passenger, and be shocked to see that he or she seems to ignore what is preached. They seem to drive quite abruptly and aggressively. Well, don't be fooled; remember, it's all relative. They are likely going a lot faster than you - particularly in the turns - and what seems abrupt is only what is necessary to make the car do what the driver wants it to do. Different cars and speeds require different levels of input, and as the speed rises, the inputs must be more assertive. There is a key element - one that we have discussed before - to concentrate on in such situations. Don't necessarily focus on the driver... focus on what the car is doing!

I learned this lesson early, and well, from one of the masters of the art. My first-ever performance driving experience was at Watkins Glen at the Porsche Precision Driving School conducted by Derek Bell. I was fortunate to have Mr. Bell pilot my pokey old '84 944 around the Glen at speeds that I had never imagined, in a car he'd never driven. What initially stunned me was his driving style. It seemed to me at the time that he was a madman behind the wheel. His concentration was immense; his eyes, like laser beams, focused up the road. His craggy face was drawn tight. His hands were a blur on the steering wheel as his arms flailed - making the minutest of corrections - for reasons that I couldn't fathom at the time. All I'd heard in the classroom was "smooth, smooth, smooth," and yet here's this crazy person driving my car!

Then something entirely seminal dawned on me. While the driver seemed crazed, the car fairly floated through the turns as if on gossamer wings. The changes in the car's attitude were barely perceptible, and it was the insanely acute vigilance of the driver that was making it so. It changed my thinking and my focus right then and there. I was indeed lucky!

What I have found with my students is that when they learn the line and begin to pick up the pace, their brains become hurried, their excitement and anticipation bubbles over, and smoothness and timing usually goes out the window. The amazing thing is that most often, the student is making erroneous inputs to the car without even realizing it. "We ran wide of our apex back there, eh? Yeh... I can't seem to get the car over there! Why did you jump on the throttle

so hard at the turn-in? Huh?!... did I? Didn't you notice the front end jump out? Yeh, but I didn't know I stomped on the throttle..." It's amazing, but it happens all the time. Time to refocus, and listen to the car... remember?

Now, if the above student had been listening to the car, even though he may have hit a perfect line, he would have known immediately that his stomping on the throttle kicked the front end out, causing him to run wide of his apex. Does fixing this problem assure a good apex. Nope. So, what to do? Well, we said don't tromp the throttle, but you may add it at your discretion to fine tune your line. If you have progressed to the point where you are setting the car hard in a clean four-wheel drift and are running toward your apex, minute additions and subtractions of throttle, along with small steering corrections, will help you fine tune your line and give you that perfect tight apex.

If you've ever been fortunate enough to do a real skid pad, then remember. Remember how you were instructed to approach the limit of adhesion, gradually bringing the speed up until the car started sliding? At this point, you were instructed to play with the throttle slightly; just a tad more pushed the nose wider, the minutest release on it tightened your line. If you slammed it shut, the rear end stepped right out. Remember? Doesn't everybody play racer on the off ramps? Try it tomorrow. Cruise through a ramp at a pace such that you feel a little tug, then back off the throttle a touch. Wow... tightens right up! Now add that throttle back in. Pushes right back out! Hmmmmm. It works for any car! Heck, I've even done it in my +-ton Ford van with the car and trailer in tow, although that may not be advisable as a rule!

This is really what we mean by the term Throttle Steer. Sure, tire smoking power slides and chop throttle oversteer are impressive, and technically under that heading too, but they have only the smallest of roles in a skilled driver's dossier. Look, anyone can bang on drums, right? Many can even play loud and fast. But only the true artist can play soft and fast. On the track, the loud guy is generally not the fast guy. He's in the weeds. So... how fast do you want to be?

Article #9 - Let's Get Wet!

“Real” racers drive in the rain. Should you be any different? The short answer would be, No; you shouldn't be different. Remember, the real mission of Driver's Education is to teach you skills you can use on the street everyday in an emergency, and sometimes it does seem like there's one around every corner, doesn't it?!

Many Driver's Ed participants dread the rain, choosing to park their vehicles rather than “chance it” in the wet. Truthfully, they may have a point. If their tires are down to their last few 32nds of tread, they need to think this one over carefully. However, you drive on the street in the rain and likely don't think twice about it, right? Every driver - be they stone novice or grizzled veteran - should jump at the chance to drive in the rain for one big reason; you simply **MUST** drive smoothly and at the peak of your skills to be successful. If you don't feel you have those peak skills yet, the rain will teach them to you in a big hurry. Like yesterday!

So how does one drive well in the rain? There are a few things to think about. First, relax. No one drives well when they are tense, and driving in the rain is not as horrifying as it may initially seem. Heck... just slow down, take your time, and work up to it gradually. Trust me, no one will expect you to be Senna out there.

Next, we need to review some of the earlier lessons in this series; specifically Car Feel, Throttle Balance (Smoothness), and the Business Cone. The great thing about rain driving is that it literally forces you to pay close attention to what the track is like and what the car is doing. In some instances, grip can be moderately to completely nonexistent, and you must plan ahead and be prepared to make split second corrections in the cars attitude.

Car Feel: You must interpret the limits of adhesion very carefully and remember where you found grip on the track, and where you didn't. This process of hunting for grip is key to your survival, and pays great dividends because it can be directly applied to high speed running in the dry as well. Driving in the rain will force you to step outside the bounds of what you have learned to be fast in the dry, and open your mind to new ways of thinking about driving swiftly.

Throttle Balance & Smoothness: You must have these in spades. You may get away with jerky driving in the dry, but you won't for a heartbeat in the wet, for that's all the time you will have to come to the realization that you need to smooth out your style, and by then it might be too late!

The Business Cone: It is absolutely imperative that you be Done with your Business before you turn in on a wet track. If you have not learned this lesson

well, you will find yourself in big trouble in a big hurry. You need to be coasting and at the ready in the proper gear so that the suspension is as close to *at rest* as possible - as balanced as can be - and there is not an overload of force on any given tire.

You may have heard people talk of the *Rain Line*. In very general terms, this means everywhere but the *dry line*! In most cases, the normal dry line will have a lot of rubber ground into the surface. If there are any slippery fluids on the track, they will more than likely be on the line as well. Also, the track surface usually tends to be polished smooth by the repeated traffic in one spot. Although it is not always the case, all of this usually conspires to make the dry line very slippery when it rains. This knowledge, along with a careful scanning of the track surface will tell you where to go for grip.

Your vision - which is always of paramount concern - will now be called upon to find areas of grip. Yes, you can actually see the areas where traction is likely available. Even more so than in the dry, the slippery, polished groove will appear extremely shiny in the rain, and indeed shiny surfaces tend to be slippery. You will be looking for the darker areas, as these are where the surface has more grain and consequently can better manage the water without becoming flooded and leading to hydroplaning.

