HIGH PERFORMANCE DRIVERS EDUCATION
INSTRUCTOR DEVELOPMENT PROGRAM MANUAL

Porsche Club of America

Niagara Region

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Notice

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Editor

Dave Irish

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Foreword

The Niagara Region Porsche Club of America (NRPCA) held its first High-Performance Drivers Education (HPDE) event in September 1987. At the onset these annual track events were essentially organized and run by one motivated individual. Instructors were utilized to teach inexperienced drivers the skills and knowledge necessary to safely navigate a race track at speed. These Instructors were either those known to instruct with other organizations or merely experienced drivers deemed to have the ability to get in the right seat and help another driver learn. The sports cars driven on track were low horsepower (by today's standards) street cars on street tires.

Over time the success of the event made it apparent that a team approach was needed to meet the demand and keep the workload manageable for organizers. An HPDE Committee was formed of the Chief Driving Instructor, Chief Classroom Instructor, HPDE Chairperson and HPDE Registrar. Over time a Technical Lead and Run Group Coordinators were added. This organization worked well and was able to expand the Niagara HPDE schedule to include a Fall and Spring HPDE and eventually two Summer Advanced (solo drivers only) HPDEs. These events began to draw faster cars; modified, higher powered, running on high performance tires. Street cars and street tires were also becoming more capable. Eventually full race cars on race tires were part of the mix.

The expansion and evolution of the HPDE Program had several goals; safe track protocols, high quality and relevant classroom instruction, consistent run group driving standards based on student evaluations, an inclusive and supportive social community, and quality on-track instruction.

These goals are dependent on the quality of the Instructors. So, it became clear to the HPDE Committee that NRPCA needed to establish an Instructor Development Program (IDP) of its own. In the Fall of 2011 an experienced IDP Lead was added to the HPDE Committee and the Niagara IDP was launched.

After reviewing several other instructor training programs, the Niagara IDP was designed to be:

An established, written program consistently delivered,

Accessible to any high-performance driver who meets the criteria to be a Candidate,

Classroom and on-track experiences over a period of time,

Mentored experiences for Candidates with at least three different Mentors, each for an entire driving event,

On-track experience with real students shared with the Mentor,

Requiring three different Mentors to support a Candidate as an Instructor, committed NRPCA to each Candidate for a minimum of one year. This provided a supportive environment for all Candidates, investment in their success and Candidate experience with a variety of approaches to the art of on-track instruction. If a Candidate does not receive approval from all three Mentors he can continue in the program until three are attained. Success, based on individual needs, is offered to all Candidates.

This manual describes the Niagara IDP and how it works. It includes the necessary elements, that shall be followed, observed and taught in the IDP, to train effective Instructors for NRPCA HPDE events. The manual serves as a resource for prospective Candidates to understand the IDP, the requirements to become a Candidate and an Instructor. It also serves as a reference for established Instructors, to help them keep their instructing skills and knowledge current as the track environment and IDP evolves. The IDP Manual also will help instructors to be consistent with the culture and expectations of the Niagara HPDE program.

This manual is not a handbook on how to drive. There are lots of resources on High Performance Driving. Two good ones are Speed Secrets, by Ross Bentley, and Going Faster by Carl Lopez.

Throughout this manual, when a Candidate or student is referred to in the third person, the pronoun "he" is used out of convenience. This male pronoun is not meant to imply any exclusion, barrier or bias against female students or Candidates. All students are welcome in the Niagara HPDE program, any qualified student may apply to be a Candidate and become an Instructor on successful completion of the IDP.

Introduction

Why would anyone want to be an Instructor? Why would anyone get into the right seat of a high-performance car and go out on a race track, at speed, with a driver who by definition does not know what he is doing? Yet Instructors do this all the time. Why do they instruct?

Every prospective Candidate should ask themselves this question. The proper motivation to become an Instructor is to feel a sense of respect for the people that helped you and a sense of obligation to pay it forward. Mentors should ask their Candidate about their motivations as a part of the mentoring process. Point out that there is a level of self-satisfaction to be gained. Occasional perks and perceived respect are nice, but pale in comparison with the satisfaction derived from helping a student make progress. When he "gets it", there's no better feeling.

Instructors are vital to Niagara's HPDE Program. Without Instructors new students can't be accepted into our events, existing students can't continue to develop their skills and progress as drivers.

Instructing is not easy. It is challenging but rewarding. It is an introduction to a community of like-minded enthusiasts. It requires outstanding communication and observational skills. We Niagara Instructors pride ourselves on our safety record, dedication to our students, and camaraderie.

Charter

Mission

To conduct a unique NRPCA program to identify Instructor Candidates, provide Instructor Mentors and train the Candidates to be effective HPDE Instructors.

Authorization

The IDP is authorized as part of its overall HPDE Program by the Board of the Niagara Region Porsche Club of America.

The IDP is managed and coordinated by the IDP Lead.

The IDP performance is monitored by an IDP Committee consisting of the Chief Driving Instructor, Chief Classroom Instructor, HPDE Chairperson, HPDE Registrar and IDP Lead. The IDP Committee will be responsible for the evolution of the IDP to ensure it continues to train Instructors able to meet current and emerging issues and requirements of the HPDE events.

Strategy

Each Candidate will be coached by a different Mentor at three or more different NRPCA HPDE events, typically in one driving season. Additionally, there will be classroom components to cover knowledge Instructors must have as well to provide sharing of Mentor perspectives on key aspects of instructing.

Policies and Procedures

Changes to the IDP, and this IDP Manual, shall be approved by the IDP Committee.

Suggestions to improve the IDP or the Manual are welcome from any Candidate, Mentor or Instructor.

The IDP Manual will be maintained by the IDP Lead.

The IDP Manual will be available via a link on the NRPCA website, Drivers Education page.

The IDP is open to any student or driver who meets the criteria to become a Candidate.

The selection of Candidates for any driving season class will be made by the IDP Committee.

The number of Candidates the IDP is able to accommodate in one driving season class and the relative qualifications of all the prospective Candidates will determine who is in any season’s class.

At least three Mentors and the IDP Lead must reach consensus that a Candidate is ready to be an Instructor for the Candidate to graduate from the IDP.

Criteria and Requirements

Criteria for drivers to be accepted into the IDP as Candidates;

A competent and safe advanced (black run group) student or equivalent (Note that the overall pace of a prospective candidate's driving is not a factor to select them for the IDP),

Able to demonstrate and explain the skills and knowledge expected of such a driver, e.g. has good car control skills and knowledge of the physics involved,

Good verbal communication skills and adequate written communication skills, in English,

Calm on track,

Makes good decisions on and off track,

Desires to be an instructor and help others,

Has completed and submitted to the IDP Lead the necessary Candidate Information Form before the start of the IDP class in which the driver wishes to be a Candidate. The form requires the recommendation of three HPDE Instructors, including a Chief Driving Instructor, to be accepted into the program.

Requirements of Candidates participating in the IDP;

Attend all required seminars, driving events, meetings and class sessions,

Own a functioning communicator,

Come to all events prepared to participate in the IDP.

Criteria for Candidates to graduate as Instructors:

Must be able to;

- Keep the student safe,
- Help the student learn,
- Help the student have fun.

Must be able to effectively communicate with the student, including;

- Initial contact (five-minute interview, emails, phone call)
- Pre and post-session briefings,
- Appropriate verbal and hand signal communication in the car,

Written evaluation at the end of the event.

Must have instructional ability to;

Stay ahead of the student,

Stay in control of the student,

Diagnose and correct student errors,

Use confirming and corrective feedback,

Set goals and assign "homework",

Teach and coach the student appropriately for their experience level and competence

Adapt to a student's preferred learning style.

Must be able to maintain a positive and professional attitude;

With the student,

With other drivers and Instructors,

With event organizers, volunteers and visitors,

Must be able to stay current on car technologies, event rules and procedures and track conditions.

Criteria for IDP Mentors;

A proficient, above average Instructor,

Willing and able to simultaneously and effectively work with and develop an HPDE student and an IDP Candidate at a driving event,

Able to present material in a classroom setting to the current IDP Candidates.

Plan and Schedule

The following describes a typical IDP plan and schedule for a driving season and an IDP class. However, for any Candidate and any driving event, the plan may be modified by the IDP Lead and the Candidate's Mentor.

Instructor Seminar (March or April) agenda to be determined by the Chief Driving Instructor (CDI). Purpose is to provide continuing education and upcoming driving season information to Instructors, potential Candidates and advanced students.

IDP Seminar (March, April or May) before the first HPDE event of the year, after the Instructor Seminar;

Introduce the Candidates and Mentors to each other and to the IDP plan and schedule for the driving season,

Review Candidate requirements to participate in the IDP,

Conduct classroom segment(s) with Mentors sharing their perspective on important aspects of being an instructor.

Candidate's first driving event in the IDP, typically the Spring (May) HPDE event;

Candidates will be paired with a Mentor for the event and assigned a Green run group student,

Candidates will attend classroom segments as designated by the IDP Lead,

Mentor and Candidate will work together, both present with the student at all times, including pre and post session discussions with the student, except actual on-track instruction,

Mentor will take the lead in contacting the student and the initial interview at the track,

Mentor will instruct the student's first session on track. The Candidate will instruct sessions each day as determined by the Mentor. The in-car instructor is responsible for the pre and post session discussions with the student,

Mentor and Candidate will write the student's evaluation together the afternoon of the second day,

Mentor will decide who will take the lead in discussing the evaluation with the student.

Mentor will coach and provide feedback to the Candidate throughout the event,

Mentor will provide the IDP Lead with an evaluation of the Candidate at the end of the event.

Candidate's second driving event, typically the Summer (June or August) Advanced HPDE event:

Candidates will be paired with a Mentor for the event.

Candidates will attend classroom segments as designated by the IDP Lead.

Candidates and Mentors will ride together, each driving at least one session each day.

In the first session the Candidate drives, he will provide the Mentor a demonstration ride as if the Mentor was a Green run group student with no track experience. In the second session the Candidate drives, the Mentor will coach the Candidate on their driving and demonstrate coaching in doing so. When the Mentor drives, these roles can be reversed.

The Candidate may coach open track drivers, such as new solo intermediate drivers, as assigned and approved by the IDP Lead, CDI and the Candidate's Mentor.

Mentor will have a discussion with the Candidate the second day on the Candidate's experience to date in the IDP.

Mentor will provide the IDP Lead with an evaluation of the Candidate at the end of the event.

Candidate's third driving event, typically the Fall (October or September) HPDE event:

Candidates will be paired with a Mentor for the event and assigned a White or Green run group student, depending on the Candidate's progress,

Candidates will attend classroom segments as designated by the IDP Lead,

Mentor and Candidate will work together, both present with the student at all times, including pre and post session discussions with the student, except actual on-track instruction,

Candidate will take the lead in contacting the student and the initial interview at the track,

The Mentor will determine which sessions will be instructed by the Candidate. Typically the Candidate should instruct the student's first session on track each day, the Mentor should instruct the second session. The in-car instructor is responsible for the pre and post session discussions with the student,

Candidate will write the student's evaluation the afternoon of the second day,

Candidate will take the lead in discussing the evaluation with the student.

Mentor will coach and provide feedback to the Candidate throughout the event,

Mentor will provide the IDP Lead with an evaluation of the Candidate at the end of the first day of the event.

What, or Who, is an Instructor?

The NRPCA Instructors are responsible for providing a safe, structured and controlled teaching and learning environment at HPDE driving events in a courteous, friendly and professional manner. Our program is designed so the students will improve their driving skills, acquire a better understanding of vehicle dynamics and driving safety.

Our students are paying customers and expect high quality professional and positive instruction at our events. All our Instructors are expected to adhere to certain guidelines to ensure the success of our events and that all our students have a safe, fun and memorable time.

The criteria listed earlier in this manual list what Instructors have to be able to do, but what are the characteristics of a good Instructor? This section of the manual provides some guidance as to how Niagara Instructors should strive to conduct themselves at our HPDE events. These guidelines may seem like common sense, but even veteran Instructors can become complacent, then no one is well served.

