Part One: HOW TO LEARN A TRACK by Reed Kryder (revised 1/9/15)

Preface:

There are many books and articles available on learning the art of high performance driving and racing. I try to read as many as I can because they are enjoyable and it seems as if there is always something new to learn. Frequently I find the style used by one expert to present their techniques is easier to understand than other interpretations. Sometimes the opposite is true. Lessons and techniques vary. Learn from all of them and do not take anyone's word as gospel. Be open minded, try anything which sounds reasonable, and find what works best for you.

The following is from my own experience. Hopefully you will be able to understand what I am trying to convey. I have a lot of experience riding with someone after they participated in my classroom. Sometimes I wonder "how did they misunderstand me so badly?" Somewhere between words leaving my mouth and entering their brain things got twisted. I always learn new and better ways to communicate a subject because of these riding experiences. I expect a similar phenomenon to occur between my written words and your actual driving. In case you read this prior to attending a Funday or one of my other beginner classroom sessions and you become confused between what you read and what I am saying in the classroom, please raise your hand and say: "But that's not what you wrote." And feel free to contact me with questions at any time.

This is also a work in progress. Feel free to correct spelling, grammar, etc.

About the author

I started autocrossing in 1971, racing in 1975, professional racing in 1981, and I still race. I have driven road courses and ovals from coast to coast. A few were even outside of the United States.
From 1981 through 1999 I raced professionally on the IMSA circuit, usually driving a GTU class Nissan which was built and maintained by Kryderacing. We competed in more than 100 events all across the country. My best season-long finish was fifth, the top independent driver that year. The factory drivers finished 1st, 2nd, 3rd, 4th, and 6th.

Along the way I participated in numerous classroom and coaching sessions, both as a student and as an instructor. From 1999 through 2006 I was the head instructor for the stock car portion of Marlboro's fantasy camp. I have been the Chief Instructor for several SCCA Driving School's over the years. And I have helped individuals with one-on-one coaching. In 2009 I was asked to help beginners attending Fundays at Nelson Ledges Road Course.

These Funday beginner sessions quickly grew into a formal half-day program of classroom and on-track activities. With this type of program it was impossible to plan for a specific class size. They have ranged from zero to twenty-six. The exact number is never known ahead of time. While class size variations have little impact on classrooms, it makes in-car instruction impossible to implement simply because the needed number of in-car instructors can never be planned in advance. As a result, the classroom instruction is designed to give guidelines on self-teaching. This program has been extremely successful and has led to a full-day beginner program entitled "NLU101: How to learn a track". What follows is subject matter and additional comments taken from that program.

I also worked as a Goodyear Race Tire Development Engineer for the Goodyear Tire and Rubber Company. Areas included Indy cars, sports cars, and stock cars. I was Section Head for the latter two areas. This experience allowed me the opportunity to learn a lot about racing from some of the best drivers and teams in the world. Lessons included driving, car set-up, race strategy, and a lot more.

I left Goodyear at the end of 1988 to devote myself full-time to Kryderacing. Over the years we have built and raced a variety of cars. Along the way we evolved from running our own vehicle to maintaining and providing trackside support for several clients. New for 2013 is a two-car TransAm program with David Pintaric and Rob Huffmaster driving.

A lot more can be learned about my history by visiting various areas of the Kryderacing website.

Sidebar stories

Throughout the "How to Learn a Track" text you will find many sidebar stories from my personal experiences. They are intended to give support for the points I am trying to make. There are a lot of these 'stories' and I will add more in the future. Feel free to read them or skip over them.

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Safety

High performance vehicle driving is risky. Let me repeat that: DRIVING A HIGH PERFORMANCE VEHICLE IS RISKY. Higher speeds and greater cornering g-forces mean bigger consequences when something goes wrong. If you know anything about physics you know potential energy increases by the square of speed. If you hit something at 120 MPH instead of 60 MPH you will be hitting it with FOUR (not two) times the force. If you could get to 180 MPH the impact would be eight times greater than at 60 MPH.

Everyone needs to concentrate on safety. The track has procedures they follow and people to help with your safety. Your car needs to be as safe as you can make it. And you need to drive within your limits. A tremendous amount of the following text is related to learning in a safe manner.

Your goals should be (in order): BE SAFE - HAVE FUN - LEARN SOMETHING

Homework (what to do before arriving at the track):

There are numerous opportunities across the country to get on road courses. Programs, dates, and information can be found on various track and organizer websites. Tracks and companies who specialize in these types of programs usually offer beginner level courses for people who want to bring their street cars, as well as race driver training for those who want to move on to another level of performance driving. If there is a structured program for beginners, please take advantage of it. Once you find the track and program which fits your schedule and objectives, make sure you know what is required before arrival. Is prepayment required or can you pay when you arrive? Are there pre-event tech requirements which require you to have a mechanic check out your car? What clothing is required? Do you need to supply your own helmet or are loaners available? Some organizations are very structured while others have lots of flexibility. Make sure you know which you are dealing with and follow their procedures.

That includes arriving at the track on time. Better yet, arrive ahead of time. There is probably a scheduled 'welcoming meeting' and there may be a tech session prior to it. If you are new you need to allow time to make a wrong turn on your way to the track, wait in line at the gate, find a paddock space and unload your car, prep the car for tech, and find a restroom to empty that early morning coffee. Do not think you will have time after the 'welcoming meeting'. Beginners frequently go straight to a classroom following that meeting. Most programs will do their best to work with people who are running late, but they will not delay the schedule. Playing catch-up could mean you miss some track-time.

STORY: During the early days of the "How to learn a track" program at Nelson Ledges new drivers would occasionally want to bypass the program. Usually 'ego' was involved. On one occasion three Corvettes drove in together. Two of the drivers were experienced but their buddy was a rookie. The rookie wanted to drive with his experienced cohorts and pretended to have sufficient experience. During the day he did something totally against the rules which caused several other cars to become involved in an accident. The incident would never have happened if the rookie knew some of the basic 'rules of the event'. The rookie's car did not have a mark on it. He was lucky, but a Mustang and a Porsche went to their respective body shops.

Attitudes have changed over the years and situations like the above are rare. New drivers are frequently told by their friends that they must attend the beginner classes.

Vehicle preparation (prior to leaving for the track):

Not included in the above discussion is vehicle preparation prior to leaving for the track. Some organizations have a specific list of inspection items. They may want a qualified mechanic to sign off on them. This approach is becoming less common due to mechanics being fearful of lawsuits if something happens on the race track. However, this list is a great guideline and someone who understands the items on the list should use it to check out your car.

The following items are typically found on many street-car checklists:

* Tires must be in good condition, have no cracks or bulges, rated at least "U" (120 MPH) or higher, and have at least 3/32nds of tread depth. Race tires have no tread pattern and hence no depth to measure. They also have no speed rating. They are rarely seen on beginners but generally accepted if in good condition. Absolutely no cords should be showing at any time on any tire during the day.

* Brakes should have more than adequate pad or lining material. 'Adequate' can vary from track to track. Nelson Ledges Road Course is very easy on brakes and at least half of new material thickness should be enough. Other tracks have been known to wear out new pads in less than a day; and even overcook (destroy) street compound pads during the course of a single session. If at all possible, discuss this with someone knowledgeable with the track you plan to attend. Regardless of the track, the fluid should have been changed within the last six months and the system bled prior to the event. Fluid must not be dark in color. All brake lines must be in good condition.

STORY: A couple of years ago there was a blue Viper in the beginner group. During its second session on track it experienced a complete loss of brakes entering the 'kink'. The brake pedal went straight to the floor. After a rather wild off-course ride the driver returned to the paddock with very little damage. There were no signs of anything mechanically wrong with the brakes, and the drivers description of what had happened fit the description of boiling brake fluid. The brake fluid was very dark in color and when asked if it had been changed recently the reply was: "Not since I bought the car (used) last week." New fluid flushed the old out of the system and the car returned to the track with no problems during the afternoon sessions. This driver was very lucky.

* Brake lights must function properly and it is advisable for all lights to work properly.

* Wheels should have no damage. Lug-nuts should be properly torqued to manufacturer specifications (DO NOT let someone use an air gun - over-torquing can be as damaging/dangerous as under-torquing).