The condensed sequence will have you done with your business well before turn-in. You will find an amazing amount of braking grip - perhaps up to 60% of normal - if you've picked the right line. You will be looking for the darker, drier pavement; perhaps entering a turn one car width inside the dry groove, crossing that groove in a relatively straight path to get to the grainier pavement on the outside of the turn, then turning and accelerating gently and crossing the dry groove again, coming out about a car width inside your normal track-out point. Generally, you drive everywhere but the dry line as much as possible. In the end, experiment to find out what works best.

And this is the wonderful lesson to be learned in the rain. Experimentation. For the novice, it will speed your learning of smoothness and feel, for although they may be masked in dry conditions, your deficiencies will scream at you in the wet. For the more experienced driver, it will refresh this lesson, plus it will force your mind to try new things and expand its processes.

Driving in rain is the best instructor you'll ever have: increase your knowledge and progress many times over. Just suck it up and don't worry. Like the legendary Gene Kelly, in no time at all... you too will be Singing in the Rain!

Chapter 10 - Be a Visionary!

Vision. Sighted people take it for granted, but 70-80 percent of the information

necessary to drive effectively is derived from it. We've already spoken of *Car Feel* and its importance to the mix. The other major component of your sensory arsenal is sight. Everyone out there can see, but it's what, when, and how you see that determines your response effectiveness.

The importance of vision begins right off when you are moving through the paddock at the track. Helmets, neck collars, and harnesses restrict your normal vision levels. You must be aware of everything in your vicinity or risk a most embarrassing faux pas. When you get on track, the first thing you will be looking for is where the safety and flagging personnel are; a most important task. Then you will be scanning the horizon for where it is that you are going, and where you should be within the barriers.

You will begin learning *the Line* right away. Your instructor will tell you where to go at first, and to aid you in developing some consistency will likely offer you some visual reference points to mark where you should be braking, turning, etc. This is a time when your brain is very busy and stimulus overload is at its peak. You may note at this juncture that you are likely looking a little farther ahead than your front bumper, and it should occur to you that this is quite helpful, not to mention, prudent. Closing speeds will be higher than you are accustomed to on the street, and you need to make certain you allow yourself the chance to adjust your reaction time.

Early on it is natural to focus on your turn-in point or your apex. This can tend to create a jerky "connect-the-dots" situation and does not allow you to look far enough ahead to drive smoothly, let alone safely. It is never too early to begin learning to look at nothing in particular, and everything in general. You should not be focussing on any one thing to the exclusion of everything else. Your visual reference points should be such that they can eventually be relegated to your peripheral vision, and mentally "checked off" as you pass by, all the while looking up the track where you want to go.

As a driver, your eyes should be scanning the road ahead as far as you can see. Your vision should never drop below an imaginary horizon line in front of the car. If you are in traffic, you should not be looking at the rear bumper in front of you. If a situation develops, it will likely not be initiated by the car in front of you, but up the line a few cars. If you are not looking through the windows of the car in front of you to scan the traffic ahead, you risk being caught in a surprise domino effect. Each car in line has to brake progressively harder, and you may be the guy caught out if you are not anticipating.

You should be glancing in your mirrors often. A good time for this is before setting up for a turn so as to anticipate faster traffic approaching and plan for their

overtaking you. Failing to learn this technique creates a situation where students are surprised by faster cars *suddenly* pasted to their rear bumpers! This is how *traffic slinkies* begin. Very frustrating! Be aware! Anticipate!

In order to drive effectively at the limit, whether in the wet or dry, your eyes need to be scanning the track surface for bumps and seams, slick spots, grainy areas, etc. Your cornering grip depends on that track surface. If you hit a bump or slick spot mid turn, you will likely lose adhesion or upset cornering balance. Don't wait for the car to get away to be scanning for potential trouble spots. Again, good vision leads to good anticipation.

Students and instructors have a lot to do out there, eh? Well instructors, once the student has started to learn the line and is responding well to your distilled list of verbal commands, here's a good drill to accelerate learning of proper visual timing. Instruct the student to look where you tell them at the precise moment you utter the command. As they begin braking, call out "Turn In." A few car lengths before they reach the turn in, call out "Apex." Just before the apex, call out "Track Out." This drill will set a concrete sequence in the student's mind that will eventually become second nature. When skill has reached sufficient levels, calling "Track Out" shortly before turn in will really get the student looking up the road.

Ever notice how when you turn your head to look at something, you seem to drift off the road in the direction you're looking? We can learn to harness this tendency to help our driving. Like the one mentioned previously, here's another excellent exercise that you can, and indeed should, practice on the street. Find a sweeping curve of 90 degrees or more (tighter freeway onramps are excellent). You will be practicing looking far ahead to where you eventually want to end up, even if this means looking out the side window. Although it feels unnatural and even dangerous at first, you will see that it can be done rather easily and quite effectively. Some tracks offer turns where this is necessary; Turn 2 at Laguna Seca, Turn 2 at Lime Rock, the infamous Turn 2 at Mosport. Turn 6 at Watkins Glen forces you to look nearly perpendicular to your direction of travel! We can use this natural tendency to our advantage: Remember, the hands usually follow the eyes.

To look, and not to see, means to drive poorly. Open your eyes. Feel the rear bumper of the car ahead of you with them. Feel the road surface. Feel every nuance, every dip, crack, undulation. The more you learn to feel, with all of your senses, the more effective you will become!

Article # 11 - Passing Grade

We've talked a lot about driving as it pertains to you specifically; by yourself, getting around the track effectively. Lets discuss an important *community* issue for a moment. Unless you are made of money and can build or rent your own track, you will not be out there alone. One thing you will learn in life is that no matter what you've got, someone's always got more. On the track that means passing. A no-brainer? Not likely!

Most venues operate in more or less the same manner concerning passing. The slower car points out the driver's window with the index finger to the side that they want the pass made. Just like anything, there are do's and don'ts, goods and betters. For beginners on tracks of clockwise circulation, it is advisable to only allow passing to your right. The slower car will stay on line at all times and give the signal for the faster car to pass *off-line* to the right. This is where most faster drivers will anticipate the pass to occur and you may cross them up to do otherwise. Incidentally, some groups allow the use of turn signals for passing, which can be advantageous in some instances. But, by-and-large you will be pointing.

Nothing less than an emphatic point up and over the roof of the car will do. Quick pokes or flips of the hand may not register and may cause a dangerous situation. Multiple cars require a signal for each, not a group point-by. Remember, the other drivers are not mind readers. If they are prudent, they will assume that you may not have one. It may not be fair, but it is safer than hoping you do. Leave no doubt... Thrust the Hand OUT!