Instructor Attributes

Positive Attitude - Always encourage your student. This is supposed to be fun, make it so. Send him home with a sense of accomplishment, a smile on his face, and a desire to come back for more. There will be times when you need to be critical and even forceful, but you must balance that with positive or confirming reinforcement. Always try and catch your student doing something right. A thumb's up at the right moment on track can do wonders. When debriefing, be as constructive as possible versus being overly critical. Help the event be safe and successful by being part of the solution to problems. Be an ambassador to the sport, event, and club. Remember, having a positive attitude can be contagious!

Professionalism (Being Responsible) - You are seen as an expert, an authority, and will be looked up to. You set the example. Words and behavior are closely watched. Smile, keep it clean, don't disparage. Be calm and relaxed. Model the behavior, both on and off the track, that is desired and expected from all participants in our HPDE events. Instructing is not about your speed, race training or showing off.

Use discretion in discussing students, yours or others, other drivers and participants. Work cooperatively with colleagues, especially in handling on-track situations. If you feel that a policy or decision is unfair, unwise or unsafe, you need to bring it to the attention

of the Event Chair or Chief Driving Instructor (CDI) promptly. If you have any issues on and or off track, have an adult conversation with the CDI or Event Chair. The CDI or Event Chair is the final arbiter of any issues encountered at any of our events. We are a Team. You are to uphold and abide by all rules and regulations set forth by the Niagara Region PCA governing our HPDE events. Do not undermine any facet of the event by doing your own thing.

When you register for an event, you have to uphold your commitment and show up for the event. The only exceptions are emergencies. A dour weather forecast is not an emergency. Don't plan on leaving early, be available to fill in for a fellow Instructor if needed.

Have your own house in order. Arrive at the track well ahead of the Instructor meeting, well rested, totally organized and ready for a positive experience. Make sure your car and equipment are fully prepared including having your communicator charged and ready.

The student is your customer, your top priority for the event. Meet your student as soon as you can. Treat him as an equal – this isn't about you! Take an interest in him and his car. Be inclusive – is he at the event alone? If so, invite him to join the group after the track goes cold. You are creating a camaraderie and culture. Be a good listener and observer. Invite him back at the end of each event

Be on time for your student's sessions and all meetings. Establish an agreed upon location and time to meet for staging. Be there for your student to do a proper debrief. Debriefs are not always convenient, especially when having two back-to-back students. Arrange to make time afterwards if necessary. Take the time to work with him off track, and be available to him to answer questions. Short your track time if necessary, never the student's. Fill out evaluation forms and log books.

Ensure that you fully understand all on-track exercises and protocols.

The student is your responsibility for the entire event. Signing off a student does not release your responsibility for his safety and behavior on track. A student who is signed off to run solo needs to have an instructor in the car at some time during a day…if only to ensure he is continuing to drive safely and competently. It does not need to be for a full session. Sign-off is not kiss-off!

Being in Charge - You are responsible for your student, for another person's well-being, education, and enjoyment as well as your own.

Establish authority. Firmly insist, rather than ask. Make sure your directives are clear, concise and timely. Set clear goals for your student before each run. Assign "homework" between sessions. Be careful to NOT mentally overload your student.

Remain engaged with your student at all times. Make sure neither you nor your student "checks-out" mentally. Remain focused.

De-emphasize speed. Allowing a student to over-drive means the instructor is not in charge. The student can not learn while driving at his limit. De-emphasize speed for the sake of learning and safety.

You are the boss. When experiencing push back from a student, the proper way to resolve these types of issues is parking in the pits; not on a hot track. Unresolved issues should be taken up with the CDI. Instill confidence in your students. You are their primary booster.

Continuing Education - Keep current. Learn new teaching techniques and philosophies. Learn about new cars and their characteristics. Learn about Porsche models other than your own. Take advantage of the talents of other Instructors through peer mentoring. Continue to improve skills as a driver and teacher. Ask for feedback from: Your students, other Instructors, the CDI, your own evaluations. Remember to enjoy and learn from those you share your experience with!

To be an effective Niagara Region Instructor is to embody all the attributes and traits outlined above. It requires commitment and desire to do what is required and a willingness to help your student at each and every single Niagara event.

How to Instruct

Safety

Think Safety – ALWAYS!

At Niagara, safety is our first priority. Make it yours.

When you first meet your student, make sure he understands our Tech Form, and all the safety related items. Yes, many of the Tech items are straightforward and self-explanatory, but never assume what your student knows or doesn't know.

Help your student check his vehicle for loose objects and review basic mechanical components of the car; properly torqued wheels, proper tire pressures, brakes, etc. Never second-guess safety. When in doubt, check with the Tech and Safety Director, or the Chief Driving Instructor (CDI). A comprehensive review of the car can help uncover issues you won't want to find on-track.

Review the flags and flag stations. Make sure your student understands what flags might be encountered before going on track. Identify all manned flag-stations for a novice student during the first day. Any soon to be soloed students must know their flags "cold". A soloed driver cannot be thinking about what a flag might mean upon seeing one. Have a beginner (not at his first event), intermediate or advanced student identify the flag stations for you.

Review the location of the emergency exits for your student while on track. Again, do this during the first day.

Review safety and emergency procedures; off track excursions, contact, staying in the car, etc.

Teach your student to be aware of changing track, car and driver conditions and how they need to adjust.

Be certain your student understands and practices all on-track protocols. If he has problems you must help him. It is your responsibility if he fails to give passing signals, gives passing signals on the wrong side, doesn't follow pit-in or pit-out procedures, passes without a point-by or follows another car too closely.

Help your students be aware of traffic. We operate in a 360-degree environment. Teach your student to be fully aware of his environment.

Deemphasize speed. Allowing a student to over-drive significantly increases the chance of an on-track incident.

Help your student safely complete his driving exercises. Coach him on car positions and pace.

Have a post session discussion of any potential safety issues you and your student may have experienced to model appropriate behavior.

Stress the importance of a prudent out lap to re-establish the line, vision and to build smoothness and consistency for the session.

Leave your ego at home, and keep that of your student in check as well. This is **NOT** racing. Everyone here is still learning, including yourself!

How Adults Learn

Instructors don't often think of themselves as teachers, or coaches, but we are. We are teaching and coaching one on one, in a classroom or practice area going triple digit speeds. We are also teaching and coaching when our student is not on track. It is important to understand how people learn, how to teach adults, to effectively help the student develop his skills and knowledge.

There is a difference between teaching, instructing and coaching.

> Teaching is information input. It is usually done in a classroom, but some information can only be taught in the car. You will do more of this with a novice.
>
> Instructing is a combination of teaching, correcting or feedback, demonstrating and coaching. This what you will do most often.
>
> Coaching is drawing information or skills out that the student already has. It involves asking leading questions, encouraging or asking the student to "show me". Coaching is typically used with an advanced student.

When to teach, instruct, or coach is actually driven by the student's "Level of Learning", as follows.

> Unconscious Incompetent: Typical of a complete novice. He doesn't know what he doesn't know. This is where everyone starts. Help your student understand that this type of driving is different and to not expect high performance early on. This student will require a lot of teaching.
>
> Conscious Incompetent: Or an enlightened novice. Hopefully after one or two sessions, your student is aware of how much he does not know and how difficult performance driving is. You will begin to shift to instructing this student.
>
> Conscious Competent: A beginner or intermediate student begins to understand what to do and will be consciously applying the instruction you are giving him.

Unconscious Competent: An advanced student can consistently drive well at a subconscious level…without extensive conscious thought required. Coaching will be appropriate for a student at this level.

An Instructor has to assess at what level their student is in general, or on specific skills or knowledge, each session and each day.

Stay aware of what the student is learning in class so as to not confuse him with your instruction.

"Fundamentals for Learning" are important basic conditions for learning. As an Instructor, you have to make them part of how you teach and relate to your student. Otherwise learning is more difficult, if not impossible.

Motivation: Your student has to be ready. He needs clear objectives and purpose. Keep him focused on improvement.

Repetition: Practice is necessary. Keep him working on consistency. Don't practice until he gets it right, practice until he can't get it wrong.

Fun: It strengthens learning. Keep the feeling light and positive.

Correct technique: It is vital. Bad habits learned early are hard to break. Reinforce positive performance without undue concentration on shortcomings.

Vivid experiences: They teach best. Use mistakes as learning opportunities.

Most recent experience: It is best remembered. Be on top of the situation, and keep your instruction in the moment. Work on recurring problems as they arise again.

There is a "Learning Process" that your student will be going through. It is circular, in four steps:

- Have an experience.
- Think about the experience.
- Develop ideas and conclusions.
- Test conclusions in a new experience.

The student will go through this learning process over the course of an event, a session, a lap, or even between two corners. You need to be aware of the process your student is experiencing. Help him with it but also be patient. Each student's progress will be different. Challenge your student with appropriate and attainable goals based on your observation and discussion with the student.

Certain problems will persist in the early stages of the HPDE learning process. Identify the core issue involved, and work with the student to find solutions. This process-oriented method of problem solving will stand him well throughout their driving career.

Be careful to get to the root cause of the problem the student is having. Don't assume a solution and spend time trying to fix a mis-diagnosed problem that doesn't exist.

Match what you do to the needs of the student. You have to make "the light go on" for him. "Learning Style Theory" suggests that different students will respond better to different inputs.

> Visual learners do best by observing. Hand signals or even demonstration rides (more later) can be effective. Use of track maps and other visual aids can also work well in off-track discussions.
>
> Auditory learners learn best by listening. Words in the car have to be in the moment and brief. But pre and post session discussions can be more extensive, and will be important for this learner.
>
> Reflective learners do best by thinking. "Homework" assignments such as mental imaging between sessions can work for him. Have him imagine perfect laps with all his inputs at appropriate locations. While off-track, have the student talk you through a lap.
>
> Physical, experiential or kinesthetic learners do best by doing. Obviously, the student is driving the car, but heightening his sensitivity to what the car is telling him, how it responds to his inputs may work best. Have him focus on what he feels, hears, sees and even smells.

Each person is a unique combination of these styles, with one generally dominant. Each instructor tends to teach in his own primary learning style. It can be your toughest job to figure out what works for your student and apply it. It will save lots of time and angst if you can do it.

You also need to be alert to the possibility of a learning disability. In the initial interview or email contact with your student always ask if there is anything about him that you should know, such as color blindness or a learning disability. Anyone who is a student at an HPDE event can learn. You just need to understand how.

We have all heard about the "Learning Curve". The concept is that as we learn, our skills and knowledge steadily increase. But with real people, it is not a continuous upward path. There are ups and downs in learning.

Rapid early improvement is typical of a novice. Then it is normal for him to plateau, or even go backwards (the intermediate's downfall).

Every student will experience this ebb and flow. Often, rapid early improvement has him feeling very confident. Even if he has above average skills, at some point as he follows instruction, he will struggle with the new speed that good technique creates. Suddenly, what was working so well before does not seem to work at all, and he can become frustrated. It is your job to explain that proper technique has created this situation. In

other words, when you start doing it right, speed happens, and things change. That's performance driving. Keep him focused, and keep his mind on the goal. It's time to recalibrate!

A student can also plateau when a skill is developed to their satisfaction, or boredom. To reach the real, higher, limit to his ability requires motivation and effort. The student's goal must be to learn to do the hard thing consistently, easily, gracefully and efficiently.

You also need to be aware of "Barriers to Learning".

People often develop various ways to cope with challenging situations. It is your job to observe these common self-defeating behaviors, help the student get past them and get back to successful learning.

> Fear – Fear can be of the unknown, of failure, of physical harm, and of showing fear itself.
>
> Stress and Anxiety – They go hand in hand with challenge. They may hinder learning, or even freeze the student's progress in its tracks.
>
> Self-Respect – It may suffer in the face of repeated difficulty.
>
> Defense Mechanisms - Rationalization (justification of failure). Flight (excuses for failure). Aggression(complaining). Resignation (giving up).
>
> Impatience, Overconfidence and Resistance to Change – Your student is most likely successful in other walks of life. His self-image is that of an expert, not a learner.