STORY: A competitor at a Funday type event at Road Atlanta experienced pulsing with his brakes after several sessions on the track. The pads in his Nissan 300ZX were also showing signs of wear and a new set needed to be installed. A buddy of his was also experiencing similar problems. Kryderacing was supplying trackside assistance at the event and worked on the buddy's car first. There were no problems other than the lug nuts took a lot of effort to break loose. When we started working on the 300ZX we could not break the front lug nuts loose. A torque wrench set at 150 lb-ft had no effect. We stood on a breaker bar (probably 200-300 lb-ft of torque) and not a single nut came loose. There was no doubt we were going to break studs if we tried harder. We inquired as to who serviced the brakes last and were told a trusted shop had done the work the previous week.

Even the best of shops use air powered guns to attach lug nuts. The problem is it is so easy to over-torque the nuts. Several problems arise when this happens. First, the studs are stretched beyond specifications and can easily break when torqued in the future. Second, if the torque levels are unequal between the lug nuts it can cause the brake rotors to warp, especially when subjected to heat levels experienced during performance driving. And, as in the case of the 300ZX, a simple repair such as a brake pad swap was not possible because of the possibility of breaking a stud (there were no spare parts available). The 300ZX driver's day on the track was over.

At the Kryderacing shop we use air guns to attach lug nuts but we do not use them to tighten them. Tightening is done with a torque wrench to the manufacturer's specifications. You should feel the torque wrench rotate to some degree before reaching the target torque. If we ever believe something has been over tightened, either by us or someone else, we loosen ALL of the lug nuts and start over.

STORY: While working at Goodyear I frequently was sent to test facilities across the country. On one trip I found myself at the Transportation Research Center (now part of Honda) in Ohio helping with a high speed vehicle comparison being conducted by "Car & Driver" magazine. On the bulletin board was an item regarding wheel torques. It stated that whenever a TRC mechanic was torquing lug nuts they should use the LOWER value of the manufacturer's recommendation range. In other words, if the recommendation was 90-100 lb-ft; set the torque wrench to 90. This seemed counter to what I always thought was best. The bulletin went on to explain that normal vehicle lug nuts were torqued only a few times during their lifetime. But a test vehicle might have the nuts torqued many more times. Every time the nuts were torqued the studs might 'permanently' stretch a tiny amount. Using the minimum recommended torque extended dependable stud life. The bulletin made a lot of sense and we use this standard whenever torquing frequently disassembled parts.

* Suspension: Shocks, springs, steering, and wheel bearings should all be in good condition.

* The glass areas on the car should have no dangerous cracks or scratches. The driver and passenger side windows should be able to be cranked all the way to their down position.

* Wipers should operate properly and have good blades.

* The exhaust system should be in good order and exit behind the driver. Some tracks/organizations have sound limits - check ahead if you have a louder than normal exhaust.

* With respect to body panels they all should be securely fastened and there should be no excessive rust. There should also be adequate ground clearance and no tire rubbing.

* Usually all cars must have a hardtop. Sunroofs and t-tops usually must be securely fastened or removed. Convertibles might be allowed if they have an approved roll-over bar and the tops are fastened in their fully 'up' or 'down' position. Sometimes convertibles not meeting these conditions are allowed to run under 'controlled' conditions (usually at lower speeds behind a lead car).

* The engine compartment should have no fluid leaks. The belts and hoses should be tightened properly and display no cracks which could indicate impending failure. The battery should be securely fastened with the positive terminal covered. All fluid levels should be within manufacturer specifications.

* ALL loose items should be removed from the interior and trunk areas. This includes compartments for maps, etc. The seats must be secure. Seat belts should show no signs of damage which would limit their safety functions. All pedals should have a firm positive feel with a strong return and no obstructions (floor mats should be removed even if there are clips).

STORY: One of the organizations I worked with in the past gave their instructors explicit instructions to immediately return to the pits with a student if they heard any noise which sounded like a loose object. It did not matter if it was coming from the glove box, the trunk, or anywhere else. Until it was identified the car was not to be on the track. If harmless, the object was to be removed before returning to the track. If it was something other than harmless, maybe we just prevented something bad from happening. The rule seemed petty, but over the years it did prevent a few undesirable occurrences.

* Helmet requirements vary with the organization. Check ahead if you plan on bringing your own. Rules do change from year to year as new standards are released.

* Do you have enough gas in your car? High performance driving uses considerably more fuel than what you become used to during everyday driving. Miles per gallon rates are frequently half while performance driving. Fill your tank on the way to the track. Even if the track sells gas it is often more expensive than your local service station. During the day it is common to have some cars start to run out of gas when their fuel gages still indicate as much as a quarter, or even as much as a half tank. Always judge your gauges accuracy while you are at speed on the track, not sitting in the paddock. Sitting still can result in a totally different reading than when you are sloshing fuel around in the tank while on the track. Even then it could be misleading. Many newer cars also have 'saddle-style' gas tanks and the transfer rate of gas from one side to another may not be adequate for track usage. This is something you will need to learn about your specific vehicle through experience.

Vehicle preparation (at track):

Performing some of these items at home will save you time at the track.

* Remove all loose items not previously removed. It is good to have somewhere to store stuff in case of bad weather. While some tracks have shelter, others may not. You may find yourself in a grassy area. Plan for changes in the weather.

* Tire pressures? There are a lot of possibilities based on vehicle, track, tire brand, driver techniques, and so on. Ask around, especially if someone experienced is running a car and tire combination similar to yours. My 'generic' recommendation for beginners is to increase pressures 4-6 psi above what your owner's manual recommends. The reason for this is the manufacturers recommendation is usually a compromise between ride comfort (lower pressures making for a softer ride) and handling (higher pressures creating crisper steering response and suspension feedback).

STORY: One Goodyear trip found me at Hockenheim in Germany working with Zakspeed. While riding to the track on the Autobahn I discovered the German vehicle manufacturers put two different tire pressure recommendations in their owner's manuals. The lower pressures were for everyday driving around town. The higher numbers were for the higher speeds of the autobahn.

* Tire wear? There are many factors which will influence tire wear. It is a good idea to ask people familiar with the track about their personal tire wear experience. Closely watch tire wear if you are a beginner. On most tracks, outside tire shoulders will show the most wear, but be sure to watch the inside shoulder as well. Wear rates will increase as you learn to drive faster. A secondary advantage to closely watching your tires is early spotting of a problem such as a flat-spot from a brake lock-up. Alignment problems can also be spotted by watching tire wear. The alignment may match the manufacturers recommendation, but remember those settings are based on everyday driving conditions, not what you are doing. Frequently, dedicated track cars have alignment settings very different from the assembly plant settings. Even experienced drivers are always watching their tires.

Regarding tire rotation: frequently it is okay even when the tire manufacturer doesn't seem to recommend it. The question to be asked is: Why was a particular rotation specified? You may need to talk to the tire company directly to get a good answer. One general rule of thumb: if the tire tread pattern is the only difference which results in the rotation recommendation, then running the tire backwards may be possible. But it is probably best to limit this "backward" running to times when tires are close to wearing out and you simply want to extend their life for a short time. Running tires backwards to their intended direction in the wet is also possible. The difference in rotation in the wet usually makes a difference, but it is generally small.

Tires vary greatly between manufacturers. When considering changes it is always best to get some experienced and/or expert advice. Get opinions from those who have actually used the tires and/or designed them. And when you make a change, whether it is a new manufacturer, new set of the same design, or simply rotating the same set around the car; give the tires and yourself several laps for adjustment.

* Brakes: You should have done this at home.

Facilities:

As soon as you arrive at a track start learning about your surroundings. Frequently these items are discussed in the welcoming meeting, but get a head-start by looking around. Traffic flow patterns in the paddock, restroom locations, meeting locations, and location of a compressed air hose are just a few of the things you should take the time to familiarize yourself with. Are there concession stands at the track? When are they open? Are they open on the day you are there? Where is the closest place to get food? What if you need gas?

Track layout:

While this is discussed in meetings it is a good idea to have a basic idea ahead of time. Don't try to learn the best ways to go fast on the track, just get an idea of track flow and what to expect 'around the next corner' or 'over the next hill'. Also be aware of the correct procedures for entering and exiting the track.