We've talked about vision previously. It is very important to good passing technique, be you the passee or passer. Good vision means being aware of not only where you are, but who is around you, and what their potential is. A good driver will be constantly scanning their mirrors for traffic coming on and be ready to let it pass smoothly.

The passee always has control of the situation, and should not initiate a pass unless they are ready for it. This requires looking in the mirrors early, assessing the closing speed of the other vehicle(s), and making the necessary adjustments. It is the responsibility of the passee to give a clear, emphatic, timely signal that they are ready to be passed, position their car properly, and even lift slightly on the throttle if necessary to facilitate a clean pass.

The passer should never rely too much on sheer anticipation of another driver's moves. The safest way is to wait for the signal, and then pass leaving plenty of room beside and in front of the passee. I also see too many drivers acting like racers; blasting by mere feet away and then clipping in at less than 2-3 car lengths. These antics may unnerve a less experienced driver. Leave your macho

joy stick driving at home... give 'em room!

What makes a good pass? Honestly, a good pass is most dependant on the pas-see being aware, and being courteous enough to give a clear and timely signal. When you gain sufficient experience and comfort on a particular track, in certain circumstances, there is nothing wrong with giving a signal before you reach your track out point, or even a quick point before you enter a turn. This lets a faster driver know that you see him and are ready to let him get on with his fast lap with minimal encumbrance.

If you are the first car in line leading onto a straight (such as entering the back straight at Watkins Glen), you really needn't - and actually shouldn't - wait till you are absolutely straight to give a signal. Give it early and move over a couple of car widths to facilitate an earlier pass. This will make you golden with the faster drivers, and minimize traffic congestion and frustration in passing zones.

Now, some tips. Traffic is something that everyone has to deal with, be they in the top instructor run groups, the novice groups, or on the street. While it is understandable, it does no good to get steamed because a car is too slow or "does not seem to have mirrors." Deal with it like an adult. Remember, you are all there to have fun and learn. Trackies are all friends, but learn at different rates. Give the more timid or less aggressive driver a break.

At the same time, if you see something discourteous or dangerous, it behooves you - or better, your instructor - to make this known to the event steward. They will then confer with that student's instructor forthwith and see that the situation does not persist.

If you are being held up by a driver that doesn't seem to acknowledge your presence, remember that it doesn't help if you are not in their mirrors. Pulling to one side or another takes you out of their field of vision, is rather rude, and can be dangerous if it distracts them. Weaving around and taking runs at them is completely uncalled for. If the problem persists, don't take things into your own hands. Again, have your instructor inform the steward.

If you are a newer driver blessed with a fast car, take note. Drivers of higher skill may likely catch you in the tighter sections. If you see a car continually looming in your mirrors through the twisty bits, don't just romp on it in the next straight. Be a great guy/gal and let them by. They will be impressed by your courtesy, will disappear in the distance, and you can both get on with your runs.

Like everything else, passing should be done properly. If done well, it improves

the experience for everyone involved. Although it seems to be less and less evident on the streets these days, you should drive at the track with a sense of deference and community.

What counts most at the end of the day is your enjoyment, your improvement, and your reputation, not a quick lap time!

Article #12 - Horsepower... the Myth!

I suppose it's not that hard to believe really, but it puzzles me nonetheless. Seems that a lot of people who get into the Performance Driving hobby somehow equate more horsepower with better driving. It doesn't take very long at all before many folks start thinking about improving the engine performance of their cars, regardless of whether they have the driving skills to utilize whatever horsepower they gain, or not. I'm here to tell ya folks... it's more likely not!

It takes years to learn to do anything complex and do it well; piano, karate, foreign language, etc. What makes you think performance driving is any different? When you're talking performance cars - particularly Porsches - it takes a lot of practice, and more to the point, a lot of self evaluation, soul searching, and envelope stretching to utilize all of the potential that exists in the car, even in bone stock form. If you think you're good, here's a way of gaining some perspective; Do you think that David Murry or Hurley Haywood or Derek Bell could jump in your car - stone cold - and in short order surpass your best performance? You bet they could! You're not as good as they are. You may never be. The point is that if they can do it better - likely by a comfortable margin - then the *problem*



with a heavy foot. When you're driving a new 996 GT3R and can't keep up with a 911 Carrera 2, there's something wrong with the equation!

Can that be a satisfying scenario for the rich guy? Of course, owning such a prize piece is quite rewarding, I'm sure. But how much fun is it to be a rolling chicane? Would not it be far more satisfying to ratchet down the expectation and demand of such a high caliber steed to a more accessible level? At Sebring, I saw a guy write off a beautiful GT3 class 911. Lost it coming out of the Esses and hit the tire wall that guards the bridge on the center straight and rolled two or three times. Guess he'd also rolled the same car the previous year. Thank goodness, he was quite all right on both occasions, but something is surely amiss here. By all accounts he is a great fellow, and perhaps even a pretty good driver, but it seems to me that a serious gut check is in order here.

If one races for a living, one must rationalize such carnage as a hazard of the profession. If one is prolific, one likely won't last long in any event. The point is, what are your goals? To drive fast or well? If it is the latter, then driving a car with accessible limits will make you a better driver sooner than the rich guy with the mondo-zoot rocketship. If you're looking for a car, be truly honest, humble, and reasonable. Buy something not because you can afford it, but because you can handle it. If you already own a suitable vehicle (and that's a big list), leave it alone and spend your money and energy on perfecting the performance of the nut behind the wheel. Indeed, most cars in stock form will slide around considerably. The question is; can you handle it? When you can truly drive a stock vehicle to a very high level, then you can honestly justify the *need* for modifications because you will have learned the salient lessons necessary to move up the ladder while remaining safe and efficient.

Now I'll let you play. And my advice? Forget the chips, manifolds, and trick exhausts. Make the sucker HANDLE !

Article #13 - Them's the Brakes!

Until you've tried Driver's Education, you might think that braking is a no-brainer. I'll tell you; there isn't *anything* in this game that doesn't require serious brainwork and practice! Braking is more than simply standing on the pedal as hard as you can. There are different types of braking used for different circumstances. Let's discuss some braking strategies.

The first type of braking we'll discuss is **Threshold Braking**. You will be using this style under ideal dry, high grip situations. Simply put, it is braking right up to, but not more than just barely *over* the limit of maximum tire adhesion. Given proper conditions, you will be standing on that pedal progressively until you sense brake lock, then ever-so-slightly lifting to avoid it, then squeezing the pedal again until you sense lockup again, then releasing, then... You get the idea. We're avoiding tire smoke here, but the occasional chirp from the tires is expected, and a sign that you are getting all the braking traction there is. This type of braking is more commonly known as a *panic stop*, and that is an unfortunate misnomer, for being in a panic is the last thing you need. As always, we're talking control here!