Reassure the student that your job is first and foremost his (and your) safety and his development as a driver. Remind him that this is not easy! It takes seat time, repetition and instruction to learn. Mistakes are natural, inevitable and will happen. As needed, check his ego. Mistakes are part of, even necessary to learning.

Always have a plan before going on track. Know what you and the student will be working on each session. Do not lose focus on the plan as the session progresses. Once a student is consistent with a new skill, insist that the skill level remains high as you work with him in later sessions. If a driver backslides, go back to the basics.

Keep it simple on track. Only work on one or two things at most during one session.

Help your student to relax on track. Remind him to breathe on the straights. Encourage light hands on the steering wheel. Tension is the enemy of clear thinking and of awareness.

Deemphasize speed every chance you get. The student won't develop new skills when he is going at his top speed. That is why beginning skiers don't start on the steepest hill to learn how to ski. Once the Instructor allows speed and how many cars are passed to become the measure of competence there will be little further progress made by the student. The speed will come with mastery of the fundamentals.

As an Instructor you will at some point have a student who is just not "getting it". The concepts and principles discussed above will help you find a way to get through to that student and get him back on the upward trend of his learning curve.

Communication

Instructing all depends on communication. From the initial contact before the driving event, to the written evaluation at the end of the event. If an Instructor can't communicate effectively, he can't instruct.

Initial Contact

An effective interview before the event is essential. Do not rush into any situation without covering all pertinent information and establishing a clear plan. If the student is overly anxious to "get on track ", you must take the time to discuss safety and control issues. If the student tries to rush you so they "don't miss track time" you will also be using this time to communicate who is in charge.

With your student assignment you will receive their email address. Use the email to start the introduction and arrange a phone discussion before the event. Use this phone interview to gain as much background information as possible to make things less hectic the morning of the 1st day. When you first meet at the track, you'll be able to build off the phone interview. There may be some situations when a phone interview isn't possible such as late student re-assignments. If you can't contact your student in advance you need to be prepared to do the whole interview the first morning. Have a mental checklist of items you want to review. Write them down to refer to if necessary. The minimum list should include Safety Issues, Vocabulary, Driving Position, Car Readiness and any important Information about the student before going on track. After the session continue the conversation. Get to know your student well. It will make instructing him easier and safer.

First impressions are important when you meet at the track. Find your student as early as possible, greet him with friendly confidence. If he is new to the track culture, or just to Watkins Glen, spend additional time doing your initial track interview. How you greet your student sets the tone for the student's driving experience, whether you will have the student for the weekend, for the day, or for just one session. Be enthusiastic and genuine. Convey to your student that you are glad to meet them and look forward to being their Instructor. Find out what he likes to be called. Some names are difficult to pronounce, if this is the case, repeat it until you get it correct. What is his occupation? Where is home? Is he here alone? Be inclusive, especially if he does not know anyone. Find out about their predominant learning style. Get the student to talk about himself. Create some humor, if possible, as it relaxes people that are likely nervous. Do these things while making sure you establish who is in charge.

Explore their past track experience. Has he driven on a track before? If yes, how many track days and where? What was his most recent event and was it in this car? Ask about related activities that may help on track such as autocross, skiing, flying, motorcycling or biking. "Is there anything I should know about you before going out on track, for example color blindness or a learning disability?" If he is completely new, be enthusiastic and reassuring. He may be terrified, or he may be excited. Either way, he doesn't know what is about to happen and he needs you to make this a positive experience.

What is he driving? How long has he had the car? Express interest in the car and ask questions. Confirm car preparation by doing your own personal inspection of the car with the student. This is where you find out what he knows about his car. Does he do his own work, if not, who did his car prep? You may learn about the car's set-up and characteristics or you may already know more about his car than he does, but you need to hear what he knows. Maybe he is sharing someone else's car! Ensure the car is empty and floor mats are out. Even though the car went through final tech, go over the basics such as tire brand, age, amount of wear and the pressures being run. Be ready to recommend pressures. Did he torque his lug nuts? Discuss and check his brake pads and rotors. Ask about brake fluid flushing and type. If he has an automatic transmission, does he know how it behaves depending on the various electronic settings? If he has a manual transmission, can he heel and toe downshift? Ask if he shifts while in the middle of turns. If he says yes, be worried, and set him straight! Does the car have stability control, and does he understand the various settings? What about collision avoidance systems? The nannies stay on, but semi-autonomous driving systems must be off (see Technical section for more details).

How well has he prepared himself for this event? Verify that he understands the schedule and staging area procedures. Did he drive in yesterday or this morning? Is he new to Watkin's Glen? If so, did he watch video, use a track map or drive a simulator? Orient him to the location of the classroom, where your car is located, direction of the bathrooms as well as remind him to stay hydrated and use the bathrooms often! Does he know the meaning of the flags? What about pit signaling and blend lines for pit in and pit out? Does he know where the passing zones are located and the passing protocols? Review his knowledge of run-off areas, what to do if he drops a wheel off track and what to do in a spin. Is he aware not to abruptly lift off the throttle and why? Does he know the areas he can get off track in case of a mechanical problem? Stress safety over all else. Quizzing your student on safety and emergency situations will reveal his knowledge or lack of it. The discussion also reminds a more aggressive student of the dangers and the need to build skills and knowledge before speed.

Find out his motivation for coming to the event. Is he looking to have fun and not worry about getting a speeding ticket? Did his friends talk him into it? Does he want to drive better or maybe become a club racer? Ask how is he feeling today? This is a great open-ended question to learn more about physical health and mental attitude. What are his expectations and goals for this event? If your student has a long list, pear it down to 2 or 3 and include safety and fun. If he doesn't know, give him a short list and include safety

and fun. If he knows what he wants to work on, great, just make sure it includes safety and fun.

Be sure to end the interview by checking if he has any questions for you!

"Let's go have some fun!"

In the Car

Before going on track the first time check proper seat position and mirrors. Do NOT take the right-side mirror. You don't want the student to develop the habit of not using his right-side mirror. If his side mirrors are correctly adjusted to clear his blind spots, you can use the mirror to help the student by simply tipping your head a bit forward. Ensure he holds the steering wheel at three and nine. With helmets on, check that his chin strap is fastened and be absolutely certain you both can clearly hear through the communicator. Review the terms you will use on track as well as the hand signals in case something happens with the communicator. Review your expectation for him to acknowledge your instructions and let you know if there is any instruction he doesn't understand. Make it clear that what you say in-car is not up for debate. Review the mutually agreed upon objectives for the run session, which include safety and fun!

It was famously written by William Shakespeare that "Brevity is the Soul of Wit." So too did The Bard scrawl for the same character in Hamlet to opine that, "Though this be madness, yet there is method in't!" Method indeed. Instructing is a keen blend of method and wit, sometimes amongst perceived "madness," and rarely if ever suffering from excess brevity. Things can get pretty busy at times, and those situations are NO time for blather. The experienced Instructor has learned that all the dense driving theory in the world goes right out the tail pipe when a student's brain is in over-load. The wise Instructor uses the time honored K.I.S.S. method; Keep It Simple, Stupid!

Be mindful that your student is developing his sense of car balance and spatial position of the car. Excess chatter in his ear won't be helpful.

Examples of simple instructions are Brake, Off Brake, Turn-in, Throttle, Apex, and Track-out. You can use other terms such as Unwind to describe decreasing steering input. Feather if you want the student to slightly decrease throttle input. Track right or Track left if he doesn't know how to setup for the next turn. Gently Release if you want him to get off the brake more gradually. Use a calm, clear, firm tone of voice. Never yell, but make sure to get your point across. To direct the driver clearly you may have different levels of brake application instructions "Brake, Brake Hard, HARDER!" Be prepared to escalate these instructions in quick succession if you are not getting the needed response. Anticipate potential problems before they happen to avoid urgent situations. Your student most likely is in the moment or thinking about the last turn! To be effective and keep everyone safe you must be thinking well ahead of your student!

The list of common on track terms above is not all inclusive. A more complete list of other concise and short track terms that can be used is at the end of this section. What's important is that instructions are clearly understood by your student, you are consistent with their use and you have clearly communicated their meaning in advance of going on track. Save lengthy explanations for the paddock. If you need to have a more extensive discussion before the session ends, that is ok, but have him pull into the pits. Focus on one, no more than two areas to work on per session to avoid overloading him. When your student makes a mistake, your job is to remember his mistakes then focus forward. The next time around you will tell the student what to do differently, not what they did wrong. When they make improvements use confirming reinforcement!

From the very beginning, while the student is driving well within their limits, incorporate hand signals while verbally instructing. This will reduce the possibility of miscommunication due to not being able to hear an instruction. If your student responds well to verbal commands, carry on with those as your primary communication. If he does not seem to be getting it, despite your best effort, you must adjust your instruction accordingly. Hand signals may be more effective for your student. The speed and amplitude you move your hands can express the pressure and speed of pedal or steering inputs. This subtly of movement may get your point across in a way words don't penetrate your visual student. He may respond so well to your hand signals you may transition to using them almost exclusively on track.

Feedback

Before getting into the post session debrief it is important to discuss feedback. Think about why you give someone feedback. We either want the student to continue doing what he is currently doing, or we want him to change what he is doing. So, we're either confirming that his current behavior or action is correct, or we're correcting it. Which means the two types of feedback are "Confirming feedback" and "Corrective feedback".

Confirming feedback is not the same as positive feedback. Positive feedback is along the lines of "Hey, way to go. Great job!" It's positive, but it's unclear as to what was actually done "great." And it's likely that it won't result in more of the desired behavior. An example of confirming feedback would be, "Hey, way to go. Your brake release was smooth and perfectly timed; the car rotated just enough on entry that you were able to get to full throttle sooner than ever." What does confirming feedback do? Encourages the student to do more of the same - and maybe even more of it. Human nature is to do more of what we're rewarded for, and by pointing out exactly what a student did well, he is more likely to do it again.

Corrective feedback is not the same as negative feedback. It's the difference between saying, "Release the brake slower and more gently the next lap," versus "You popped your foot off the brakes". Negative feedback tends to be aimed at the person. It is personal. Sometimes it even sounds accusatory, which often leads to a person becoming

defensive. Corrective feedback is targeted on the act or behavior that you want changed. It's not personal, and therefore easier for someone to act on.

After the Session

Once you are off track set the tone for the debriefing as you remove your helmet in the car. Make eye contact with your student. Focus your feedback on the behavior, not the person and be very specific. Note any serious safety issues or concerns. Make sure he is aware of the possible result and that you are in the car as well. Don't beat him down, but express that the car needs to be driven home. Pick up on the positives by confirming what he did well. Comment on the car's suspension, weight transfer, the brake inputs and the line but never straight-line speed. Discuss awareness of other cars and traffic flow. Stress positives and only dwell on a negative if it is a safety issue.

Be a Good Listener

While in the paddock learn from your student. Ask your student how he felt about the session. Listening is a great way to gain insight relative to your student's attitude (eager, confident, apprehensive) and learn more about his motivation. Ask if you are talking too much, or not enough. Make use of your student's responses. Find out if he has a log book, if not, encourage him to keep notes. What is his mental state? Is he tired, alert, anxious? This is going to change from session to session and from day one to day two. Review how he learns best, to formulate and modify the plan for instruction. Have a track map available will help you communicate during the debrief. We tend naturally to teach in our own learning style, so be prepared to consciously think outside your personal norm. Begin planning for the following session. Find out what the student would like to work on and offer guidance. Always encourage questions, seek feedback and checking for understanding. Above all, find out if he is having a good time and if not, figure out why!

Follow through

At the end of the day it is helpful to give homework. One type is to ask your student to mentally drive the track when they are alone. This can be done in the car or sitting in a chair. Pick out your brake points and turn in points. Apexes and track out. Find the exact line. Speed is not the concern.