Meetings:

There is usually a 'welcoming meeting' at the start of the day. This meeting is targeted towards all of the participants: beginners, intermediate, and experienced. Instructors usually attend this meeting. The meeting will outline the schedule for the day and include many safety items related to that event. Later meetings are targeted towards specific groups. Expect beginners to have more than one meeting during the day.

Flags:

There is usually a brief review of flags during the 'welcoming meeting'. Beginners can expect a more detailed briefing during their first beginner classroom. Flags contribute enormously to everyone's safety during the day and it is very important to know them. It is common for some tracks to simplify flag meanings for track days and there may be a couple of minor differences between tracks. Know what is used at the facility and for the event you are attending. Below are some 'generic' meanings:

GREEN = the course is clear.

YELLOW = Take caution, there is a problem ahead. NO PASSING. A waving flag indicates increased danger. Slowing down is usually required but be aware of surrounding traffic as you decrease speed.

YELLOW with red vertical stripes = Frequently referred to as the 'slippery flag' due to its common use for oil on the track. But it could be a warning of other objects (parts, dirt, grass, etc) on the racing surface.

STORY: While practicing in a steady rain at Watkins Glen during an IMSA weekend the corner workers started showing everyone the 'slippery flag'. This made no sense to any of the drivers. Later on we learned they showed it because of 'changing conditions'. For several minutes there had been hail mixed with the rain.

BLUE = Another car is close behind you. If it is stationary the corner worker is simply making sure you are aware of the following vehicle. Let it pass you if it is faster. If the corner worker is waving the flag they are instructing you to let the faster car pass as soon as convenient and in a safe manner. (Sometimes this flag has a yellow diagonal stripe.)

WHITE = There is a slow moving vehicle ahead. It could be a wrecker, ambulance, crippled car limping to the pits, etc. You can (and should) pass the slower vehicle, but do it safely. Note: Ambulance and wrecker crews are usually trained to give race cars the right-of-way when they need to cross from one side of the track to the other. They might actually stop waiting for you to pass.

BLACK = This flag can be shown to individuals or the whole group. Slow down and proceed to the pits. Someone in the pits will inform you of the reason for the flag. If someone shakes a furled black flag at you they are saying: 'We saw what you did. Don't do it again.' You don't need to pit for a furled black flag.

BLACK with an orange ball = Pit ASAP. Someone has noticed what may be a mechanical problem with your car. You may or may not be aware of it. Pit for information.

Note: Whenever either type of black flag is waved someone will meet you in the pits to explain. The only exception is the furled flag shaken at you. They will unfurl it if you keep doing whatever it is that is making them unhappy.

RED = STOP ASAP, but in a safe manner. If possible, stop at the NEXT manned corner station and wait for further instructions. Stay on the racing surface (but at one side or the other so emergency vehicles can easily get by). Do not proceed around the track until directed to do so. This is one type of flag which could vary from event to event. Ask if you don't know the procedures at the event you are attending.

STORY: At a SCCA Driver's School a couple of years ago I saw one of the worse cases of ignoring a red flag I had ever witnessed. Over the years I have seen numerous drivers proceed several turns (or more) looking for a good place to stop during a red flag situation. At this particular school I happened to be in the starter's tower when the red flag was displayed. There was no reason for it other than an exercise for the students. Several students came to a quick, safe stop on the front straight. But one Datsun 510 came out of the last turn, slowed to a crawling speed, and proceeded to work his way down the entire straight while weaving slowly around the stopped cars. He finally stopped around the third turn. What made the incident even more puzzling was the driver had raced years earlier and the school was supposedly a refresher. The procedure he used was never included in any past rulebook..

When a red flag is displayed, most likely something happened which needs immediate attention. Frequently there may be a medical emergency and the officials want to send the ambulance ASAP. For obvious safety reasons they CANNOT send the ambulance out into race traffic. Therefore they wait until all traffic has stopped. Looking back at the '510' incident above, what if someone had needed immediate medical attention on the backside of the course? Don't be the person who delays the ambulance.

CHECKERED = The session is over. Proceed safely to the pits. Slowing down is optional so be careful of traffic. Sometimes the checkered flag is shown elsewhere than the start/finish line. Unless other options are mentioned by the organizers, always pit at the first opportunity after receiving the checkered flag.

STORY: The cool-down lap can be the most dangerous. There was a race where as I approached the start/finish line to start my last lap the checkered flag came out for Freddy Baker (who was the overall leader and about to lap me). But he didn't get past before the line and I still had a lap of racing to go. Fred had passed most of the field by that portion of the race. During my cool-down lap I came across several of them who had dramatically slowed and were no longer paying attention to traffic around them. There were several close calls.

During cool-down laps you may encounter several extremes. One car may be on the verge of overheating and the driver has slowed a lot in order to nurse the car back to the pits. Another driver may want a good set of tire temperatures and treats his cool-down lap as a 'hot' lap. Someone else may be wandering back and forth across the track and are totally unaware of approaching vehicles. Most people slow a little while still driving the proper line. But even that approach can be dangerous if you go off line a little. After driving at what feels like the limit, slowing 5, 10, or 20 MPH will seem like you creeping around the track. In reality you are still carrying some impressive speeds and you need to stay focused on what you are doing and where you (and your fellow drivers) are on the track.

Track days may have specific rules for cool-down laps and you should know them. Ask if you don't.

STORY: Flag usages and meanings slowly evolve. There was a time when the red flag had two meanings within the SCCA. In 1978 I participated at Bridgehampton in a SCCA National. On Sunday morning the Chief Steward called a meeting for everyone. Because of something which had happened on Saturday in another group's session, he felt we all needed an education on the meaning of a red flag. He was not too happy and targeted his displeasure towards everyone. Up until that point I felt it wasn't my problem because I knew how I was supposed to react to a red flag. After all, I had already raced at numerous tracks and spent several years as a race tire engineer working at tracks all across the country. But I had never been to Bridgehampton and, as it turned out, I did not know their definition of the 'proper' usage of the red flag.

Several years later at Putnam Park there was a disagreement between the track owner and the local SCCA group regarding usage of the red flag. The SCCA National Office still recognized two distinct methods back then and different areas of the country picked which one they felt was correct. There was no middle ground between the two factions. Each group had strong arguments for their chosen usage. Following a nasty looking incident on the front straight at Putnam Park the track owner mandated the local SCCA club switch procedures or they could no longer race at his facility. The local club was adamant about how they would continue to do things. The SCCA has not raced at Putnam Park since that dispute.

A few years after the Putnam Park incident the SCCA National Office decreed a single usage. It was not what Bridgehampton used. It was what the GingerMan track owner mandated. It is also the usage described above. But there remain other places and clubs who use something different.

Passing zones and procedures:

These should be covered during the welcoming meeting. Similar to flags, they will be covered in more detail during the beginners first classroom session. Most organizations will have designated passing areas. They are usually located on the longer straights. Passing can be on the right side, the left side, or maybe it is optional. Know what the rule is at the track you are attending. They are not all the same.

Passes are usually initiated by the slower car indicating which side they want the faster vehicle to pass on. This is usually done with a hand signal out the driver's window. Sometimes the slower car needs to move over, sometimes not. What if there are multiple cars waiting to pass? Most rules state "one hand signal per car".

What if you are driving the faster car? Do not pass without a signal. If someone is not using their mirrors it will become obvious to the corner workers and action will be taken. It may take a few laps. Try shaking your fist out the side window at the car holding you up as you pass the starter. It might work. Note: If the driver in front of you is not signaling he may not be looking behind him and have no idea you are there. Be leery.

Sometimes a situation arises where a car which corners faster catches a car which is faster in the straights. If you are in that car with higher speeds on the straight, consider this: How did the car in your mirrors catch you? Obviously it is much faster somewhere else on the track. It is time for you to let them pass by going slower down the straight than you normally would. After they have passed, follow them and learn from what they are doing.

When should the passing be completed? Sometimes landmarks will be referenced during the meetings. My rule of thumb is all passing needs to be totally completed before anyone enters the braking zone for the next corner. If necessary, the slower vehicle may need to brake early to allow the faster car to properly enter the braking zone. Under no circumstances should two cars enter the turn side-by-side.