A second type of decelerating is **Cadence Braking**. This style is used under emergency and/or low grip situations. Essentially, you will be mimicking the function of ABS brakes by jabbing your foot up and down on the brake pedal with the strongest, fastest tempo you can muster. The idea here is that you are getting slightly more than maximum braking (threshold) for short bursts, but making sure that your tires don't lock for very long at any given time so as to maintain steering control. It sounds strange, and it is somewhat violent in application, but the results will surprise you. If you need to take evasive maneuvers to avoid a spinning car or a kid on a bicycle, you will soon see the efficacy of this technique.

One basic tenet of braking is that you should generally do so only in a straight line. Certainly, under ideal circumstances you should be done with your braking before your turn in point. However, in some instances it can be helpful and even necessary to employ a technique called **Trail Braking**. Trail braking logically suggests that you are going to continue your braking past the turn-in point and as far into the turn as needed in order to assure that you can make the corner.

Trail braking is used primarily in racing when one is attempting to go deep and out-brake an opponent going into a corner. It can also be employed if you have overcooked your entrance a tad, or if your car just won't quite get the desired amount of front end grip to steer the way you want it to.

What you are doing, after slowing and downshifting, is reapplying the brakes smoothly as you head toward your apex. This keeps weight that you need for

steering on the front tires, and also allows you to decelerate further to make the corner. It also tends to make the rear of the car want to pass the front, which can be desirable, but potentially problematic. One must be ultra-vigilant and ready to apply the throttle for rear weight shift at a moments notice. This is an advanced technique, and should not necessarily be used continually. It is a neat little trick to have in your bag in case you need it.

One specific technique that can make trail braking - and other situations - much more manageable is **Left Foot Braking**. I caution you that this is also an advanced technique that requires tremendous familiarity and, additionally, the right footwear. Getting ones feet tangled during braking is not quite an appetizing reality! Because of the rather violent nature of the sport, in general, left foot braking is most applicable to autocrossing, where it eliminates the jerky transitions between brakes and throttle application and keeps the car's attitude more stable. However, there are many places on the big tracks where I find left foot braking really helps keep a car on an even keel; the left hander at Lime Rock and the off camber at the Glen are two that spring to mind.

For autocrossing, you simply leave your left foot over the brake pedal, and your right, the throttle. For long track driving, what you are doing is completing your braking and shifting in a straight line as per normal, then sliding both your feet one-to-the-right; your left to the brake pedal and your right back to the throttle. By applying gas and brake simultaneously as needed, the car does not rise, nor fall, but "plains out" and remains completely level. This technique is tremendously useful in situations (like the turns listed above) where it always seems that the rear wheels are

threatening to jump out at any moment. It can also be effective in high traffic or low grip situations where constant re-evaluation and adjustment may be called for.

Now, one last point that ties in with Threshold Braking.

Chicago Region

Porsche racer and tuner extraor-

dinaire John Ruther (Northstar Motorsports) wrote an article a couple of years



back called “*Don’t Brake Backwards.*” The message is one that seems incredibly obvious after reading the article, yet rather illusive and typically overlooked until ruminated upon. Many drivers, not having fully explored their or their car’s capabilities, have a tendency to brake harder as they approach the turn in point. He offers that a driver should perform maximum braking early in the braking cycle, gradually easing up as turn in is anticipated. This has several benefits.

First; it gets heat in the brakes in a hurry, which increases their effectiveness. Second, it levels or even lessens the accumulated heat stress in brake components by progressively easing their burden as total braking time increases. Third, it allows the car’s suspension to start to level off as the turn-in point is reached, increasing cornering stability. A good concept, no?

What do these techniques all share in common? They all need to be practiced faithfully. Each of these has its perfect application, but they won’t come to fruition without first building the knowledge to understand them intimately, and the ingrained reflex to call them up in split-second times of need.

In the case of Threshold Braking without “*Braking Backwards,*” you need to practice them in tandem. Pick a braking point and have a go. If you do things correctly, chances are you will stop well short of your turn-in point. Keep making adjustments; deepening your braking point until you find a spot that accomplishes the dual goals of maximum utilization of adhesion, and initially-high-but-gradually-descending pressure application as your intended turn-in point nears.

Regarding Cadence Braking, you’ll simply have to try it. Find a remote parking lot, set up some cones or soda cans or whatever in a curving line, then approach this “turn” at a healthy speed and try to Threshold Brake around the corner. If you keep increasing your approach speed, you’ll reach a point where you experience brake lock, but cannot react quickly enough to maintain the turn, nor much steering control at all. Now try the Cadence technique of jamming your foot up and down as hard as you can on the brake pedal. With a little practice, you’ll see that you can steam into that “turn” at least as hard (if not more so) and still get turned and stopped without hitting anything. Neat!

Lastly, Trail and Left Foot Braking are definitely advanced techniques that require a lot of practice and should not be used unless one is very comfortable with them. If your region or club has a skid pad or autocross school, you should not miss the opportunity to take part. Chances are they will teach these or similar techniques. Failing this, a little discretion and some smarts can find you a place to practice without getting arrested!

If one is want to go, one must eventually stop. A fast car is utterly useless without good brakes, and a proficient driver to utilize them. Don't find out too late that you should have practiced your braking. "Put a Stop To It" right off the bat!

Chapter 14 - R Compound Tires

Like many track-enthused people, I have entered into the pursuit of higher performance, fun (hopefully), and challenge in my track driving. Anyone who has used sticky tires before will likely understand my chagrin at *burning up* a set of **R-compound** tires in less time than I deemed reasonable. From what I have seen since, I am not alone, and from what I have subsequently learned, it is not all that surprising!

There is no doubt - the quickest way to faster cornering is to buy a set of "R", or race compound DOT (Department of Transportation) approved radial tires. They simply stick much better than regular street rubber - period! However, as with most things in life, they have their idiosyncrasies and their own set of special parameters for efficient operation. At the same time, one must be careful to apply the right ministrations to the right patient.

I have done a lot of research on this subject, mostly the best way... (by trial and error). Unfortunately, I've found that most of the information floating around out there - the word-of-mouth stuff discussed in the pits that most of us end up relying on - is incorrect, or at best, misinterpreted or misapplied.

Tire Temperatures

This is a hot topic in racing and filters down to Driver's Ed. Many people have invested in a pyrometer to take their tire temperatures. It seems that the standard goal of most people has been to try and achieve the best relative equality in temperatures across the face of the tire as a means of discerning the correct pressure to be used. This is done by measuring the outside, middle, and inside of the tread surface and noting the difference. If the differentials were too great, they adjusted the **pressure** trying to equalizing it.