The next morning is usually "Ground Hog Day". Help and let the student get back to where he left off. Express that track driving is a progression and it cannot be achieved all at once. That is why they call it "SEAT TIME". The last session should be a bit of a motivational session. Point out where he started from to how far he has come. Review your student's evaluation with him before submitting it. Be positive about progress, even if OSB!

On-track Terminology – Be Consistent!

1. Brake - slow the car down

   Light brake - slow the car down a little.

   Modulate the brake pedal - brake, release some, then brake etc. (for washboard surface) prevents lock up if the car has no Anti-Lock Brake System (ABS).

   Squeeze the brake - gently adding pressure to the brake.

   Feather or lift off the brake - gradually reduce pressure on the pedal.

   Threshold braking - brake hard without locking up the wheels or engaging the ABS.

   Locking up…. when the wheels no longer rotate.

2. More gas - accelerate the car

   Squeeze the throttle - gently adding pressure to the throttle, a constant depression of the gas pedal.

   Lift off the throttle - reduce speed by lifting off. A constant release of the gas pedal. Not abrupt.

3. Shift - to change gears

   Upshift - go to the next higher gear.

   Downshift - go to the next lower gear.

   Heel and toe…using the right foot to depress the brake pedal and blipping the throttle at the same time. Used during a downshift to match engine speed with transmission speed. This is not double clutch. A necessity for a smooth transition.

   Feather the clutch - letting the clutch petal up slowly at the point of engagement, rather than popping the clutch.

   Popping the clutch - letting the clutch petal up fast.

   Riding the clutch - keeping the left foot on the clutch petal.

   Power shift - keeping the throttle fully depressed while upshifting…not recommended.

4. Turn in - to enter a corner

   Turn in point - location of initial turn into the corner.

   Early - turned in too soon, correction at the apex is necessary.

   Late - turned in too late, reducing the radius entry to the corner.

Tighter - add a little more steering input to be closer to the apex.

Hold the apex - stay on the apex longer, necessary with an early entry.

Unwind the wheel - after exiting the apex, slowly bringing the wheel back to center.

Track out - upon exiting the corner, bringing the car to the edge of the track.

Track out area - the area on the outside edge of the track where you should be at the end of a turn.

5. Handling - how the car is reacting to driver inputs

Understeer - the car is not turning as much as it is being asked to. There is more adhesion, stick or grip in the rear than in the front.

Oversteer - the car is turning more than it is being asked to. There is more grip in the front than in the rear.

Bite - the amount of traction or grip a tire has…synonymous with adhesion, stick or grip.

Balance - do not add more gas, or steering or brake. Just be smooth and steady.

Squeeze off the gas - release gas pedal a bit so as to transfer some weight from the rear to the front of the car.

Squeeze on the gas - push gas pedal down a bit to accelerate the car and transfer some weight from the front to the rear.

6. Track physical features

Pit Out, or Entry to the track - where a car first enters the track and must stay off line until up to speed and it is safe to blend on line.

Pit In, or Exit from the track - area on track where a car stays off line and slows down before entering the pit.

Turn-in cone - reference point at each corner that marks the entry to the corner.

Apex cone - reference point that marks the mid-point of a corner's apex.

Track-out cone - reference point that marks the end of the turn.

Curbing - found usually in the apex and exit to a corner. Of various configurations. Also referred to as "rumble strips", speed bumps and other descriptive terms.

The Line - recommended route around the track that will properly position a car for the next turn. Most cars on a track will be "on line".

Off-line - anywhere on the track other than on-line. Cars will be off–line for passing, entering and exiting the track and mechanical problems.

Flag stations - where flags are displayed to communicate with drivers. Some tracks also have lights.

Run-off areas - places off to the side of the track where cars can go if necessary.

Passing zones - areas on the track where one car may pass another with a signal.

Distance markers - notations at the side of the road which advise the distance to the next corner's entry. Not found at all corners.

Braking zone - area on the track where cars will be on the brakes prior to entering a corner.

Blend lines – painted lines on the track that mark areas where pit-in and pit-out protocols must be followed.

Armco - physical barriers near the edge of the track to stop cars from going too far. It can be made of metal, concrete, fencing.

7. Miscellaneous terms

Trail braking - braking and turning at the same time for a measurable distance.

Late pass - a pass where the passing car cannot safely get back on line before the braking zone or turn-in for the next corner.

Throttle steering - using increased or decreased pressure on the throttle to assist in making a turn.

Transition - change from one driver action to another.

Being smooth, or smooth transition - going from one action to another without upsetting the balance of the car. Requires incremental input of throttle, brakes, and steering.

Brake fade – brakes are not working well, combined with a soft brake pedal that engages "lower" requiring a longer braking zone.

Tires going away - tires have less traction resulting in the car not turning or braking as well.

Cheating in - moving from the edge of the track before beginning a turn. This narrows the track and usually results in an early apex.

Blipping the throttle - a quick stab of the throttle to raise the engine rpm's in order to downshift without overly abusing the drivetrain. Done only when the clutch is in during "heel and toe".

Brain fade - loss of concentration on track due to fatigue. Also called "red mist".

Instructor Roles

To be a successful Instructor, you must do more than give driving tips. You need to perform numerous roles, switching between them seamlessly. When you do this well, both the student and you will be energized by the experience.

It's natural for your student to feel apprehensive, sitting in the closed classroom of a powerful car, heading out into an unfamiliar environment. As you take on the role of **Psychologist**, put the student at ease well before getting into the right seat. Find out what's on their mind. Ask specific questions to gain insight into his knowledge and attitudes. Use open ended questions such as "what is your goal today?" or "Why do you come to the track?". These types of questions can give you valuable information. Use what you learn from "reading" the students mood, to help shape your instruction. Be prepared in case your impressions are incorrect. A student who is reserved and aloof at first, may turn out to be a focused and progressive driver. Others, who seem to exhibit all the positive traits in the paddock, can inexplicably become possessed by demons when leaving pit lane.

Putting your student at ease is important but you also must immediately establish control. If you don't, the student will. It has to be you. Never leave any doubt that you are in charge!

In your role as a **Strategist**, you will clarify terminology and set objectives for what is expected on track. Your strategies will vary greatly depending on the experience level of the student. During a session, be prepared to refocus him to the objectives. Carefully consider the timing of when you give instructions. The timing is just as important as what you say. Determining what you will emphasize on a demonstration ride, as well as homework you assign, will also play into your strategy.

As a **Tactician** prepare to change priorities quickly. When someone is suddenly overcome with "red mist" you must instantly refocus the driver's attention. "BRAKE HARD"! If the overdriving is subtler "Slow down until you touch every apex". If he is overwhelmed, you may instruct "Drive in one gear for the next 3 laps". For a more advanced driver you may give a new challenge such as "Enter the next 3 corners off line", or if no one is behind you… "Pretend you lost your brakes, try to come into the pits without using them".

The **Communicator** is responsible for the proper flow of information. You need to be sensitive to the amount of information that can be absorbed. The amount varies among individuals and the student's level of experience. What you say on the racetrack must be clear and succinct. Focus your guidance on inputs (throttle, brake, steering & gear changes) and other critical instructions such as visual reference points, gear changes, flagger instructions, passing decisions and track entry and exit protocols. Explanations about vehicle dynamics are best left for the paddock. Always coach what's about to happen. If he makes a mistake, the Communicator and Tactician simultaneously focus the driver ahead without looking back. The Strategist waits for the segment on the next

lap, then instructs the correction just before it's back in the windshield. Ensure what you say is heard and understood. From the student, "Brake? I thought you said Great!"

Also, the Communicator uses a communicator! A helmet-to-helmet intercom is an absolute necessity to instruct. An Instructor without a communicator must raise his voice to be heard in the cockpit. This is a natural source of stress for both driver and instructor. While a charged and functional communicator is an expectation, be prepared in case of a malfunction. Before going on track, ensure the student clearly understands the hand signals you will use.

The **Disciplinarian** sometimes needs to appear for everyone's safety. You must always be clear about who's in charge. A student may need to take a break after repeated failure to follow directions. Don't hesitate to use "Pit in this lap" during the middle of a session. A discussion in the hot pits should drive home the seriousness of the issue and place the student in a situation where he can better process your instructions. It is your responsibility to clear up any misunderstandings of what needs to happen, for everyone's safety. Instructors who have had an off-track excursion, typically had warning signs in advance. Don't ignore your instincts. Bring him in when on-track communication isn't addressing a safety concern.

The **Nurturer** acknowledges the difficult and frustrating portions of the learning process. Your student is likely a high-achieving individual, accustomed to succeeding in their professional life. He may begin the event with confidence about already being a good driver, assuming he'll quickly succeed on track. The learning curve can be surprisingly frustrating for newer track drivers. The student needs to hear confirming reinforcement: "Well done" or "nice apex" after a good corner. It could be "good brake release" or "nice smooth turn in" if his inputs are improving. You may compliment his "good awareness" after he points by traffic appropriately. Recognizing his progress can do wonders to encourage your student and make the event a successful experience.

The **Motivator** encourages continuing improvement. The incentive to achieve a specific reward for successful performance sharpens a student's focus. "Touch every apex and we'll move on to our next goal." Or "Drive this run as smoothly as your last session and you'll be able to drive solo." When your student makes mistakes or express dissatisfaction with himself, "We all make mistakes, ease off a bit to get your rhythm back." If you set a speed restriction on the straights for a newer driver with a powerful car "If you brake as consistently this session, we'll up the speed allowed on the back straight another 10 mph". Never encourage your student to drive over their head. In your role of Motivator, you inspire the driver to improve their skills, while staying within his driving abilities.

The **Sportsman** sets the example for good behavior. Showing respect for others on and off the track are qualities expected and required as part of the Niagara HPDE culture. "You can't pass here. Following too closely isn't helping you or the driver in front of you". "When passing, give plenty of room before you go back on line." "Give them a wave when they let you pass". Never speak poorly of another instructor or driver in front of you student. If you have an issue with another participant's driving take that

conversation off-line, either with the individual, the Run Group Coordinator, the safety steward at the black flag station or the CDI.

Ultimately, the Instructor as **Pragmatist** must assess if the relationship is working to the student's advantage. It is your responsibility to recognize if he is benefitting from your instruction. If the student is not, it is the Instructor's responsibility to discuss this with their Run Group Coordinator or the CDI. They may give you advice on a different approach or possibly recommend rotating Instructors. It is better to recognize the issue, and get help to resolve the situation, then for both of you to have a bad experience. Instructors are not expected to have all the answers. Having good self-awareness and the desire to continually improve is the reason someone recommended you for the role of Instructor!

A good Instructor is also a good **Student**, open to new ideas and techniques to use and pass on to others. Every Instructor has an opportunity to improve whenever they are in the company of a student. "Tell me if what I say isn't clear." "Do you have any suggestions for me?" "Is this too much or too little information?" If an Instructor is coaching next year the same way as he did today, he is not being a good student.

So, who are you now? As a Teacher/Instructor/Coach you play all these roles, often simultaneously. Teaching someone to find their way around a race track, to use his car effectively, is a complex interaction between two people. Be well-prepared to serve your student as an inspiring coach. You are not just a skilled driver giving directions. Recognize the difference. Hopefully you now have a better understanding of this interaction. Understanding and using all these different roles will lead to greater success as your student says, "AHA, I GET IT!" and affirms the rewarding gratification that inspires both you and your student to continually improve!

Demonstration Rides

The demonstration ride offers many different learning opportunities. For the visual learners – "a picture is worth a thousand words." This is a unique opportunity to "show" good technique, lines and inputs with complete control, command, confidence, and absolute smoothness. The student can see, hear, and feel more when not concentrating on driving at the same time. Ask them to observe your inputs, the gauges, to listen to and feel the car. The student can ask questions in real time. Set a positive, open, and collaborative tone straight away. You are in command, but this is a two-way process. Encourage him to ask questions or make observations.