Note: I do not personally like the idea of using turn signals for passing indicators or other uses such as indicating you are entering the pits. The question always becomes: does the signal indicate which side to pass on, or is the car going to move over in that direction? Regardless of your personal preference, will everyone remember and follow the exact same meaning? What happens if someone gets it wrong?

First time on the track:

Your first time actually going around the track could be as a passenger, driving a lead/follow with an instructor, or solo in your own vehicle. Regardless of the procedures, DO NOT GO FAST. The main purpose of these laps is to get you used to the flow of the track and your surroundings. Drive comfortably and allow yourself the ability to look around. Learn what's 'around the bend' and 'over the hill'. Become aware of corner station locations and which ones are actually manned. Also look for patches on the track surface, curbing, changes in pavement, barriers, and so on. Make mental notes about run-offs areas and potential hazards. You will be using many of these observations later on. Expect the classroom instructor to refer to a few of them. Frequently the objective of this session is to ingrain what the track layout looks like in preparation for classroom discussions. Save faster speeds for after the classroom sessions. In classroom you will learn techniques which tie in with your track observations.

A note for experienced drivers driving a new track, or a different vehicle on a familiar track: take several laps to learn the 'flow' of the new track or 'feel' of the different car. Some tracks may require an entire session, but it is worth it. Having a good understanding of the track layout and vehicle's performance basics is strongly recommended before trying to find limits.

STORY: My first trip to Mosport was while racing an IMSA GTU car in the early 1990's. I had been there several times as a spectator and tire engineer. I knew it was a fast track and have since come to believe, as do many other drivers, there is nothing to match it in the United States with regards to needing "big attachments". Anyway, I was talking about the track with one of the more experienced drivers while we were unloading our equipment. We were both familiar with each other and had shared advice in the past. But he had Mosport experience and I did not. He told me not to go fast for ten laps. I must have acted as if I didn't take him seriously because he started repeating the advice and kept it up until I promised him I would do it. So on my first time on the Mosport track I drove well within the car's limits for ten laps, which was virtually the entire session. It seemed very wrong compared with how I normally attacked a new track, but my fellow co-driver had been so adamant. I didn't go slow, but I never tried to find tire limits during cornering or braking. I learned the 'flow' of the track. The importance of the lesson really hit home when two of my fellow Mosport rookies crashed their cars during the session. To this day, Mosport is one of my favorite tracks. A lot of that feeling had to do with getting comfortable with the track before trying to push the car's limits.

Being comfortable in your car:

Being comfortable is critical to good and safe driving. Your hands need to be on opposite sides of the steering wheel. You should be able to turn the steering wheel close to 180 degrees without either hand letting go. AND your shoulders should stay against the back of the seat while doing it. Your legs should be able to FULLY depress pedals without any 'butt' movement in the seat. Some instructors advise having a slight bend left in the knee area at the point the pedals are fully depressed. Mirrors need to be properly adjusted. And seat belts properly located and securely fastened.

The above are guidelines. They basically outline extremes and you will probably have some freedom of adjustments within their limits. For example, some people prefer sitting close to the steering wheel while some like to sit further back. Regardless of your personal preferences, being able to correctly work all the controls while remaining securely strapped into your seat is the critical part.

I mentioned being able to cross your arms while turning the steering wheel close to 180 degrees. This exercise is intended to help find a comfortable sitting position, it is not intended as a recommendation as how to drive while on track.

Hand positions on the steering wheel while driving:

Different instructors teach different techniques. Almost all techniques want you to have your hands opposite each other (commonly called the 9 and 3 positions) while driving straight. It would be nice if you could keep your hands in these same positions while going through turns. That way you could easily, and quickly, make steering corrections if the need arose mid-turn. There are a variety of techniques used to keep hands somewhat on opposite sides of the wheel while negotiating a turn. Ask experienced drivers and sample a few techniques. But you should never have your arms crossed up while driving.
Exception: If you watch racing on television you may see drivers going through turns with the steering wheel turned 180

degrees and their arms crossed. This is common with Formula One drivers and some other formula type vehicles. But their situation is somewhat different from driving a typical car. Formula One steering wheels have numerous controls and the wheel itself is designed for only two grip positions. The steering ratios and handling characteristics for a particular track and driver style are all computed and designed into the car before it arrives at that circuit. Under those circumstances when a Formula One driver crosses their arms to the max they are at the fully locked steering angle and additional steering in that direction is no longer an option.

Another exception: Stock car drivers will frequently have both of their hands somewhat on the left-hand side of the steering wheel in the middle of a turn. They do this to help with the g-forces acting on them during cornering. It isn't so much a matter of strength as it is minimizing fatigue during a long hot race. Bear in mind their turns are always to the left, the cars are aligned to turn left all by themselves, and several other factors make the situation very different from driving a car on a road course. With the set-ups they use they can still make quick corrections in the middle of a turn if necessary. But I think minimizing effort and saving energy are still the biggest factors.

"Entering the track"

Most tracks have procedures for leaving the false grid and entering the track. There is usually at least one spot either in the false grid area or as you drive through the pits where someone wants to check and make sure you are properly fastened in the car and are going on track with the correct group. There will probably be a system of controlling your pit exit. It could be a person using hand signals or waving a flag. Or it could be a set of lights at the pit exit. DO NOT enter the track until you have the proper signal. As you move from the pit exit to the track you should keep your car on the same side of the track as the pit exit. Do not move over until after you are traveling through the first turn. This is to avoid problems between your car and someone already on the track, probably moving at a much higher speed. During the first lap you will want to gradually get up speed while making sure everything is okay with your car. If anything feels wrong, pit and find out what is going on. Do not trust the problem to go away as speed increases.

Start becoming aware of traffic around you. Drivers have different patterns they follow for getting up to speed, warming tires, etc. If possible, try to minimize traffic issues on your first few laps so you can concentrate on the track and driving your car.

STORY: While working with Goodyear at a Mexico City race a Formula Atlanta driver and I were discussing air pressures and the start of the race. They used a 'standing start' procedure. The front straight was long and the cars would arrive at the first turn at a high rate of speed. These cars also liked to run very low air pressures. We had seen a couple of tire beads come unseated during the previous races. The problem was always traced to very low air pressures combined with high cornering loads.

There is always a difference in cold and hot pressures. This particular driver was concerned about starting with low 'cold' pressures and arriving at the first turn with no tire warming and still low pressures. He was convinced his tires would de-bead during the first turn. He did not want to start with a higher pressure because that would result in too high a pressure once the tires were warmed. Basically, should he start at the low pressure he always used and risk crashing in the first turn, or start at a little higher pressure and not be at optimum pressure the rest of the race? There was no correct answer from the engineering standpoint.

Another driver with a F5000 car was having problems getting his tires hot during a June Sprints weekend at Road America. He knew the tires would not give optimum grip until they reached a good operating temperature. This was not a tire pressure problem, but a case of the driver believing he needed to warm up his tires before he could go fast through the turns. There is some truth to that, but the problem was this driver believed driving his V-8 formula car on the straights would do the trick. He didn't realize the vast majority of tire heat is generated during cornering. And Road America has long straights which actually cool hot tires. There was no way the tires were ever going to get sufficiently hot without subjecting them to some cornering forces.

Frequently I hear race drivers comment on taking a few laps to warm up their tires and the rest of the car (brakes in particular). Warming things up is very necessary, taking several laps to do it is a waste of time. You want to get everything up to operating temperatures. The key word here is 'operating'. If you drive the car at 70 percent you will achieve 70 percent of optimum operating temperatures.

So what can you do? Consider a professional level driver (NASCAR, Indy, GrandAm, ALMS, etc.) pitting under green flag conditions. While in the pits a new set of tires are installed. Does that driver return to the track and drive at 70 percent for a few laps waiting for the tires to warm up? No. Starting with the very first turn he (or she) attacks it at a speed they believe will succeed. They may be at 70 percent in that first turn but they are seeing if they can do 71, or 72 percent. Whatever level is reached in the first turn, they will attempt to raise it in the second. And raise it again in the third. And so on. The rate with which they push the limits is determined by experience and feel. Their goal is to get the tires up to optimum working conditions ASAP. And to do that they need to be pushing them each and every turn. For a performance driving program you do not need to copy this technique. But you also don't need to drive slowly for several laps waiting for things to warm up.