Unfortunately, this information - like much of it out there - was derived from bias ply tire experience and has only very limited correlation to DOT radials. Like any other, bias ply tires are designed to run with their tread flat on the road. In practice, the sidewall deflects and deforms considerably to absorb cornering loads and keep the tread surface relatively flat on the track surface. Therefore, tire temperature differentials are a good measure of correct tire pressures. If you had a close temperature spread across the tread surface, it meant

that you had a pressure that was conducive to the proper amount of sidewall flex, thereby keeping the tread surface more completely in contact with the road. Pressure up, less flex. Pressure down, more flex. This was achieved somewhat apart from suspension set-up.

DOT radials, however, do not rely on sidewall flex to maintain the contact patch. They are designed with a stiff sidewall and steel tread belts that flex very *little*. These tires are predominantly dependent on camber settings to maintain optimal surface engagement. For these reasons, pressure has very little effect in changing surface temperature differentials.

Proper radial tire set-up involves varying degrees of negative camber, and generally, the inside of the tread surface will run hotter than the rest (15-30 degrees) simply because it is in greater contact with the road when driving in a straight line. Within limits, the higher temperature is of no real concern as it is derived from simple road contact, not from potentially damaging cornering overload.

On a properly set-up car with radials, the body/suspension of the car will lean and effectively tip the wheel up into a more perpendicular attitude (decamber), thereby utilizing the entire tread surface. Tire pressure has little effect on the contact patch.

Put This Under Your Tongue

The tire thermometer, better known as a pyrometer, is becoming a common sight, even at \$100-\$300 per. However, their proper usage seems to be as big a mine field as their purpose. If you're shopping pyrometers, you'd best know what type to purchase and how to use it correctly.

The **ONLY** type of pyrometer to buy for testing your tire's health is the probe type! Then, only a probe length of 3/8" or longer will do the trick. Here's why. The surface of the tire is not where the heat damage occurs. The danger zone where the tire will start disintegrating is under the outer tread rubber layer at the Cap Ply (the layer of chord you see when you wear through the tread). Because this area is under the tread surface, you need a probe type pyrometer of sufficient length, and inserted to the *bilt*, to access it. Otherwise, you are not getting your measurement from the area where the damage is occurring. Incidentally, for this very reason, the hand-held infrared pyrometers are essentially worthless for gauging your tire's needs. They may seem ultra-trick and real easy, but they only read the surface temp of the tire (which cools almost immediately), not under the tread where the tire will start separating. Buy the infrared style pyrometer to check your brake, exhaust, your driver's forehead, or your pot roast. Buy the probe-type for tire testing.

Under Pressure

We now know that the radial tire surface temperature differentials are not truly indicative of the need for pressure adjustments. But they will tell if a suspension adjustment is called for.

If, for example, you measure a surface temperature drop of over 50 degrees from inside to outside, chances are you're running too much negative camber. This means that the tire never leans over - or de-cambers - enough in a turn to employ the full tread surface; it is only riding on the inside half, and that's a lot of unused rubber.

This over-cambered situation will be much more easily and accurately evidenced by excessive inner tire wear, as tire surface temperatures usually drop so fast that it is virtually impossible to get measurements that you can rely on to prove the point. Unless you have a crew to help, of course!

Where air pressure does effect radial tires is in handling feel. Radial tires have produced incredible advances in cornering power, but are much less forgiving at the limit than bias ply tires. A properly inflated radial tire can seem "twitchy" at the limit, where a bias ply tire has a controlled and gradual breakaway. This could lead you to the conclusion that bias ply tires may be a wiser choice until you notice you are going much faster to reach the breakaway point with a radial. Everyone wants to go faster, after all. What other justification do you need?

This twitchy feeling in radials can be tweaked by raising or lowering the pressure of the tire. If the change does not exceed a reasonable margin (4-5lbs either way from the recommendation), this will not adversely effect the tire's health.

However, keep in mind that the fastest drivers usually run at the high end of the tire's pressure range, as this gives maximum cornering power. They also, ironically, seem to get better tire mileage, which suggests that the tires are actually much healthier at the high end of the pressure scale. This is probably due to the inner structure of the tire being optimized by the higher pressures and working more effectively at handling the cornering forces.

So...

What all this tells us is that, given a proper inflation range, a radial "R" type tire will be effected much more by suspension set-up than pressure. This is not to say that over or under-inflation is not of concern. Either of these is a no-no (particularly under-inflation), as the tire will not be operating with proper support and in a mechanically efficient manner, and will suffer internally, with drastic wear or catastrophic failure the result. It is much better to start at a higher pressure and work down, as this will not harm the tire's inner structure.

It also tells us not to look to tire surface temperature differentials as the ultimate sign of suspension or pressure optimization for radial tire use. Because of camber settings, the inside temperature will naturally be higher. As long as this variance doesn't become excessive, things are looking good.

The ultimate guide to assessing the efficacy of your suspension settings is good old tire wear! Again, assuming specified inflation levels and proper toe settings, if you see excessive wear on the inside, you've likely got too much negative camber. Conversely, if you see chunking or blistering on the outside of the tread surface, you don't have *enough* negative camber.

So run your "R's" at or near the factory recommendation for pressure, crank in the right amount of negative camber, and watch the wear patterns for the real signs of your success. Save that money you were going to spend on a pyrometer to buy more tires. You'll be going so much faster, you'll probably need them soon!

Chapter 15 - RCompound Tires, Part 2

Let's chase the DOT racing radial situation some more. Last article, we set any basic rules for their proper utilization.

We learned that:

- Since DOT radials are much different in construction than bias ply or even radial slick tires, the set-up requirements are very different. There is little, if any, overlap in data between these different tire types.
- Since they have little sidewall flex, they are optimized by camber settings, not pressure.
- They should be run at or very near the recommended pressure to protect their inner structure and maximize their performance and longevity.
- Within the recommended inflation range, pressure has little to do with surface temperature.
- Because of higher negative camber settings, the middle to inside of the tire will naturally run hotter.
- Pressure tuning primarily effects the tire's feel rather than its actual performance. However, the highest cornering potential is obtained at the high end of the pressure range because the tire is better able to handle the job mechanically.
- Don't buy a pyrometer solely to measure surface temperature differentials. Within the proper range, pressure has little effect here. They can be

useful as a general guide to overall tire performance. Buy a minimum 3/8" probe type, not an infra-red.

- Tire wear patterns are the most accurate and dependable guide to proper set-up. Optimum settings will show very little wear on the outside shoulder of the tire.

Now that we've established some general rules, let's expand on some of those points. To say that a pyrometer is worthless is incorrect. However, their proper usage is severely compromised by circumstance. The main problem is that tire surface temperatures drop so quickly that if you don't measure them almost immediately, you've missed your window. If you've run any straightaway distance before the measurements are taken, you've already significantly altered the temperature profile. These factors make it awfully hard to get real usable data unless you have a crew and a paved surface all to yourself.