What you show your student can and should vary based on his level of experience. Regardless of your student's experience there are some key features of all demonstration rides that are important to follow. First, and most important, is to model courteous track behavior. This is a critical time where your student learns about Niagara on-track culture from watching your etiquette. Always demonstrate a positive regard and patience for your fellow drivers. You are instructing, not racing, give other cars extra space when passing. Drive at an appropriate pace based on your student's level. Consider your normal first lap pace, as a reference, for the type of speed you should not exceed. While the pace may not seem fast for you, it is likely much faster than your student has ever experienced. Demonstrate smooth and relaxed driving while maintaining a dialogue. Explain where you are looking. They will be surprised just how far ahead (and behind) your vision is scanning. Talk about the traffic. Explain how you are planning to take and receive passes well in advance of them happening. Your dialog will show how an experienced driver anticipates and controls the flow around them.

If you have a beginner level student, this is a great time to reinforce track terminology. Use the same basic terms when instructing your student. If he is new to the track, the demonstration ride may be in his car. If you are driving your student's car dial the pace way back to match those in the run group and be extra conservative. Your focus will be on the basics and talking your way around each turn. This is a chance to identify flag stations when they first come into view. Your student will be surprised how far away the station is when you see it. Take the time to explain safe track entry and exit protocols, point out the blend lines and have them notice the orange paint on the Armco and what it signifies.

If you have an advanced beginner or intermediate student, the demonstration ride will be a little different. You will be driving your car at a reduced pace but something more appropriate for their experience level. These demonstration rides will be in your run group and after you've been in his right seat. You will know the areas he is focusing on improving. Call out portions of the track you'd like to focus his attention before you demonstrate the skill. Don't be afraid to critique your own driving. This demonstrates self-awareness which is important for continued progress especially with advanced beginner and intermediate students. If you drive at a pace way beyond your student's skill level, they may take that as a hint they too should be driving as you demonstrate.

This could lead to him being discouraged by his abilities or he can take it as a hint he should be driving much faster! Beware your student may end up over driving immediately after your demo ride! It is important to remember the demonstration ride is all about teaching the student and not about you. If it feels "weird" to drive at a reduced pace it may help to explain to the student, the purpose of the ride. Explain how you plan for the demonstration to be about certain skills or lines you want to demonstrate and not about going your fastest.

What to Teach and What to Watch For

What to teach is just as important as how to teach. You may think it is obvious. For a driver at your level it should be! But the following discussion is at least useful as a checklist for what to focus your instruction on as you work with your student.

For Any and All Students

These concepts are introduced to the novice, reinforced to the beginner, and second nature to the advanced student.

"Safety" – No matter who you are riding with, or what your instruction is focused on, make sure the student understands that new skills and concepts have to be developed safely. Make sure he does so! That is always your first priority as an instructor or coach. Learning can't be effective or fun if it isn't safe.

"Awareness" - Nothing good in performance driving happens without it. Every skill you hope to develop in your student depends on it. It is vital that you start very early to build a sense of acute awareness in your student, especially given today's high-performance cars that can almost drive themselves. If awareness is never developed, he will never achieve true driving success. Every sound, smell, every undulation of the track, every twitch of the car, every puff of smoke or dust cloud ahead is information that the driver needs to analyze and assess.

Awareness, very similar to Levels of Learning, ranges from:

> I did not even know that!
>
> I am aware of what to do and beginning to practice it.
>
> If I think about it, I can do it consistently!
>
> It's automatic…no thought involved!

Every input to the car is important. Help the student build a keen sense of the relationship between input and outcome. Of cause and effect. Then you can help him develop the skills that make driving safer and more satisfying.

"Vision" is our overwhelming dominant sense: the "king of the senses". Your eyes lead the way and control smoothness. Help place the student's eyes further ahead. Have him look ahead as far as he can. Having his eyes up gets a driver where he needs to be and focuses concentration. It also helps to anticipate. Anticipation protects against mistakes.

Scanning techniques are an important part of proper use of the eyes. A driver has to not only look far ahead at the track, he has to check his mirrors, look for his reference points, check each flag station as he approaches it and, on the straights, check his gauges. In

traffic he also must monitor nearby cars. Moving the eyes, avoiding "tunnel vision" or "Target Fixation" is necessary. Practice this behind the wheel on the track and continue practicing on your way home in the street car. It will improve the odds of doing the right thing at the right time.

When vision gets shorter, or the eyes drop, speed increases anxiety. When eye placement is inside reaction distance, eye movement becomes fixed; scanning for crucial information stops and anxiety increases. The result of increasing anxiety is fear. Fear can bring panic. Panic driven inputs are involuntary and always wrong. Proper use of the eyes is crucial.

Here are some favorite maxims regarding vision:

Eyes up and vision forward.

The car goes where you look.

Turn your head, point your nose.

The hands follow the eyes.

Scan, don't fixate. Look at and note everything, but concentrate on nothing in particular.

Look 3 seconds ahead.

Trust and use peripheral vision.

Look past, around, or through the car in front of you.

The future is more important than the past.

The future is closer than you think!

You can only drive as fast as you can think.

Everything a person does is created twice, once in the mind, once in the execution.

"Recognizing Fatigue, or the Red Mist" - Driving suffers from fatigue. That is no mystery. Fatigue focuses concentration on the body. If attention is on the body it is not on driving. Your student has to develop awareness of fatigue. Use the "Three Mistake Rule". With awareness of three successive mental or physical mistakes, more may have gone unnoticed. Slow down and re-focus, or go into the pits.

"Mistakes" are golden opportunities for learning; often the primary opportunity for learning something truly new. A mistake does not become a failure unless the student refuses to admit it, and correct it. You need to make sure your student's mistakes don't result in an unsafe incident or situation and that he can learn from the experience. Push his comfort zone in a reasonable manner, so that when mistakes do occur, and no lap is

without mistakes, they are small enough to manage. Your approach should be that a mistake is a correction and loss of speed, not a spin or wheels off track.

Common Mistakes: (At all levels of driving)

- Missing apexes
- Over aggression – doesn't help develop skills
- Over driving – too hard too soon on the throttle or carrying too much speed into a turn. How much speed is too much? When it keeps you from going precisely where you planned to. Carrying too much speed into a turn may feel fast, but it prevents putting the car in its proper positions. (The reason for overdriving is pushing too hard. Beginners should not expect to perform like world champions. Old hands should expect to spend practice time refining existing skills. Pushing too hard just increases fatigue, anger and overconfidence.)
- Showing off
- Mimic the car ahead – just scan the car ahead, don't focus on it. Don't drive the line of the car ahead. Drive your own line, always!
- Driving the mirrors – just scan all the mirrors for motion or flashes of color
- Chopping off after passing - Give the slower car room. Enter the upcoming corner off-line if need be to avoid chopping off
- Unpredictability – predictability is necessary for other drivers to trust your student.
- Missing flags – means not looking ahead far enough or not scanning. The Glen is a great track for looking ahead to corner stations. It has great sight lines to the flaggers.
- Not using all of the track – again, the student needs to look ahead.
- Mis-managing chassis and contact patches – the student needs to think about what the car is doing: Feel the car. Balance the car.
- Hands – too busy, death grip. Light hands are needed for smooth competent driving.
- Shifting – be gentle, don't rush shifting to avoid missed shifts.
- Foot work – keep constant pressure on the brake pedal when heel and toeing. The brake and throttle are not on/off switches. All inputs must be smooth.
- Breathing – take a couple of deep breaths on the straights.
- Anger at others slowing you or at your mistakes. Anger itself is not a driving mistake, but it is self-destructive, a distraction from needed focus and leads to poor decision making. Then the risk of mistakes goes up. Keep your student calm on track. Stay calm yourself!
- Dwelling on mistakes – don't. Make sure the student registers them and focuses forward. Correct the mistake the next time around.

- Unresponsive student – a driver who doesn't acknowledge and follow your instruction is not under your control. He is a hazard to himself, you and others on track. Pull into the pits and re-establish control.

Mistakes are proof that a student is trying. But the instructor must help the student minimize risk and provide a **"Margin for Error"**. Providing a Margin for Error means keeping the student within the limits of his capability and not at the limit of his capability. Everyone makes mistakes. Mario Andretti admitted that he never drove a perfect lap! Learning from mistakes is key to mastering something challenging and being successful.

The Margin for Error required depends upon the student's experience, his familiarity with the track, condition of the track, condition of his car and the sum total experience of others on track.

The Margin for Error needed can be reduced through awareness, practice, coaching and more practice. As a student advances as a driver, he is able to reduce the Margin for Error while remaining safe, consistent and in control.

Safe means the student knows and practices track protocols, is courteous and respectful of other drivers, has 360-degree awareness, sees flags and responds correctly, has a plan for the session and knows when to come in.

Consistent means the student hits his marks and drives with precision. His steering, braking and throttle inputs are always appropriate and timely.

In control means the student drives the car! He is in control and never over drives the car. He is in control of himself. He knows what the car is doing and why; he adjusts accordingly. He is aware of changing conditions such as the track, brakes, tires, traffic and his brain. He is always looking ahead and behind. He makes plans to manage traffic.

The challenge to Margin for Error is speed! Speed is fun…it is why the student came!! Speed is addictive. However, speed is not a measure of how skillfully the student drives. Speed reduces the Margin for Error. Everything happens more quickly. Driving with more speed requires more precision, increased awareness, and excellent car control. The harder the student pushes, the more Margin for Error is needed. Low risk speed comes with competence.

Don't let the student be suckered by the adrenalin rush. Driving is all about making good judgments. "Judgment" is not a sensation. Judgment is based on experience and knowledge. It takes the form of thought. Motion generates feelings too, but feelings of going fast are usually a distraction. Feel fast sensations are usually quite unrelated to actual speed.

For the Novice

Novice Students need immediate teaching for proper driving position, setting the mirrors to clear blind spots, staging, pit in and out procedures, flag meanings and suggested actions, safety and emergency procedures - recognize and react, on-track terminology and instructor hand signals.

Once on track teaching shifts to:

- Driving the line (turn-in, apex, track-out and positioning between turns.)
- Operating the car (steering - hand position and movement, accelerating - smooth throttle control, shifting - up and down, and shift timing, braking – smoothness, brake timing and pedal pressure, overall smoothness.)
- Vision and awareness (look up and out beyond the car, look for reference points and corner worker positions, check the mirrors.)
- Passing (where and how, too soon, too late, being passed, point-byes, safety margins.)
- Traffic (staying calm in close traffic, anticipating slower cars in front and not tailgating, giving prompt passing signals.)
- Car control (recognition and reaction to understeer and oversteer, smoothness and balance, consistency and accuracy.)
- Warm up and cool down laps.

What to Expect from a Novice

A novice, especially a first-time novice, will likely be concerned with following protocols and not holding up other drivers. Help him with both to reduce his anxiety until he is managing on his own.

Be on the alert for changing conditions as they require adjustments in how to best drive a car. You must help this student with this. The novice is most likely suffering from information over-load so don't leave it to chance. As an instructor you must anticipate these changing conditions and predict what adjustment will need to be made in the student's driving to insure everyone's safety.

Because the novice will almost certainly suffer from information over-load, at a point in time, during an entire session, an entire day or event, be on the alert for confusion. Keep it simple on track. Always default to the safest choice as you teach, instruct and coach. Teach him to always make the safe choice.

Of equal, or even more importance, is the condition of the student. He gets tired, loses focus and makes mistakes. All of a sudden, he starts missing braking points or apexes. He misses something he should have seen. He does something inappropriate or not consistent with what he has been doing. A student who loses focus must be brought in immediately.

You also need to help the very busy mind of the novice become aware of all of the little things he is doing wrong without even realizing it. Self-awareness of mistakes is vital to progress. Once the novice can identify his mistakes, you have given him the greatest of driving gifts, and the precious device of self-analysis as well.

Common Novice Errors – What to Watch For:

- Indecisive use of controls.
- Jerky, abrupt inputs.
- Early apexes.
- Creeping in or drifting away from the track edge before actually initiating the turn.
- Failure to let the car track out or pinching the exit of the turn.
- Turning in before releasing the clutch.
- Mis-judgement of braking distances and effort.
- Inconsistency as speeds increase.
- Overly concerned with lap times.
- Traffic issues: Worrying about holding others up or not being able to pass.
- Mirrors: Not checking or overly obsessed and not looking forward.