Have you ever watched cars warm up during a pace lap? They are weaving back and forth and many people believe they do it to warm the tires. At least that is the impression most television announcers used to give. Over the years the announcers have switched to talking about keeping the tires clean. In fact, the squirming of the cars adds a small amount of heat, but the major advantage is the clean tread surface.

A final comment: brakes can be significantly warmed during pace laps by speeding up and then standing on the brake pedal. Race drivers do this all the time, but I do not advise it at a performance school because trailing drivers may not be expecting you to do it.

Smooooth:

One thing is in common with all instructors regarding performance driving. You will find they stress the importance of being smooth. You can expect to see the word in print, hear it from your classroom instructor, and be reminded of it if riding with an instructor. The four tire contact patches between your vehicle and the road are your primary means of controlling where you want the car pointed. Whenever the tires are sliding you have lost that control until they stop sliding. Many modern cars have ABS and Traction Control systems. They are safety features which do their jobs by eliminating or minimizing tire slippage on a slippery road surface. They perform the same function when the driver is acting in a non-smooth manner (usually during a panic stop or rapid steering movement to avoid something) creating potential tire sliding on the pavement.

These modern features are great aids and it seems as if every year there is something new designed into our cars which will make it more difficult for a driver to lose traction. But the driver is still important and the best way to keep a rolling tire from becoming a sliding tire is to have smooth inputs with the steering and pedal movements. Think of driving on ice. What would happen if you suddenly stomped on the brake pedal, jerked the steering wheel, or hit the throttle hard? Imagine you had no ABS, etc.

There are always exceptions to every rule and every once in awhile you find a turn which requires you to break the smoothness guideline. Sometimes it is difficult to get a car to rotate enough to make a turn and you might want the rear end to slide around. Drifters do this all the time. While spectacular, it is rarely the fastest way around a turn. And guess what, once the rear end has been tricked into sliding by inputs from an experienced drifter, that driver inputs go back to being very smooth to maintain the balance required for the drift. Keep in mind, drifting is rarely the fast way through a turn. Work on the smoothness, not the spectacular.

When should you turn 'off' the ABS?:

You can also apply the following answer to other systems such as Traction Control and Stability Control. If your car is equipped with any of these controls, leave them 'on'. If the controls have different levels and some are designed to enhance performance driving, go ahead and use them. But do not turn the controls totally off.

With lots of track experience you will start to feel a consistency in when these controls are impacting what you are doing with the car. There is no problem with using the ABS to its full extent, but you might want to try braking hard enough to 'almost' activate it. The same can be said for Traction Control. It is unlikely you will go any faster by balancing between using and not using these controls, but you will develop a better feel for your vehicle.

Another advantage of these controls is reduced wear and tear of mechanical parts. When traction control was first used at Indianapolis there was no speed advantage. But by keeping the tires from spinning under acceleration their wear rates improved and drivers could run faster than non-traction control equipped cars as their tires started to wear out.

You might consider turning the controls 'off' after you have developed a good feel for your vehicle (following many hours of track time) and you start getting an impression one of these controls is actually interfering with what you are trying to make the car do. Most modern systems are so good it is difficult for human reaction times to improve upon them. This subject is covered more extensively in my intermediate lessons. For beginners, leave the safety controls turned on.

STORY: Shortly after the C5 Corvettes hit the streets I was offered the opportunity to drive a Z06 version at Virginia International Raceway. I had never been in one before and was impressed immediately with its road manners. It wasn't too long before I started pushing some limits. Approaching a slight curve in the road I lightly applied some brake pedal pressure in order to take weight off the rear and help the car rotate into the turn. This was a common technique for me with many cars. But all of a sudden the brake pedal pulled away from my foot. My first thought was the pedal assembly had broken. But I could feel the car still had the brakes applied, just harder than I desired. As I completed the turn the brake pressure was released and the pedal returned to its normal position. I tried the brakes on the following straight and they seemed okay. The car owner was with me and I explained what had happened. Truthfully, it had spooked me. It turned out there was a stability control system built into the car which could sense when the vehicle's angle of rotation (yaw) combined with speed exceeded design parameters. When these parameters were exceeded the computer felt the car was starting to spin out and sent a command to apply brake pressure to the inside rear brake in order to help straighten the car. I wanted a little slippage at the rear to get the car to rotate, but the computer thought I was losing control. Since then similar controls have become common. Some you can turn off (as with the C5), some you can adjust for different driving styles, and some are on all the time.

STORY: In 2004 I was fortunate to drive one of the first Cadillac CTS V's to come off of the assembly line. John Bender had bought the car and we competed in the One Lap of America that summer. Chuck Mallett prepped the car prior to the event. Due to a very short lead time Chuck barely had time to change wheels and tires while swapping the brake lines to a braided variety. We did get a little practice in prior to the event and knew we had a problem. There was no 'off' switch for the stability control and the massive power of the car combined with some of my car control techniques (see above story) were not always in agreement. The slightly smaller tire diameter was adding to the computer's confusion.

When we arrived at Tire Rack for the start of One Lap we found another CTS-V. They were experiencing similar problems. We left Indiana, raced at several tracks across the country, and four days later were at Sears Point, still with no solution. Both Cadillac teams were trying different approaches and neither of us were having any success. We were even talking with GM experts back in Detroit and following their suggestions. But nothing we tried allowed us to turn off the stability computer. Both cars were running fine (we were the faster of the two) but we could tell the computer was limiting us. The day after Sears Point found us at Las Vegas Motor Speedway. Chuck Mallett called early in the day and had a suggestion. It worked and for the last couple days of the One Lap the stability computer no longer interfered with my driving techniques. Was it worth it? The improvement in lap times was probably less than one second. Not really all that much. I doubt a less experienced driver would have noticed any improvement.

Also think about this before you consider turning off your controls. Most top level racing cars in the world use these controls when permitted. Their programming is a better match for racing than a street designed program would be, but the programming reduces driver-induced errors.

Looking ahead:

This relates directly to being smooth. Simply put: the further ahead you look, the more time you have to think and react to what you are seeing. The result is you are less rushed in making your decisions, even if only by a fraction of a second. Since you aren't as rushed in making decisions you will be more relaxed, and probably make better decisions. The more relaxed you are, the smoother your driving will be. You can try to be smooth in other ways but looking ahead works almost like magic. And it takes little effort other then changing some habits.

Looking far ahead is not normal for most people. Even experienced race drivers must constantly work at it and avoid falling into more natural (lazy) habits. Endurance racers often find it is a sign of fatigue when they stop looking far ahead. You must force yourself to do it. Practice during everyday driving.

Turn-in, Apex, and Track-out points:

If you think of a turn as having a constant radius it should be obvious that a tighter radius turn requires slower speeds than a turn with a bigger radius. You can create a slightly bigger radius, and therefore faster transit speed, in any turn by entering the turn wide, tucking into the inside of the turn in the middle, and exiting wide. There are a lot of other factors to consider when determining the best line through a turn, but this basic approach of driving the path with the greatest curvature is usually the first consideration.

Almost every turn will have a Turn-in point where you are near the pavement edge on the outer side of the track as you approach the turn. The Apex is where you are somewhere near the middle of the turn and very close to the pavement edge on the inner radius of the curve. The Track-out is once again on the outer edge of the pavement as you exit the turn.

Not everyone has the same exact points of reference, but they are usually close. Sometimes track day organizations place pylons to indicate these positions. If they are there, use them. If not, read on and use the following as an approach to determine them.

Turn-in points are usually determined by you and your cars ability to hit the Apex. This may sound strange, but the goal is to hit a proper Apex. The Turn-in point is where it all starts. Find your desired Apex before finalizing a specific Turn-in point.

Track-out points will vary lap to lap depending on your speed, how close you came to your Apex, and the arc you took through the turn. As your consistency through a turn improves your Track-out point will become better defined and more regular. Just keep the car on the pavement.

The Apex is the most important target to hit. And it is by far the easiest to get wrong. Almost everyone has a natural tendency to Apex early. This can be very dangerous. A conscious effort must be made to always hit the proper Apex. If your tires are near maximum grip and you Apex too early you may not be able to keep the car on the track as you near your Track-out point. This is a very common mistake, even with experienced drivers. The results can be costly.