Secondly, full bodied cars tend to alter the surface temp profile because the inner area of the tire naturally receives less cooling air than the outer portion. Once again, surface temp differential measuring came from bias ply usage, primarily on open wheeled cars.

Use your pyrometer to judge the overall effectiveness of pressure adjustments as they pertain to how hard the tire is working internally, not its surface temp differential. Since a majority of tire heat comes from the machinations of the various belts and bands in the casing, higher temps generally call for an increase in pressure to keep the tire supported structurally. Somewhere out there exists a pressure setting that will not only allow the tire to work extremely hard, but allow it to do so in relative comfort temperature-wise.

Pressure is not the baseline tuning method for DOT racing radials. However, once you've discovered a camber setting that agrees with your car and gives good tire wear characteristics, pressure and a stop watch become the final building blocks in the foundation of speed. It should be noted here that any camber changes will likely require pressure adjustments for ultimate optimization. However, in the end, pressure adjustments have more to do with *what the driver likes* than anything else, as comfort generally brings a driver's fastest times initially.

Many drivers today are running low pressures because they equate the feeling of safety and confidence with speed or tire adhesion. As mentioned previously, radials tend to be a little twitchy, particularly in the first laps. Lowering the pressure eases the "hard edge" feeling of these tires, giving a wider comfort threshold. But, as we've learned, they may be damaging their tires - both the mechanical and chemical makeup - and preventing them from working in a range that will give the best performance and longevity.

Let's say you started with 30psi cold and measured 40psi hot. You then lowered the pressure to 26psi cold and still measured 40psi hot; what would that tell us? It would suggest that while the car perhaps "felt better" at 26psi cold, it was actually stressing the tires more because of under-inflation. The missing key is temperature.

Your now trusty pyrometer (now that you know its true purpose) would have shown that the second run produced higher temperatures because the tire was working harder. While the softer pressure provided more driver comfort, it was not providing optimal internal support for the tire, thus creating more stress and heat. The car may "feel" better at low pressures, but more performance and tire wear are to be found at a higher pressure.

Obviously, confidence is a very important component of speed. As mentioned previously, the fastest drivers usually run in the upper end of the pressure scale; a range where the radial tire can feel loose or twitchy. However, the higher pressures likely allow - and even demand - the car to be driven harder so as to utilize this maximized cornering power and grip. This raises the bar higher - the commitment level as well as the rewards to be had. True, it takes a more skilled and daring driver to run in this range, but the benefits are there, both in speed and - ironically - tire life. Speed equals fun. Tire life equals MONEY!

Most of the R-compound tires available today have a "sweet spot" around 40psi - hot. This is a pressure where they give maximum performance. However, you must remember that much more than initial cold pressure is used to get to this zone. Using well researched suspension settings in concert with pressure adjustments, you will be shooting for the proper balance between them all that gives you good tire wear, moderate cold-to-hot pressure changes, reasonable surface differentials, and good handling. Lots of parameters to deal with, but you asked for it when you bought the tires, eh?

So now you've got a good foundation under your tires. Anything else to do? YOU BET!!

But That Rubber Costs Money!..

"Removing about half the tread from most R tire's surface by having them shaved will help them last longer." Sounds ludicrous, doesn't it? Well, let's discuss why it is an absolute fact.

The main enemy of a tire is excessive heat, particularly if it is localized. Most excessive heat situations are caused by improper inflation or suspension set-up. Surface friction is not a major producer of heat; remember, the tire's surface cools quickly!

As we've learned, the surface of the tire is not where the danger lies; it's under the tread at the cap ply. This is where the tire separates or *chunks*. By removing rubber from the surface, you are effectively removing insulation, or *heat sink* from the tire, thereby allowing the heat to dissipate more easily. A smaller, thinner object will hold less heat than one bearing more mass. A thinner tread surface holds less heat!

In addition, shaving a tire will improve the transient response and feedback it gives because of reduced tread squirm. A 2 foot steel bar is much easier to bend than a like 1 foot example because of the increased mechanical advantage working against it. The same applies to the individual tread blocks of a tire. A shorter tread block will deflect or squirm less than a taller one.

Incidentally, this mechanical squirming of the tread produces more heat than surface friction, and it is transferred under the tread to the cap ply, not to the surface.

Tires on Tires off!

Here is something that is most beneficial, but is impractical for most of us to achieve: Heat Cycling! Like many other items, race tires function best when broken-in properly. Although they feel incredible in the first laps, this is not the time to abuse them. Tires are made up of many mechanical and chemical components. These components need to be *familiarized* with each other and the task at hand to achieve maximum performance. If a tire is abused early, its performance will degrade rapidly. If it is brought along slowly, its performance will be more consistent for a longer duration.

Here's the scoop: The tires should be inflated 4-6 lbs. over normal cold settings (this provides added safety against mechanical damage). You then proceed to gradually bring the tires up to full operating temperature by driving increasingly swiftly, but smoothly and conservatively; no skidding, sliding, or other laying-down of rubber.

At approximately the 15 minute mark, the tires should be up to full temperature. You then proceed to the pits, remove the tires, decrease their pressure, and allow them to cool 24 (absolute minimum) to 48 hours.

What you are attempting to achieve is analogous to the heat treating of metal. Many metals must be heated to just the right temperature, and then cooled slowly to form the proper molecular links. If you over-heat or cool them too fast, you ruin the metallurgical structure and they become very hard, but brittle.

Here's another analogy: did you know that ice that freezes slowly is much less brittle, or *chippy*, than ice that freezes rapidly? If you were making hockey rink ice, this would be important. Following some of that reasoning, you should never artificially cool tires with water. As with steel or ice, if you artificially cool them (quenching), or cool them too rapidly, you *shock* the rubber and it becomes hard. You are trying to make the molecular bonds of the rubber tough, not hard.

Black Magic

We've covered lots of ground here. This tire thing really runs a lot like life: Trial and Error! The best you can hope for is some good solid information to help you make the right choices. It also helps that if, having good information, you are applying it to the proper area in the proper way. As a recent Pirelli ad campaign suggests: "*The Wrong Equipment can Ruin a Performance!*" To that, we can add that the wrong information, incorrectly applied, can ruin the equipment! In order to optimize the longevity and performance of your DOT R-Compound tires, you will likely have to increase the amount on negative camber you run. If you drive your car on the street as well, this will cause accelerated wear in your street tires and make the car wander more, particularly on crowned or well-worn road surfaces. Once again, we are left to deal with another trial and error situation where we will be looking for the best compromise between track and street tire utilization.