When instructing a novice, you must have strategies for:

- Over or under aggressive drivers – keep your student's confidence and capability in balance.
- Trains – help your student manage traffic. Drive through the pits to escape trains.
- Incidents, spins and wheels off – make sure your student knows what to do before you go on track.

For the Intermediate Student

Operating the Car:

Steering – Instruct for consistent and economic steering motions, proper hand position and movement. Steering inputs must be decisive but smooth.

Throttle control – Instruct for proper timing on all occasions, especially accelerating out of a corner for good balance of the car. Inputs must be decisive but smooth.

Throttle steer – Teach this more advanced technique of chassis balance and line control.

Braking – The hardest skill to learn. Teach threshold and trail braking, proper pedal pressure in the brake zone, extending the brake zone and using the brakes to balance the car. Inputs must be decisive but smooth.

Shifting timing, heel and toe – You may have to teach it (off-track only!). It is required for effective advanced driving.

Skills and Techniques:

Vision – The student should be looking far ahead, no longer driving point-to-point.

Increasing Awareness – Instruct to develop 360-degree awareness.

Car Control – Help the student deal with variable handling situations.

Managing the contact patch – This depends on the student's feel for the car. Get him to focus on it.

Passing – The student must be courteous, safe, and keep intervals well managed.

Handling close traffic and off-line turns – Make sure your student is prepared for any situation.

Smoothness and Balance, Consistency and Accuracy – Emphasize the need for, and reinforce the achievement of these qualities in your student's driving.

Different Lines and Off-line Corner Entries - Explore them with your students. Develop their knowledge of different corner types.

Awareness of Errors and Ability to Correct – This capability must be developed in the student for him to drive solo.

Automatic command of all flags and their meanings – requirement before being soloed.

Mental Preparedness:

Concentration, Judgment, Situational Awareness, and Decision Making – These skills come with seat time, but you must help the student develop them with your coaching.

Courtesy and Driving Comradery – The student has to see the other drivers on-track as friends, not enemies. Your attitude sets the tone.

Self-Analysis and Receptiveness to Learning – These are attributes that you can coach to, but the student has to decide for himself if he wants to make progress or just plateau out.

For the Advanced Student:

Students in advanced run groups should have been exposed to all the skills and knowledge to be completely safe, consistent and in control on track. Yet any advanced student, even a fellow Instructor, can develop a bad habit or be able to improve some aspect of their driving.

When in the right seat with such a driver, even one whose skills are superior to yours, you will be able to help him. A good driver is one who has mastered the basics. When coaching an advanced student, always go to the basics for improvement opportunities. Use all the sensory inputs you get in the right seat, what you see, feel, hear and even smell to determine what to coach him on. Tell him what you observe. Ask questions, make suggestions. Talk it over off track. You can even suggest a demonstration ride. It is more about how to instruct or coach this driver, much less about than teaching him.

How to Handle the Unexpected:

Expect the unexpected!

Being able to handle the unexpected begins with situational awareness.

As an Instructor, knowing what is going on around you at all times is essential. The track is a 360-degree environment and anything can happen in the blink of an eye. You need to constantly be aware and prepared. You need to teach your student to do the same.

You are the student's second set of eyes and ears. You should be ahead of the student with not only what is going on outside of the car but also inside the car and relaying this information to them.

The unexpected is going to happen. The more prepared you are for different scenarios the more control you will have of the vehicle. Experience will help you with this. Learn from your own and others unexpected situations.

Take the time off track to talk through some likely scenarios with your student. Talk about how to anticipate, understand and react to various situations.

Stay focused, you should know when you're about to have an unexpected situation, or someone else is about to suffer one ahead of you. You need to be able to anticipate what a student may be thinking or what he is about to do before he actually does it. Trust your gut!

If you do find yourself in a student's car that is out of control, remain calm and in control of yourself. Give clear precise orders to the student, not suggestions, for braking, throttle, steering, where to look and, worse case, both feet in. Don't just watch it happen. Use your expertise to help the student lessen the severity of the incident.

The "Challenging Student":

At some point you will have a student that is really struggling. Making progress with him will require a team effort for you and your student. Make sure it is not a learning style or learning disability issue first, then use the preferred style or method to teach. If not, back to basics is the approach.

Give him a demonstration ride at the start of his session – each time. Drive as you would in the beginner group. The visual information and your smooth inputs are very important to this student. If your student asks about the track time he is missing, remind them that he is still getting instructional time on the track when he rides with you.

Move the student down a group to allow for slower speeds on the track.

Have the student approach turns using slower speeds, earlier braking points, slow entry into the turn, focusing on the exact line, apex and track out point. Use references.

The student should use slow hands to initiate the turn. If necessary, rest your hand on the steering wheel as a guide through the turn. Drop this as he improves. The goal is a single smooth arc through the turn – set it and forget it – as the turn allows.

Set a "target speed", not a speed limit, for the straights (same thing but sounds better).

Use the pits frequently as an extension of your instruction.

If the student is making errors that need correcting, bookmark them for him, then come into the pits. In the pits discuss what could use improvement in a "classroom" that is not moving at 75 mph.

Give the student a chance to first explain what he thought happened. Then provide your thoughts.

Give him some positive or confirming feedback from other areas on the track. Return to the session and have fun.

Coming into the pits often with a struggling student enables you to immediately and clearly provide feedback and discuss improvement. Waiting until the end of the session is too long to provide timely inputs. This is also a good time to reinforce positive actions.

Debrief your student after every session. This includes in-car discussion and "classroom" time looking at a track map. Reinforce the line, references and flag stations. Emphasize situational awareness. Ask the student where he did well and where he could have done better. The goal is for the student to fully understand, and tell you, what improvements he made and where further work is needed. If your student cannot describe where he needs to make improvements, you may need to reinforce an objective on the demonstration ride. "This is what I meant. Do you see that, or feel that?"

Keep the student relaxed and upbeat. He is not being penalized. Reinforce that this is a skills-building exercise. It will allow a safer learning curve for him and everyone else on track. You can stay firm and have fun at the same time, but you must keep it fun.

Be social. Introduce your student to everyone as you walk by. When the two of you are making great progress, let others know that.

While you are orchestrating this very detailed experience, it is important to keep assessing your student after every run. Only continue working with him if he is safe, has a positive attitude, is still learning and is consistent. If the student is not making progress, not following your directions, continues to be too fast, or has no idea what he is supposed to be doing on the track, talk to the Run Group Coordinator or the CDI.

If you wish, or the decision is, to have another Instructor ride with your student, give that Instructor a full update of the student's issues and instruction that you have already provided.

If the decision is to ask the student to leave, you need to document your interactions, assessments, your student's attitude and behavior on the student's evaluation form. Highlight the issues that led to the decision. State your observations of the student's capabilities and your opinion of his capacity to improve his driving. If appropriate, offer the opinion that he could safely return in the future.

Many of us have worked with challenging students in the past. Consider using these non-traditional methods for safety's sake and to help him make progress.

Instruction in Cars with the New Technologies:

Anti-lock braking systems (ABS), traction control and stability control are great learning tools. When they operate, ask the student if he felt it and why it happened? If he is unaware of these systems intervening, teach him to feel their effect on the car when they kick in. If necessary, you can drive the student's car to show him the difference between the car intervening and good technique. When you drive the student's car be smooth! Avoid car interventions except intentionally. The goal is for the student to learn to drive on pace with the systems not intervening.

There is also a safety issue with these systems. Newer cars are most assuredly more capable than the student. They can make the student feel secure. But safety is NOT an option! You have to help him recognize that the car's technology can enable him to do some ridiculous things with the car far above his talents.

For a novice, you will likely have to rein him in so he can build skills without depending on the car.

An intermediate's confidence can overcome his skill level, especially an intermediate solo driver. You will need to raise his awareness of the systems operating, and coach him to avoid their intervention while maintaining pace.

An advanced student should be fully aware of car interventions and able to drive at an appropriate pace without the car intervening.

Whenever you are riding with a student in a car that has these systems, make sure they are ON.

In some cars, especially high-performance cars, there may be selectable settings for these technologies. Settings such as "Economy", "Highway or Normal", "Sport", Sport Plus", "Track" or "Race" are available. This one selector switch may adjust not only the sensitivity of the Electronic Stability Control and Traction Control Systems, but also the throttle map (accelerator pedal sensitivity), spark timing, ride height and suspension stiffness. Always have your student select the settings that are compatible with his skill level. In other words, the more inexperienced the student is, the more conservative, less aggressive settings are to be used.

Signing Off a Student and Check-Out Rides:

NRPCA provides student evaluation forms for Green (Novice), White (Intermediate) and Black (Advanced) students. These forms not only guide you through the student's "performance appraisal" at the end of the event, but also provide you with a guide to the competencies and behaviors expected of students in each run group.

If your student demonstrates that he has met and mastered these expectations, talk to the Run Group Coordinator or CDI about next steps. In some instances, NRPCA requires another Instructor to take a check-out ride with the student before they are promoted to the next run group up or cleared to drive solo.

If you are asked to take a check-out ride, with any driver, you may have very little time for a "Five Minute Interview". Make sure you at least ask about his high-performance driving experience and his car. Once you are in the car do NOT take anything for granted about his driving ability, awareness, safety and conduct on track despite what he claims or others offer. Always judge everything about him as a driver for yourself. Be prepared for anything!

Track Walks:

Track walks are a great learning opportunity for any student, including Advanced students and even Instructors. The walks are generally conducted by the Chief Classroom Instructor, the CDI, another highly competent Instructor, a pro driving coach or pro race driver. The goal of the walk is to familiarize the student with the features of the track that

can’t be seen at speed. Encourage your student to take advantage of these opportunities. Take advantage yourself!

In addition to listening to the track walk guide, and asking questions, look closely at the track for yourself. Look for:

Which curbs that are friendly and which are not.

Camber; where it begins and ends, where it is most pronounced.

Elevation changes.

Polished or other pavement conditions. Touch the surface of the track or rub it with the sole of your shoe to check for different levels of surface polishing on and off-line.

Where the water runs off or across the track; where water puddles on the track. This is not only useful to know for a wet track but if camber, elevation changes or any feature of the track surface will affect the flow of water, they will affect the car in the dry or wet.

Skid marks that indicate areas of common mistakes in corners or that tell you something about braking zones (few marks in a braking zone indicate most drivers aren’t braking as deep as possible, lots of marks indicate many drivers are locking up).

Track shoulders to avoid or that can be used.

Dips, swales and other sweet spots that affect grip.

Look not only in the direction of travel, but also look back against the direction of travel. Get down and look close to the track to make sure of subtle camber and elevation changes etc.

Sometimes there is no track walk organized by the event but the opportunity exists for a student to walk the track on his own. Encourage your student to take advantage of these opportunities as well. Better yet, go with him!

Technical and Background Material

Advanced Automobile Safety Features:

Anti-lock braking systems

From Wikipedia, the free encyclopedia (https://en.wikipedia.org/wiki/Anti-lock_braking_system)

An anti-lock braking system (ABS) is a safety anti-skid braking system used on cars. ABS operates by preventing the wheels from locking up (STOPPING ROTATION) during braking, thereby maintaining traction and control contact with the road surface.

ABS is an automated system that uses the principles of threshold braking and cadence braking which were once practiced by skillful drivers with earlier non-ABS braking systems. ABS operates at a much faster rate and more effectively than most drivers could manage. Although ABS generally offers improved vehicle control and decreases stopping distances on dry and slippery surfaces, ABS may significantly increase braking distance on loose gravel or snow-covered surfaces, while still improving steering control. This replaces the need to manually pump the brakes while driving on a slippery or a low traction surface, allowing to steer even in most emergency braking conditions.