Tip: Always assume a later Apex than what you feel is the true Apex when first learning a turn. There is only one downside of a late Apex. If you are going at max speed through the turn using a late Apex you may not need all the pavement exiting the turn. That means you probably could have taken the turn a little faster if you used a slightly earlier Apex. Compare that to the downside of early Apexing (see above paragraph). Another way of looking at this is: If you Apex too late while learning you will get a chance to correct it the next time around. If you Apex too early, your car may go off the track. When that happens you may not get another lap and the opportunity to improve. Whenever learning a new track (or even driving an unfamiliar car on a well-known track), make your first few Apexes late. Then adjust them as you learn the track and/or car. It is a much better approach then Apexing early and fixing bodywork or going home.

STORY: If you go on You-tube and put in Red Viper at Nelson Ledges you will see some very interesting in-car video of what can happen when you apex too early. The driver of this car hates my telling this story but is illustrates several very important points.

First of all, the driver is very good and was performing a qualifying session using all the correct techniques. He had a new set of tires on and knew his best laps would occur early on. It was important to go as fast as possible during the second or third lap. As lap two started he was totally focused on getting the pole position. The in-car video shows him apexing slightly early for turn three. This resulted in dropping two wheels off the pavement on the left side at the track-out point. If it had not been a qualifying lap he might have focused on regaining control of the car, but he did not want to throw away what might be one of his two best laps on the new tires. Staying hard on the throttle he brought the car back onto the pavement. Since the right side tires were clean and left side tires were dirty the car rotated slightly and proceeded to slide totally off the right side of the track. Now he had all the tires in the grass and quickly slid to the tire wall. The impact launched the car into the air. When he landed the car was ON TOP of the turn four corner station. The driver was okay, but the car needed some extensive repairs at the Kryderacing shop. A few weeks later the car and driver were back racing and winning.

In summary, even a very talented driver can make the mistake of an early apex and bringing the car back onto the pavement before regaining full control.

Analyzing a turn:

All turns require compromise in order to maximize efficiency. Your first decision is to determine which is more important for the turn you are studying: fast entry, fast exit, or a compromise. 'Fast exit' turns are usually the most common and therefore learning them should be a top priority. Any corner which leads to a straight is probably one of these types. Sometimes you have a turn at the end of a long straight and you might desire to carry your speed a little longer. This would be an example of a "Fast entry" turn. It can be beneficial as long as it doesn't mess up a 'Fast exit' turn. "Fast entry" turns may seem common, but careful analysis is required since you rarely want to compromise acceleration onto the next straight. "Compromise" turns are found where turns are connected to other turns with little or no straights in between. "Compromise" turns often have several seemingly good options. Analysis of these turns usually requires trade-offs and experimentation.

For beginners we will concentrate on the most common turn and how to learn it. Your objective should be to exit the turn with as much controlled acceleration as possible. To do that you need to be on the throttle as soon and as hard as possible. To accomplish that you need complete control of the car in the middle of the turn. Your actions during turn entry determine when you achieve the level of control you need to start accelerating. Entering the turn too fast usually results in a slightly out-of-control car mid-turn, and a delay in getting on the power for turn exit.

Lesson: When learning, DO NOT enter a corner fast with the idea of maintaining control for a fast exit. Work on the exit portion of the turn first.

Start by entering the turn at a speed which allows you to play with throttle application. You goal should be to find a point at which you can start applying throttle and gradually increase it as you accelerate out of the turn. The rate of throttle application may vary between slow and quick, but you should strive to make it one continuous, smooth motion with no lifting of the throttle. If you need to lift to regain control simply try to get it perfect the next lap. This technique works for all cars, but is critical for turbocharged vehicles.

Once you have found the best way to 'charge' out of the turn start trying to find faster entry methods which do not interfere with your ability to exit with the maximum acceleration you discovered earlier. The final result should be one with controlled threshold braking leading to proper vehicle positioning and rotation of the car during the middle part of the turn so that early and maximum acceleration can follow as you exit the turn.

STORY: I first learned the importance of this technique after several years of racing. The event was one of the early 24 Hours of Nelson and it was my first time racing a turbocharged vehicle. I had lots of experience on the track and had been very fast and consistent in whatever I drove. But during practice, laps which felt quick were slow and laps which felt slow were quick. The differences in lap times weren't great, but they were noticeable. Every time I pushed the car's limits in the turns I went slower. I wasn't making mistakes, just driving harder. It was very frustrating.

Then a teammate started teaching me about a necessary technique for driving a turbocharged racecar. When I was driving on the ragged edge trying to go fast I was also getting on and off of the throttle mid-turn in order to maintain control. Turbos do not give maximum power until they have had a chance to spool up. My 'on the edge' driving mid-turn was delaying the start of uninterrupted full throttle application. When I drove fast, but did not play with the throttle, the start of continuous full throttle was slightly earlier. This resulted in a slightly higher straightaway speed and better lap times.

I believe the technique also works for non-turbo vehicles. You may have heard from race drivers that they frequently go faster when they stop trying to go fast. The above story is probably a partial reason for this strange, but common, occurrence.

Focus and Feel - Instinct

Hopefully the above information will be helpful and make your on-track experiences safer. As you learn you will notice the amount of focus required is extreme. Driving in a high performance environment requires 100% focus and no distractions. Some people find this level of mental focus relaxing because the mind is doing only one thing. Actually the mind is doing a lot, but it is all targeted towards a single objective. ALL the incoming information and outgoing commands from the brain are critical to car control. At some point along the way you recognize these inputs and outputs are closely related to your survival and you shut out other thoughts. If you cannot maintain that level of focus, please get off the track.

STORY: You may hear stories of drivers who have spotted a good looking woman in the spectator crowd or some other item which catches their eye and distracts them while driving. It is true, but they don't start out looking for something. What happens is they become so focused on things that background patterns start to form. This allows them to focus on the action of the moment. But if something changes in the background pattern, be it a waving yellow flag or something different in the crowd, they will momentarily look at and analyze it.

So what should you focus on? Turn-in points, apexes, track-out locations, engine RPM, gear selection, shift points, braking points, cars around you, and probably a few hundred other items with every lap. All of these items are very important and beginners are often overwhelmed by the volume of things they must keep in focus.

Because of this 'focus overloading' many beginners spend little time 'feeling' what the car is doing. Even experienced drivers, when asked what a car feels like, will often answer with things like which gear they are in, where they are braking, or reference points around the track. All of which is definitely important, but none of which answers the question about 'feel'.

It takes lots of time to develop 'feel', but you should try to pay attention from your very first lap. Learning what feels right will help you know when something feels wrong. It could be a tire slowly losing air, some change in the grip level of the track surface, or many other things. When negotiating a turn, the sooner you can 'feel' something different during initial turn-in, the quicker you can start making adjustments. The neat thing about 'feel' is the more you concentrate on it, the better your mind records it for future reference. Your sub-conscious can actually handle a lot of this type of thing if you program it by feeling what is happening. Your sub-conscious can then let you know when something is different. That is when 'instinct' will start to play a role.

And don't forget your other senses. That burnt oil smell could be your differential failing. The change in sound you hear could be worn-out brake pads or an exhaust leak. Your eyes are always involved but your ability to notice changes is extremely useful, especially regarding changing track surfaces such as experienced during rain. Taste?

STORY: After about a year of racing I found my eyes focusing on an apex point (assuming it was visible) shortly before I arrived at my turn-in point. I was consistently looking ahead as instructed in school the previous Spring. But as I started to try and push the limits of traction and speed, I also found myself frequently making tiny corrections with the steering wheel and the throttle or brakes immediately after starting the turn-in. My eyes were telling my brain where I wanted to end up (the apex point). Even before I was consciously aware that hitting the desired apex was becoming problematic, my sub-conscious was supplying the necessary corrections to my inputs (muscles) to make it happen. The sub-conscious was first to wave a warning flag if I was going to miss the apex so I could start making corrections for what could happen in the later part of the turn. Your sub-conscious is a very active component of your driving. Supply it with good information.

Guts!