The answers will be there in front of you. By looking at your tires, you will see the efficacy of your settings. By interpreting the evidence presented correctly, you will know what adjustments to make to get you where you want to be. Hopefully, these articles will help clue you in to what you are looking at, how to interpret it correctly, and what to do to improve the situation. It may be only money, but seriously - **Who's got money - or rubber - to burn?**

Chapter 16 - Tire Math

Were you thinking of changing tire and/or rim sizes, but hit the numbers game wall?

Trust me... no one ever thought they'd get a math lesson from me! Well, if I can do this stuff believe me... anybody can! We won't talk about how many calculators I burned out making sure I had it right. Anyway, why bang your head when I can do it for you in this handy little primer on tire sizing and *Plus* conversions.

As you may already know, or will soon discover, upgrading to larger tires is a little tricky. Changing rim diameters is even more so! Upgrading rim diameter is called *Plus Sizing*. A 1 inch increase in rim diameter is called a *Plus 1* upgrade. A 2" increase is a *Plus 2*, and so on. Let's do some math before the smoke from

my brain gets too thick.

OK, a common Porsche tire size is 225/50-16. The first number is the tire's Section Width (in millimeters), the second is the Aspect Ratio, which says in this case that the tire is 50% tall as it is wide. The third number is the rim diameter. This tire is 225mm in Section Width, the Section Height is 50% of that (112.5mm), and the rim is 16 inches in diameter (which would be 400mm). The overall wheel/tire diameter here is 25 inches or 625mm.

Now, if one were looking to get a little more *rubber on the road*, but stay with the same rims, one could not simply buy a wider tire because that would also make it taller, eh? Remember the Aspect Ratio! Not changing the Aspect Ratio accordingly would obviously foul up the gearing and speedometer readings. Now, if you're building a track car and are a pretty serious driver, you likely don't care what the speedo reads. You likely have also found that the stock gearing runs a little short in some spots on the track, forcing you close to the rev limiter just shy of your braking point. Well, now you can play the tire size game to *tune out* those annoying instances where you have to back out or shift.

Going to a wider tire requires going with a smaller Aspect Ratio. So, if you wanted to upgrade to a wider tire that maintained the same relative height, you would look for a 245/45-16, which has a width of 245mm and would give you a height of 110.25mm... about as close as you can get. The 2.5mm difference will not affect things noticeably. To do this stuff requires searching the tire charts for the right combination of numbers.

So, let's build an equation for this problem. Given: 1" = 25mm - Where: W = Width, A = Aspect Ratio, H = Height, R = Rim diameter. (16" = 400mm). We could then write the equation: W divided by A = H (or W times the decimal equivalent of A) to solve for our tire section height. Plugging in the numbers from the example would give us: $225 \times 0.5 = 112.5$. Got it? Now, to figure the overall diameter of our wheel and tire we would write: $W / A = H \times 2 + R =$ Overall Diameter -or- $225 \times 0.5 = 112.5 \times 2 = 225\text{mm} + 400\text{mm} = 625\text{mm}$ or 25".

For our bigger tire, we would write: $245 \times 0.45 = 110.25 \times 2 = 220.5\text{mm} + 400 = 620.5\text{mm}$ or 24.82". Yeah baby... this is easy!

Well, now it gets trickier. When you look to upgrade to larger diameter rims, you must obviously look for a tire that is commensurately shorter to make up for this increase in diameter and still keep the same overall wheel/tire diameter. 1 inch is equivalent to 25mm. So, if you took our example above, and upgraded to 17" rims, you would need a tire that was approximately 25mm shorter over-

all to keep the same overall wheel/tire diameter. The tire that would give you this would be a 255/40-17. Using our formulas from above we would write: $255 \times 0.4 = 102 \times 2 + 425 = 629\text{mm}$ or 25.16". Again, about as close as you can get. So there you have it. Simple eh? Damn... the smoke detector just went off!

Chapter 17 - Demon Time

The subject of timing equipment is a sore one for many performance driving event organizers. Their insurance companies would seize upon it as proof of danger, so track owners hate it, and, therefore, event personnel should and must frown upon its use.

This was my response to a well reasoned and intended query on the Porsche Rennlist by a fellow *lister* wondering if a stopwatch were not a very effective means of judging driver improvement, even during the novice stage.

Robert B. Wrote: *“How would you suggest getting an unbiased measure of improvement from event to event? I agree that smoothness and consistency are the goals at this (early) stage. How does one measure this? Would not consistent times be a good indicator? Regards, Bob”*

I replied: Yes Bob, that is one obvious way to scale it. However, the clock also has a nasty narcotic effect, and obscures the novice driver’s focus from the most effective means of gauging their success. Anyone can pay attention to lap times. It only requires the skill to read. Where in that equation is the skill to drive made mandatory? You need this before a watch will do anything but frustrate the $H\% \text{€}^*$ out of you.

The HUMAN BODY is the most precise instrument at your disposal, and it is that which you MUST seek to develop as your meter of success. Using a watch externalizes the process of novice driving, as if the watch were in control. Driving is an intensely INTERNAL experience, and the novice driver needs to be lead around by the nose until he starts to zero in on what he is doing, and how it effects the car.

No matter how gifted, novice drivers do not have a completely developed sense of feel, which is absolutely IMPERATIVE. Without a finely honed sense of EVERY nuance of the act of cornering at speed, a driver will NEVER reach anywhere near his/her potential. Again, it is an intensely INTERNAL process.

Given little instruction, a novice driver will invariably go out and drive over their heads without knowing it. This results in their being so busy mentally, that they are not able to process what is really happening and interpret it. It is only a matter of time before they get frustrated because no matter how hard they try, they never get any faster, just more out of shape. Their lack of fundamental experience in driving technique keeps their driving limit artificially low, and frustration results. Timing equipment only makes this worse.

What we do as instructors is take people out and MAKE them drive a basic, conservative line. It is not because we are scared or because we necessarily want

to keep them under our thumb. It is because we are programming their mind through repeated behavior. We know that given a good line, SPEED HAPPENS. The student will eventually find their initial limit safely, and that limit in reality is far from what they can (and hopefully will) achieve. Reaching their initial limit at relatively low speeds puts us in the second AND MOST IMPORTANT phase of the process: CAR FEEL.

I have never had a novice student who had a completely developed sense of car feel. I can't really remember having ANY novice student who really had much of that sense at all, at least not to the experienced instructor's level. That is not to say that they were hopeless boobs - far from it in some cases. It is just not something that most people think that much about, excepting perhaps mechanics or ski racers.

When the car starts to reach its limit and begins to talk back to the student, we have reached the break point. It is now that the good driver is made or broken. What caused that understeer? Did you feel the tail wiggle back there? At first, they never do. After a while, they start to clue in, and can actually critique their own driving, eventually even correctly. NOW we are getting somewhere.