Since ABS was introduced in production vehicles, such systems have become increasingly sophisticated and effective. Modern versions may only prevent wheel lock under braking, but may also alter the front-to-rear brake bias. This latter function, depending on its specific capabilities and implementation, is known variously as electronic brakeforce distribution, traction control systems, emergency brake assist, or electronic stability control (ESC).

Operation

The anti-lock brake controller is also known as the CAB (Controller Anti-lock Brake). Typically ABS includes a central electronic control unit (ECU), four wheel speed sensors, and at least two hydraulic valves within the brake hydraulics. The ECU constantly monitors the rotational speed of each wheel; if it detects the wheel rotating significantly slower than the speed of the vehicle, a condition indicative of impending wheel lock, it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel; the wheel then turns faster. Conversely, if the

ECU detects a wheel turning significantly faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied, slowing down the wheel. This process is repeated continuously and can be detected by the driver via brake pedal pulsation, this comes from the rapid opening and closing of the valves. This pulsing also tells the driver that the ABS has been triggered.
Some anti-lock systems can apply or release braking pressure 15 times per second. Because of this, the wheels of cars equipped with ABS are practically impossible to lock even during panic braking in extreme conditions.

The ECU is programmed to disregard differences in wheel rotational speed below a critical threshold, because when the car is turning, the two wheels towards the center of the curve turn slower than the outer two. For this same reason, a differential is used in virtually all roadgoing vehicles.

If a fault develops in any part of the ABS, a warning light will usually be illuminated on the vehicle instrument panel, and the ABS will be disabled until the fault is rectified.

ABS is offered or comes standard on most road vehicles produced today and is the foundation for electronic stability control systems and traction control systems, which are rapidly increasing in popularity.

Use

There are many different variations and control algorithms for use in ABS. One of the simpler systems works as follows:

The controller monitors the speed sensors at all times. It is looking for decelerations in the wheel that are out of the ordinary. Right before a wheel locks up, it will experience a rapid deceleration. If left unchecked, the wheel would stop much more quickly than any car could. It might take a car five seconds to stop from 60 mph (96.6 km/h) under ideal conditions, but a wheel that locks up could stop spinning in less than a second.

The ABS controller 'knows' that such a rapid deceleration is impossible, so it reduces the pressure to that brake until it sees an acceleration, then it increases the pressure until it sees the deceleration again. It can do this very quickly, before the wheel can significantly change speed. The result is that the wheel slows down at the same rate as the car, with the brakes keeping the wheels very near the point at which they will start to lock up. This gives the system maximum braking power.

Effectiveness

On high-traction surfaces such as asphalt or concrete, many (though not all) ABS-equipped cars are able to attain braking distances better (i.e. shorter) than those that would be possible without the benefit of ABS. In real world conditions, even an alert and experienced driver without ABS would find it difficult to match or improve on the performance of a typical driver with a modern ABS-equipped vehicle. The recommended technique for non-expert drivers in an ABS-equipped car, in a typical full-braking

emergency, is to press the brake pedal as firmly as possible and, where appropriate, to steer around obstructions. In such situations, ABS will significantly reduce the chances of a skid and subsequent loss of control.

In gravel, sand and deep snow, ABS tends to increase braking distances. On these surfaces, locked wheels dig in and stop the vehicle more quickly. ABS prevents this from occurring. Some ABS calibrations reduce this problem by slowing the cycling time, thus letting the wheels repeatedly briefly lock and unlock. The primary benefit of ABS on such surfaces is to increase the ability of the driver to maintain control of the car rather than go into a skid, though loss of control remains more likely on soft surfaces such as gravel or on slippery surfaces. On a very slippery surface, it is possible to lock multiple wheels at once, and this can defeat ABS (which relies on comparing all four wheels, and detecting individual wheels skidding). Availability of ABS relieves most drivers from learning threshold braking.

ABS is required on all new passenger cars sold in the EU since 2004. In the United States, the NHTSA has mandated ABS in conjunction with Electronic Stability Control as of September 1, 2013.

Electronic Stability Control

From Wikipedia, the free encyclopedia (https://en.wikipedia.org/wiki/Electronic_stability_control)

Electronic stability control (ESC), also referred to as electronic stability program (ESP) or dynamic stability control (DSC), is a computerized technology that improves a vehicle’s stability by detecting and reducing loss of traction (skidding). When ESC detects loss of steering control, it automatically applies the brakes to help "steer" the vehicle where the driver intends to go. Braking is automatically applied to wheels individually, such as the outer front wheel to counter oversteer or the inner rear wheel to counter understeer. Some ESC systems also reduce engine power until control is regained. ESC does not improve a vehicle's cornering performance; instead, it helps to minimize the loss of control.

Since November 1, 2011, EU Type Approval is only granted to models equipped with ESC. By November 1, 2014, ESC is required on all newly registered cars in the EU.

The NHTSA requires all new passenger vehicles sold in the US to be equipped with ESC as of the 2012 model year. A similar requirement has been proposed for new truck tractors and certain buses, but it has not yet been finalized.

Operation

During normal driving, ESC works in the background, continuously monitoring steering and vehicle direction. It compares the driver's intended direction (determined through the measured steering wheel angle) to the vehicle's actual direction (determined through measured lateral acceleration, vehicle rotation (yaw), and individual road wheel speeds).

ESC intervenes only when it detects a probable loss of steering control, i.e. when the vehicle is not going where the driver is steering. This may happen, for example, when skidding during emergency evasive swerves, understeer or oversteer during poorly judged turns on slippery roads, or hydroplaning. During high-performance driving, ESC can intervene when unwanted, because steering input may not always be indicative of the intended direction of travel (i.e. controlled drifting). ESC estimates the direction of the skid, and then applies the brakes to individual wheels asymmetrically in order to create torque about the vehicle's vertical axis, opposing the skid and bringing the vehicle back in line with the driver's commanded direction. Additionally, the system may reduce engine power or operate the transmission to slow the vehicle down.

ESC can work on any surface, from dry pavement to frozen lakes. It reacts to and corrects skidding much faster and more effectively than the typical human driver, often before the driver is even aware of any imminent loss of control. This has led to some concern that ESC could allow drivers to become overconfident in their vehicle's handling and/or their own driving skills. For this reason, ESC systems typically alert the driver when they intervene, so that the driver knows that the vehicle's handling limits have been reached. Most activate a dashboard indicator light and/or alert tone; some intentionally allow the vehicle's corrected course to deviate very slightly from the driver-commanded direction, even if it is possible to more precisely match it.

All ESC manufacturers emphasize that the system is not a performance enhancement nor a replacement for safe driving practices, but rather a safety technology to assist the driver in recovering from dangerous situations. ESC does not increase traction, so it does not enable faster cornering (although it can facilitate better-controlled cornering). More generally, ESC works within the limits of the vehicle's handling and available traction between the tires and road. A reckless maneuver can still exceed these limits, resulting in loss of control. For example, during hydroplaning, the wheels that ESC would use to correct a skid may lose contact with the road surface, reducing its effectiveness.

Due to the fact that stability control can be incompatible with high-performance driving (i.e. when the driver intentionally loses traction as in drifting), many vehicles have an over-ride control which allows the system to be partially or fully shut off. In simple systems, a single button may disable all features, while more complicated setups may have a multi-position switch or may never be turned fully off.

Components and design

ESC incorporates yaw rate control into the anti-lock braking system (ABS). Yaw is a rotation around the vertical axis; i.e. spinning left or right. Anti-lock brakes enable ESC to brake individual wheels. Many ESC systems also incorporate a traction control system (TCS or ASR), which senses drive-wheel slip under acceleration and individually brakes the slipping wheel or wheels and/or reduces excess engine power until control is regained. However, ESC serves a different purpose from that of ABS or Traction Control.

The ESC system uses several sensors to determine what the driver wants (input). Other sensors indicate the actual state of the vehicle (response). The control algorithm compares driver input to vehicle response and decides, when necessary, to apply brakes and/or reduce throttle by the amounts calculated through the state space (set of equations used to model the dynamics of the vehicle). The ESC controller can also receive data from and issue commands to other controllers on the vehicle such as an all-wheel drive system or an active suspension system to improve vehicle stability and controllability.

The sensors used for ESC have to send data at all times in order to detect possible defects as soon as possible. They have to be resistant to possible forms of interference (rain, holes in the road, etc.). The most important sensors are:

Steering wheel angle sensor: determines the driver's intended rotation; i.e. where the driver wants to steer.

Yaw rate sensor: measures the rotation rate of the car; i.e. how much the car is actually turning. The data from the yaw sensor is compared with the data from the steering wheel angle sensor to determine regulating action.

Lateral acceleration sensor: often an accelerometer

Wheel speed sensor: measures the wheel speed.

Other sensors can include:

Longitudinal acceleration sensor: similar to the lateral acceleration sensor in design, but can offer additional information about road pitch and also provide another source of vehicle acceleration and speed.

Roll rate sensor: similar to the yaw rate sensor in design but improves the fidelity of the controller's vehicle model and correct for errors when estimating vehicle behavior from the other sensors alone.

ESC uses a hydraulic modulator to assure that each wheel receives the correct brake force. A similar modulator is used in ABS. ABS needs to reduce pressure during braking, only. ESC additionally needs to increase pressure in certain situations and an active vacuum brake booster unit may be utilized in addition to the hydraulic pump to meet these demanding pressure gradients.

The brain of the ESC system is the electronic control unit (ECU). The various control techniques are embedded in it. Often, the same ECU is used for diverse systems at the same time (ABS, Traction control system, climate control, etc.). The input signals are sent through the input-circuit to the digital controller. The desired vehicle state is determined based upon the steering wheel angle, its gradient and the wheel speed. Simultaneously, the yaw sensor measures the actual state. The controller computes the needed brake or acceleration force for each wheel and directs via the driver circuits the valves of the hydraulic modulator. Via a Controller Area Network interface the ECU is connected with other systems (ABS, etc.) in order to avoid giving contradictory commands.

Many ESC systems have an "off" override switch so the driver can disable ESC, which may be desirable when badly stuck in mud or snow, or driving on a beach, or if using a smaller-sized spare tire which would interfere with the sensors. Some systems also offer an additional mode with raised thresholds so that a driver can utilize the limits of adhesion with less electronic intervention. However, ESC defaults to "On" when the ignition is restarted.

Traction control system

From Wikipedia, the free encyclopedia (https://en.wikipedia.org/wiki/Traction_control_system)

A traction control system (TCS) is typically (but not necessarily) a secondary function of the electronic stability control (ESC) on production motor vehicles, designed to prevent loss of traction of driven road wheels. TCS is activated when throttle input and engine torque are mismatched to road surface conditions. The basic idea behind the need for a traction control system is the loss of road grip that compromises steering control and stability of vehicles because of the difference in traction of the drive wheels. Difference in slip may occur due to turning of a vehicle or varying road conditions for different wheels. When a car turns, its outer and inner wheels rotate at different speeds; this is conventionally controlled by using a differential. A further enhancement of the differential is to employ an active differential that can vary the amount of power being delivered to outer and inner wheels as needed. For example, if outward slip is sensed while turning, the active differential may deliver more power to the outer wheel to minimize the yaw (essentially the degree to which the front and rear wheels of a car are out of line.) Active differential, in turn, is controlled by an assembly of electromechanical sensors collaborating with a traction control unit.

Intervention consists of one or more of the following:

- Brake force applied to one or more wheels

Reduction or suppression of spark sequence to one or more cylinders

Reduction of fuel supply to one or more cylinders

Closing the throttle, if the vehicle is fitted with "drive by wire" throttle

In turbocharged vehicles, a boost control solenoid is actuated to reduce boost and therefore engine power.

Typically, traction control systems share the electrohydraulic brake actuator (which does not use the conventional master cylinder and servo) and wheel speed sensors with ABS.