There is a commonly held belief by those who watch what we are doing that driving fast requires guts. There is a small element of truth to that, but it probably isn't what most people think. Anytime someone does something they have never done before there is an element of risk and it takes guts to take that chance which could result in failure. Some people are afraid to meet new people while others are afraid to bungee jump. Obviously there are major differences in the consequences when you attempt something you have never done before. Some failures could simply be embarrassing while others could lead to injury. Most people somehow find the guts to do the things they really want to do.

However, when driving a car at high speeds there is a type of guts which you should avoid. There is a difference between the person who uses guts to find a way to go a little bit faster through a turn and a person who simply thinks all it takes is guts to go fast through a turn. One person is learning while the other is putting their life at risk.

Over the years I have watched people have their share of incidents. Mechanical issues and miscalculations are frequently the blame. But there is another example which seems to occur all too often. It is usually when a new driver is showing off to an instructor or trying to impress a friend who is an experienced high performance driver. They want to make a good impression but feel their current level of expertise will appear too slow to the more experienced driver. Please, leave your ego in the paddock. An experienced driver riding with you usually wants to help. Show them your current skill level and they will offer advice to build upon those skills. Show them 'guts' and they will ask you to slow down before something bad happens.

One of the most common quotes from an instructor to a student shortly after they have started a session is 'slow down'. Step one: learn to drive within your personal limits. Step two: use your guts to test and experiment with the limits. Golden rule: never put step two before step one.

MISC ITEMS

Passengers: Sometimes passengers are allowed but most organizers will only allow instructors to ride with you.

Riding with instructors in their cars: Take advantage of this whenever possible. Learn from the experience but be careful trying to copy it. Instructors have a couple of advantages which beginners do not possess. First, they have a wealth of time on the track which translates into a smoothness of driving at high speeds. In other words, they make it look easy. Usually not mentioned is the fact their wealth of track time has probably included numerous mistakes. With experience they have learned ways to minimize mistakes while making the proper corrections when they occur. If you try to copy their speed because they made it look easy, do you have the experience to make the correct correction when you inevitably make a mistake?

Letting instructors (or anyone else) drive your car: You have one question you need to ask - who is responsible if something goes wrong? While driver error is possible there are other things which can go wrong. What if there is a mechanical failure? What if an outside factor (another car, animal on the track, etc) led to damage? And don't trust any unforeseen damage will have a clear cut cause. Make sure both parties are in agreement on responsibility BEFORE going on the track.

Driving someone else's car: See above.

Insurance: In most cases your vehicle insurance company will not be covering your on-track activities. If you are uncertain, check your policy before coming to the track. There are some exceptions and a few of them will repair damage which occurs during 'driving instruction classes'. Even though these programs stress safety and usually improve your everyday highway driving skills, chances are the insurance company's interpretation of 'high performance driving' instruction may not be the same as yours. There are differences between racing schools and high performance driving schools. You will rarely see a stopwatch at a high performance driving school and the reason is you are there to improve driving skills, not to see how fast you can complete a lap.

Dropping four wheels off the track: First, be aware of traffic on the track. Corner workers can be helpful with hand signals indicating when it is clear to return to the track surface. Look for them. And be careful when you re-enter the track surface. Your tires could be wet or muddy and your traction capabilities are probably reduced. Different organizing groups have different rules you need to follow if you go off course. Regardless of any rule, it is a good idea to stop in the pits and have someone check for damage, especially underneath the vehicle. You may have an exhaust pipe knocked ajar, lots of sod jammed underneath, or there may be a damaged tire or rim. While stopped in the pits analyze what caused your off-course excursion. Discuss it with someone if possible, but at a minimum sit and reconstruct what happened and why. Critiquing is a very useful learning tool and having someone join the discussion, even if they are simply listening to your self-critique can be very helpful. Avoid critiquing while on the track. It can be a major distraction to focusing on the next corner.

Someone else off-course: At some point in time you will come across another car off the track. There may or may not be a yellow flag displayed. Be careful, especially if the car is trying to re-enter the track. Even if they see you they may come across the track due to loss of control from reduced traction. Or they may simply drive in front of you because they never looked for traffic. If you think the car may be stuck due to damage, mud, or for some other reason, please enter the pits and let someone know what you have seen. Hopefully the officials are already aware of the situation, but you can never be sure.

Stuck off-course: If you become stuck off-course, stay in your vehicle. Other cars could lose control and potentially join you. If they were to hit something it would be best it was your car with you in it as opposed to you standing outside of your car. Help will be on its way. The only time you should exit your vehicle before help arrives is if there is a danger from staying in your car. Such a danger might be fire.

Wet versus dry surfaces: It should be obvious there is less traction in the wet than in the dry. But traction levels don't change the same everywhere. Differences in pavement (including patches) can lead to big differences in traction in the wet. Water runs downhill so lower spots on banked areas of the track will have slightly deeper water. Puddles will form in other low spots. And the area's most traveled (the normal racing line) will generally have a more polished surface and offer less grip than other areas. If you are looking ahead you may notice shiny and dull areas of the track. In general, the

shiny areas have standing water while the dull areas are simply wet. You cannot avoid all the shiny areas, but you may be able to find a path which minimizes how many you drive through. Two additional challenges when driving in the rain are vision and changing track conditions. You must be able to see well enough to tell if the rain is lessening or worsening. Each lap will contain slightly different conditions and you need to recognize them. Good wipers and defoggers are a must.

Brake fluid: Having fresh brake fluid was stressed earlier. But what fluid is best? There are lots of good choices but you need to be aware of a few basics. Your owner's manual probably recommends DOT 3,4,or 5. Without getting too technical, usually the higher the number the better the fluid is able to handle higher brake temperatures. High performance driving will increase brake temperatures above those of street driving. But the fact these ratings are based on 'dry' and 'wet' boiling points of the fluid tends to muddy the issue. 'Wet' temperature ratings are determined when the fluid has a certain percentage of moisture in it. Virtually all brake fluids absorb moisture over time and the 'wet' rating is a way to determine quality for fluids after they have absorbed a specified amount of moisture. Using a DOT 4 fluid usually works well for beginners at most track events but you may want to change to higher levels of 'dry' boiling points for tracks demanding more severe braking and as your own braking skills improve. This is another area where talking with experienced participants and instructors can be very educational. One word about DOT 5: most of them are silicones and could have very high boiling points, both 'dry' and 'wet'. Silicone does not absorb moisture and results in a excellent 'wet' boiling levels. But silicone also produces a spongy pedal feel and most racers want nothing to do with it. It is great for stored vehicles which are rarely driven.

STORY: For many years in the middle 1990's Kryderacing attended high performance driving programs. Our prime purpose was to take care of Russ Wilson and his modified Corvette ZR-1. But we also provided a service to other participants who were experiencing vehicle problems. Advice was free. We fixed something if it could be safely done at the track. If the problem was serious or we lacked the proper tools or parts to do the repair, we suggested they go home and have a proper repair performed. Probably 90% of the work we did was brake related, and most of it required brake bleeding.

We were at Road America, a track notorious for severe braking. It seemed as if we spent most of the day bleeding brakes. Cars were frequently waiting their turn. I looked up one time and noticed a red Corvette which had been next in line was no longer there. A father and son were sharing the car. The father said he had to pump the brakes (a good sign the fluid had been boiled) and that was why they had brought it to us. The son did not want to miss his session on track, so the father told him to be careful, something wasn't totally right with the brakes, and pump them if necessary. Turn Twelve at Road America is called Canada Corner. It is a ninety degree bend at the end of one of the longest (and fastest) straights on the circuit. If you fail to get slowed adequately you end up in a gravel trap on the outside of the turn. The red Corvettes brake problems worsened but the son simply pumped them more vigorously. Finally the brakes totally failed as he approached Canada Corner. The car barely slowed as it sped over the gravel trap, hit the barrier, and launched itself into the air. When it stopped it was between two trees in the spectator area. Fortunately there were no spectators for this event and neither the driver nor the instructor riding with him were injured. The car was another story.