Lap times are only important to drivers for race qualifying and bragging rights. What is really important is SEGMENT times. This tells you quite accurately where you are fast or slow as a driver. If you need a more practical and instructive measure of how well you are driving, you need *look* no farther than the seat of your pants... your internal pendulum - and your tachometer. Do a corner right and not only will the car feel great, but you will see a few hundred more RPM at the exit than ever before. Do a corner right and you will find yourself running out of braking room in the next corner because of the extra speed you manufactured.

Using a stopwatch is setting the wrong goal. The goal is not speed - it is skill. Using a watch obliterates the acquisition of skill, and focuses the driver on the END goal with no foundation with which to achieve it. Stopwatches have their place, but it's not Driver's Ed. OK, so people bend the rules. Save it for when you reach the Black and Red run group. Then you'll know what it's for!

Chapter 18 - A Shift in Time: What's the Rub?

You've all heard of it. All the hot shoes do it. You'll have to learn it eventually if you want to be a really swift and skilled driver. Those who can't **Heel & Toe** must brake to the desired speed, then do their downshift, then turn in, or simply choose a gear and let the clutch out while braking. The former takes a long time because each operation is performed separately. The latter is hard on the driveline. The idea behind optimized corner setup is to accomplish both braking to cornering speed and downshifting to the proper gear simultaneously, thereby shortening the distance needed for these tasks. Pretty ingenious, and simple in theory. Yet, there is so much mystery surrounding it that it warrants close scrutiny. Let's start by clearing up the misnomer.

The term **Heel & Toe** comes from a distant time when car companies had varying ideas on many topics, including what would be a standard pedal placement. There was also different equipment in those days. In general the phrase stems from many cars having their throttle *between* the clutch pedal on the left and the brake on the right. The pedals were arranged thusly to facilitate stepping on the brake while also engaging the starter, which was often a button or lever on the floor to the right of the brake pedal! Some slick dude figured out he could brake and match revs (or double-declutch for those old crash boxes) at the same time. Heel on the central gas pedal, Toe on the brake, the right foot tipped top-to-the-right in a very natural position.

Even now that our pedals are conventionally located as they are, there are still people that learn it the *old way* in terms of foot position; with the top of their foot out to the right, but heel on the brake, toe on the gas. **I do not recommend this at all**, because the heel will never have the braking sensitivity to allow for variations in braking traction and the minute and instantaneous adjustments that this calls for. Modulation of the pedal is accomplished far more deftly with the articulated ankle than by lifting the entire leg. That is my opinion, and I stand by it! Now let's get into some of the difficulties before we cover the sequence of events.

First, let's dispel another myth. You are not trying to literally *match revs*. To sit there and try to exactly match the engine speed with the driveline takes far too much time, and more importantly, concentration. The idea is to reduce the length of time in the braking zone, and trying to get a perfect match is just wasting too much time. You are merely getting the engine revs up in the neighborhood of the driveline speed, and ideally slightly higher. Instead of gradually bringing the revs up to a *perfect spot*, you simply slip over and give the gas a good hearty boot.

Second, it is very helpful to be on the brakes hard enough that the pedals are close to the same level. This makes it hard to learn on the street because one

seldom if ever reaches the kind of speeds necessary to generate that kind of braking. As a result, many people are tempted to play with the pedal height adjustments, but I would suggest you not, as the stock heights are very well chosen for track use. Under full compression, you always want the brake higher by at least half an inch than the gas. For instructional purposes, you might attach a small block to the gas pedal to bring it closer to brake height. This could easily be removed when you've got it down to a science, and would greatly assist you in learning how to Heel & Toe on the street. Incidentally, the track is **not** the place to learn it, as you've got a bit much to think about at a 100+ mph to try something new!

Now, the actual positioning of the feet is not difficult, but it is crucial. Some cars are better configured for this purpose than others. 911s can be tricky because of the pedals being a little right of the driver centerline, and because they pivot off the floor instead of hanging from under the dash. 944 pedals are pretty well situated, but are not perfect. They are slightly too wide apart for lightening quick no-brainer shifting. Many people are tempted to add all kinds of crazy things like wings, extensions, or other home made or store bought contraptions to the existing pedals. I suggest you refrain from using these, as they often bring about unintended and unforeseen mechanical consequences. If anything, simply get a piece of 3/16th aluminum and make a cover for the brake pedal that is the same shape, but slightly wider. Bolt it to the surface and you're on your way!

Let's do it. The idea is for the ball of your right foot to be on the brake pedal. If you are wearing a proper thin-soled rubber shoe, you can even *hook* the ball of the foot on the edge of the pedal. You should have plenty of surface area to work with, and lots of feel. When you have slowed to the proper speed and it comes time to blip the throttle, you simply roll your foot over to engage the gas pedal. Again, it helps to be on the brakes hard so the pedals are close to the same height. Also, remember not to *pussy-foot* the thing. Give it a good boot and try to raise the engine revs slightly higher than the driveline RPM. This is the easy part.

The real trick is in the timing. You have four functions to undertake:

1. The ball of your right foot is stepping on the brakes hard as you slow for the impending corner.
2. The right edge of that foot lurking over the throttle, ready for the blip
3. Your left foot will be moving to the clutch.
4. Your right hand will move to the shifter in due course.

One is the only portion that is continuous. The others are not implemented until they are called for, and quite importantly, are then done simultaneously. A fraction of a second after you quickly depress the clutch, your right foot rolls

over and boots the throttle as your right hand selects the proper gear. Immediately after the gear is selected, the clutch is released and the corner is engaged in earnest.

If you've gotten it right, the revs should be at their peak as the gear is selected, and the clutch can and should be engaged very quickly before the revs start to fall again. Done correctly, this can literally be accomplished in little more time than it takes to snap one's fingers!

If you've fouled up the timing, you'll know soon enough; the grinding of gears or the lurch from improper revs telling you it didn't quite come together. Don't try to do it too quickly at first. Concentrate more on the timing, as it is the most crucial ingredient in the mix. Just like cornering, learn the concepts slowly and correctly, and the speed will happen all by itself!

Remember, declutch, then *immediately* blip and shift simultaneously, then *immediately* release the clutch. They say A Shift in Time Saves Nine. I don't know what that phrase means in the larger scheme of things, but I know in terms of performance driving, it means a good corner setup, and a real savings to your equipment!

Chapter 19 - The Double Edged Sword...has a Dark Side



Since I joined the club in 1990, I have had occasion to do a moderate amount of performance driving. I have also cultivated no small amount of interest in instructing others in the finer points of this avocation; to pass along what I have learned for their benefit. These are things that I, along with many others in the PCA, regard as a great privilege; as food for the soul. I find it all a very stimulating experience. No, not nearly in the way of fist pumping and high-five'ing, but in a deeply, inwardly satisfying sense. I'm not completely sure why, but that's the way I feel about it.