Speed shifting: It is a fact that the faster you shift the quicker your lap times will be. When you declutch the car you are not applying power and the car is coasting. Whether accelerating or braking, if you can reduce the time spent coasting you will turn faster lap times. I have heard drag racers use the term 'banging gears' to describe speed shifts. During accelerating they want to get from one gear to the next as fast as possible. This makes a lot of sense except for the case of the synchronized transmission. If you have a street vehicle with a manual gearbox you probably have a synchronized transmission. The 'synchros' are designed to make the shifting smoother and avoid grinding of gear teeth. But the synchros need a small fraction of a second to align the pieces within the gearbox so one half of a gear set can smoothly engage the other half. If your shift lever movements are quicker than the synchros can do their job you will create excessive wear of the synchros and gears. This wear will not show up immediately, but it will over time. Your question should be: Is the tiny fraction of a second from a quicker shifting speed worth the cost of rebuilding the transmission earlier than expected? If you can shift quickly and smoothly while feeling the linkage go through neutral you are probably doing pretty good. If the gearshift lever goes so fast from one gear to the other that you never sense anything with the linkage, you are probably shifting too fast for the synchros to align the gear set halves.

"Heel & Toe": This skill has been a basic skill taught to new race drivers for many years. It is a very important skill to learn but I suggest you concentrate on other skills first. I rarely 'heel & toe' but have had a very successful racing career. I do admire drivers who are good at it and believe there is a place for it. But you can drive quite well without it. Don't believe me? Read the following story.

STORY: During my early years of racing I used to 'heel & toe' all the time. But I was never happy with my braking skills while doing it. And I always felt my skills at matching rpm's could be better. It was an area I worked hard at and felt competent doing. But I was never comfortable with it. Then I was reading a book on Mark Donahue and discovered he DID NOT 'heel & toe'. It got me to thinking. There must be some other method? I don't know if what I developed is what Mark did, but it works great for me. I won't go into a long explanation at this time, but basically I threshold brake without shifting and do the shifting in the same time frame as I reapply the throttle.

A comment: Prior to when I started racing many people used their engines to assist the brakes in slowing the car. Shifting to catch a gear at high rpm's and then letting the clutch out accomplished this quite well. But by the time I started racing brakes had improved greatly. Some people started to question whether the contributions to braking from the engine and transmission were necessary, especially when you factored in the costs to rebuild or replace the various parts we were using to slow the car. My technique still requires matching of rpm's, but it is not done so as to hit as high of an rpm as the classic method. And my foot is totally off of the brake and just starting to get on the accelerator when I do it.

2nd Comment: My method has one serious shortcoming. It does not work with multiple downshifts. Learning to 'heel & toe' proficiently still has its advantages.

LISTEN TO EVERYONE'S IDEAS

Hopefully you will have learned by now there is no clear-cut way of doing most things. Depending on the vehicle you are driving, the track you are on, the weather conditions, and a few hundred other factors, what works for you may be slightly different from what works for someone else. Turn-in points, apexes, and track-out points will usually be close to whatever an instructor tells you to use, but the perfect points for you may vary slightly, depending on your suspension, tires, shocks, etc. Even your driving technique affects with what the car wants. It is best to listen to any advice you can obtain and carefully experiment with it.

It always amazes me how often a faster driver will assume slower drivers are doing everything wrong in comparison to their techniques. Watch and learn from everyone, not just those who are faster. The slow driver may be slow because of his car, not his driving style.

STORY: During the early 1990's I met Shane Lewis while we were doing some 'Ride & Drives'. Back then Shane was a young, up-and-coming formula car driver with roots at the Willow Springs race facility. He was obviously very talented and was in the infancy of what would become a very successful professional career, primarily in endurances races around the globe. Shane had one characteristic in those early days which caught my attention. He was always looking for advice from anyone. At first I thought it might simply be his way of being polite and making conversation, but he followed up these quiz sessions with actually trying a lot of what he was told. He soaked up advice from anyone willing to discuss stuff with him. I assume he is still doing the same.

STORY: Driving technique can have a lot to do with how a car is handling. I became a Goodyear Race Tire Engineer in February of 1976. Most of my time that year was spent with Champ (Indy) Cars and some sports cars. When you take thousands of tire temperatures you start to recognize suspension set-up characteristics. Understeer ('push')and oversteer ('loose') conditions became easy to spot. By late summer I had spent lots of time analyzing various set-ups with drivers and teams. The general routine was for the driver and chief mechanic to start talking with each other as soon as the car stopped. While they were doing this I would take tire temperatures. As soon as I finished the three of us would compare notes. With the majority of professional level drivers the tire temperatures would confirm the driver's comments.

But I learned something new during the late-summer IROC race at Michigan International Speedway. The IROC Camaros were intended to be as equal as possible for the dozen superstar drivers racing them. At every venue several drivers who were not part of the series would work long hours making sure all the cars were equally prepared. Included were three cars to be used exclusively for practice. The 'stars' would receive some test time in these 'practice cars' prior to the race. The only changes allowed to the practice cars were custom fitted seats for each driver. During the IROC practice sessions the twelve drivers would swap back and forth between the three cars with no changes other than seats.

Michigan International Speedway is a two-mile oval. Back in those days the cars circulated the track with only a slight lifting of the throttle for the turns. Since there was no braking or other radical changes to how the car was being driven during these two-mile laps you would expect all the drivers would have the same comments regarding any handling issues. After all, these were the best of the best in those days. And a lot of these drivers had extensive experience on the MIS oval. Surely Foyt, Unser, Petty, Allison, and the others would be in agreement on the basic set-up, good or bad. You would be wrong.

When taking temperatures on a track such as MIS you start with the right front tire, proceed to the right rear, and go around the back of the car to do the left side (rear first). By the time the engineer has taken the right side temperatures they can easily tell if the car was neutral, loose, or pushing. Mixed with the background noise of the other cars I could hear the driver loudly commenting to the mechanic as I took temperatures. What I found amazing was not that the handling characteristics described by the driver matched those of the tire temperatures, but that the characteristics changed from driver to driver. If a driver said the car was loose, the tire temperatures indicated loose. If the driver said the car was pushing, the temps showed it. The professional drivers and the tire engineer's temperature readings always agreed. But different drivers in exactly the same car (except for the seat) were experiencing different handling characteristics on a race track with minimal differences in how you could drive it. It was my first experience with just how much a driver can impact handling, regardless of suspension set-up.

In later years I would come to discover how much individual driving styles dictate shock set-up. I will talk about shocks elsewhere but the speed with which a driver operates their controls (throttle, brakes, steering) has a lot to do with shock settings. When you reach the top level of racing the shocks are adjusted to fit the individual driver style as much as anything else.

Closing

Performance driving is more of a mental exercise than physical. The amount of mental focus mentioned above becomes evident at an early stage with every driver who ventures onto a race track. Most experienced drivers go fast because of experience and a high level of focus on what they are doing rather than anything related to ‘guts‘. They definitely realize they are going dangerously fast and mistakes can be costly, but they also know they must focus 100% on the driving. Brave thoughts, fear, and thinking about ‘what might happen‘ must never be part of their thinking.

Beginners frequently make mistakes from which they can recover with no ill effects. Hitting the brakes too late, apexing too early, and jumping on the gas too soon are all common mistakes. If you are being the typical beginner you probably are not at maximum speeds when you make mistakes. And you will make mistakes, but hopefully they are all small. Ask yourself this question: Would you want to enter a turn at 7/10^{ths} and make a small mistake, or enter it at 10/10ths and make a small mistake? Now ask yourself a follow-up question: If you make a mistake, what are your chances of correcting it if you are going 7/10th? 10/10ths? One final question: As a beginner, what are the odds you will make a mistake?

With time and laps you will acquire smoothness and speed. Instead of entering a turn at 7/10ths you will enter it at 8/10ths, and even faster as your experiences expand. Along the way you will make mistakes. You will also learn how to make corrections for those mistakes. A 7/10th skilled beginner going 10/10ths will never have the skill and/or experience to make a 10/10^{ths} driver level correction. Going faster is all about pushing boundaries and learning new techniques. Start by developing a good foundation and then build upon it.

BE SAFE, LEARN SOMETHING, and HAVE FUN

Part Two: “How to re-learn a track” will cover a lot more stuff and in greater detail. The idea behind ’re-learn’ is based on a driver’s becoming consistent in what they are doing and starting to wonder if they are falling into a pattern and not really driving at the limit. Unless you are consistent in your driving, “How to re-learn a track” could cause problems in learning. Please become consistent in your high performance driving techniques before following the advice in ‘relearn‘.