Operation

When the traction control computer (often incorporated into another control unit, such as the ABS module) detects one or more driven wheels spinning significantly faster than another, it invokes the ABS electronic control unit to apply brake friction to wheels spinning with lessened traction. Braking action on slipping wheel(s) will cause power transfer to wheel axle(s) with traction due to the mechanical action within the differential. All-Wheel Drive (AWD) vehicles often have an electronically controlled coupling system in the transfer case or transaxle engaged (active part-time AWD), or locked-up tighter (in a true full-time set up driving all wheels with some power all the time) to supply non-slipping wheels with torque.

This often occurs in conjunction with the powertrain computer reducing available engine torque by electronically limiting throttle application and/or fuel delivery, retarding ignition spark, completely shutting down engine cylinders, and a number of other methods, depending on the vehicle and how much technology is used to control the engine and transmission. There are instances when traction control is undesirable, such as trying to get a vehicle unstuck in snow or mud. Allowing one wheel to spin can propel a vehicle forward enough to get it unstuck, whereas both wheels applying a limited amount of power will not produce the same effect. Many vehicles have a traction control shut-off switch for such circumstances.

Components of traction control

Generally, the main hardware for traction control and ABS are mostly the same. In many vehicles traction control is provided as an additional option to ABS.

Each wheel is equipped with a sensor which senses changes in its speed due to loss of traction.

The sensed speed from the individual wheels is passed on to an electronic control unit (ECU).
The ECU processes the information from the wheels and initiates braking to the affected wheels via a cable connected to an automatic traction control (ATC) valve.

In all vehicles, traction control is automatically started when the sensors detect loss of traction at any of the wheels.

Use of traction control

In road cars: Traction control has traditionally been a safety feature in premium high-performance cars, which otherwise need sensitive throttle input to prevent spinning driven wheels when accelerating, especially in wet, icy or snowy conditions. In recent years, traction control systems have become widely available in non-performance cars, minivans, and light trucks and in some small hatchbacks.

In race cars: Traction control is used as a performance enhancement, allowing maximum traction under acceleration without wheel spin. When accelerating out of a turn, it keeps the tires at optimal slip ratio.

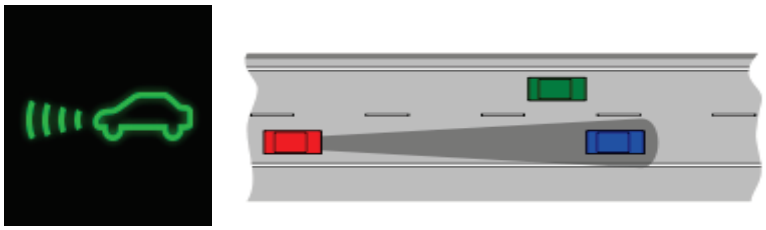
Traction control in cornering

Traction control is not just used for improving acceleration under slippery conditions. It can also help a driver to corner more safely. If too much throttle is applied during cornering, the drive wheels will lose traction and slide sideways. This occurs as understeer in front wheel drive vehicles and oversteer in rear wheel drive vehicles. Traction control can prevent this from happening by limiting power to the wheels. It cannot increase the limits of grip available and is used only to decrease the effect of driver error or compensate for a driver's inability to react quickly enough to wheel slip.

Automobile manufacturers state in vehicle manuals that traction control systems should not encourage dangerous driving or encourage driving in conditions beyond the driver's control.

Adaptive cruise control

From Wikipedia, the free encyclopedia (https://en.wikipedia.org/wiki/Adaptive_cruise_control)



Schematic of Intelligent Cruise Control. The red car automatically follows the blue car.

Adaptive cruise control (ACC; also called traffic-aware cruise control) is an optional cruise control system for road vehicles that automatically adjusts the vehicle speed to maintain a safe distance from vehicles ahead.

Control is based on sensor information from on-board sensors. Such systems may use a radar or laser sensor or a camera setup allowing the vehicle to brake when it detects the car is approaching another vehicle ahead, then accelerate when traffic allows it to.

ACC technology is widely regarded as a key component of any future generations of intelligent cars. They impact driver safety and convenience as well as increasing capacity of roads by maintaining optimal separation between vehicles and reducing driver errors. Vehicles with autonomous cruise control are considered a Level 1 autonomous car, as defined by SAE International. When combined with another driver assist feature such lane centering then the vehicle is considered a Level 2 autonomous car.

Adaptive cruise Control does not provide full autonomy: the system only provides some help to the driver, but does not drive the car by itself.

Laser-based systems do not detect and track vehicles in adverse weather conditions nor do they reliably track dirty (and therefore non-reflective) vehicles. Laser-based sensors must be exposed, the sensor (a fairly large black box) is typically found in the lower grille, offset to one side.

Radar-based sensors can be hidden behind plastic fascia’s; however, the fasciae may look different from a vehicle without the feature.

Single radar systems are the most common. Systems involving multiple sensors use either two similar hardware sensors or one central long-range radar coupled with two short-range radar sensors placed on the corners of the vehicle.

A more recent development is the binocular computer vision system. These systems have front-facing video cameras mounted on either side of the rearview mirror and use digital processing to extract depth information from the parallax between the two cameras' views.

Assisting systems

Radar-based ACC often feature a pre-crash system, which warns the driver and/or provides brake support if there is a high risk of a collision. Also in certain cars it is incorporated with a lane maintaining system which provides a power steering assist to reduce steering input burden on corners when the cruise control system is activated.

Multi-sensor systems

Systems with multiple sensors can practice sensor fusion to integrate the data from to improve safety and/or driving experience. GPS data can inform the system of geographic features such as a freeway off-ramp. A camera system could notice driver behavior such as brake lights and/or a turn signal. This could allow a following car to interpret a turn signal by an exit as not requiring the following car to slow down, as the leading car will exit. Multi-sensor systems could also take note of traffic signs/signals and not, e.g., violate a red light while following a vehicle that crossed before the signal changed.

Predictive systems

Predict systems modify speed based on predictions of other vehicles' behavior. Such systems can make earlier, more moderate adjustments to the predicted behavior, improving safety and passenger comfort. One example is to predict the likelihood of a vehicle in a neighboring lane moving in front of the controlled vehicle. One system predicts a lane change up to five seconds before it occurs.

Lane departure warning system

From Wikipedia, the free encyclopedia
(https://en.wikipedia.org/wiki/Lane_departure_warning_system)

In road-transport terminology, a lane departure warning system is a mechanism designed to warn the driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction) on freeways and arterial roads. These systems are designed to minimize accidents by addressing the main causes of collisions: driver error, distractions and drowsiness.

There are three types of systems:

Systems which warn the driver (lane departure warning, LDW) if the vehicle is leaving its lane (visual, audible, and/or vibration warnings)

Systems which warn the driver and, if no action is taken, automatically take steps to ensure the vehicle stays in its lane (lane keeping system, LKS)

Systems which take over steering, keep the car centered in the lane, and ask the driver to take over in challenging situations.

Lane warning/keeping systems are based on:

Video sensors in the visual domain (mounted behind the windshield, typically integrated beside the rear mirror)

Laser sensors (mounted on the front of the vehicle)

Infrared sensors (mounted either behind the windshield or under the vehicle)

Lane keeping

Lane keeping assist is a feature that, in addition to the lane departure warning system, automatically takes steps to ensure the vehicle stays in its lane. Some vehicles combine adaptive cruise control with lane keeping systems to provide additional safety.

While the combination of these features creates a semi-autonomous vehicle, most require the driver to remain in control of the vehicle while it is in use. This is because of the limitations associated with the lane-keeping feature.

The lane keeping assist system is being achieved in modern driverless vehicle systems using image processing techniques called hough transform and canny edge detection techniques. These advanced image processing techniques derive lane data from forward facing cameras attached to the front of the vehicle. Real-time image processing using powerful computers are being used by many Vehicle OEMs to achieve fully autonomous vehicles in which Lane detection algorithm plays a key part. Advanced lane detection algorithms are also being developed using deep learning and neural network techniques. High accuracy has been achieved in developing self-driving features including lane keeping using a neural network-based training mechanism which uses a front facing camera in a car and runs it through a route and then uses the steering input and camera images of the road fed into the neural network and make it 'learn'. The neural network then will be able to change the steering angle based on the lane change on the road and keep the car in the middle of the lane.

An advanced Lane assist system has been combined with an Adaptive cruise control system marketed together as 'Autopilot'. It includes features like lane-keeping assist and also automatic lane changing without driver input. A similar technology to lane assist is used to do Auto-park feature as well.

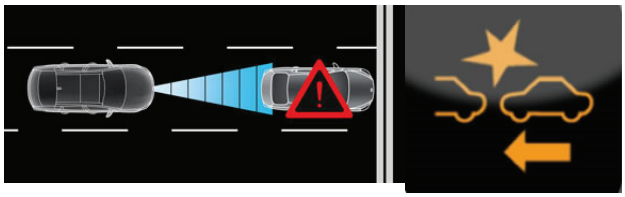
A lane keeping assist mechanism can either reactively turn a vehicle back into the lane if it starts to leave or proactively keep the vehicle in the center of the lane. Vehicle companies often use the term "Lane Keep(ing) Assist" to refer to both reactive Lane Keep Assist (LKA) and proactive Lane Centering Assist (LCA) but the terms are beginning to be differentiated.

Limitations

Lane Departure Warning Systems and Lane Keeping Systems rely on visible lane markings. They typically cannot decipher faded, missing, or incorrect lane markings. Markings covered in snow or old lane markings left visible can hinder the ability of the system.

Collision avoidance system &
Forward collision warning with auto-braking

From Wikipedia, the free encyclopedia
(https://en.wikipedia.org/wiki/Collision_avoidance_system)



A collision avoidance system, also known as a pre-crash system, forward collision warning system, or collision mitigating system, is an automobile safety system designed to prevent or reduce the severity of a collision. It uses radar (all-weather) and sometimes laser (LIDAR) and camera (employing image recognition) to detect an imminent crash. GPS sensors can detect fixed dangers such as approaching stop signs through a location database.

Once an impending collision is detected, these systems provide a warning to the driver. When the collision becomes imminent, they take action autonomously without any driver input (by braking or steering or both). Collision avoidance by braking is appropriate at low vehicle speeds (e.g. below 50 km/h (31 mph)), while collision avoidance by steering may be more appropriate at higher vehicle speeds if lanes are clear. Cars with collision avoidance may also be equipped with adaptive cruise control, using the same forward-looking sensors.

In March 2016, the National Highway Traffic Safety Administration (NHTSA) and the Insurance Institute for Highway Safety announced the manufacturers of 99% of U.S. automobiles had agreed to include automatic emergency braking systems as standard on virtually all new cars sold in the U.S. by 2022. In Europe, there was a related agreement about Advanced Emergency Braking System (AEBS) or Autonomous Emergency Braking (AEB) in 2012.

AEB differs from Forward Collision Warning: FCW alert the driver with a warning but does not by itself brake the vehicle.

According to Euro NCAP, AEB has three characteristics:

Autonomous: the system acts independently of the driver to avoid or mitigate the accident.

Emergency: the system will intervene only in a critical situation.

Braking: the system tries to avoid the accident by applying the brakes.

Features

Several features are commonly found across collision avoidance systems.

AEB systems shall detect possible collisions with the car in front. It performs it with sensors to detect and classify things in front of the vehicle, a system to interpret the data from the sensors, and a braking system which can work autonomously.

Some cars may implement lane departure warning systems.

Lane Assist

Lane assistance is designed to help the driver of the vehicle stay in the designated lane. Lane assist works through a camera mounted by the rearview mirror that detects lane markings ahead of the vehicle. With the lane markings taken into account along with the vehicle speed, and trajectory data, the vehicle makes a decision on when the lane will be crossed based upon the data from the camera. An advanced form of lane assist is lane centering which actively steers and keeps the car centered in the lane.

Blind Spot Alert

Side blind spot alert (SBSA) system is designed to assist the driver avoid dangerous situations or accidents with other road users during lane changes. The system designed will indicate to the driver if there is another vehicle traveling in the "blind spot." The vehicle is detected by a ultrasonic sensors that scan the side, and rear areas of the vehicle.

Cornering Brake Control

Cornering brake control (CBC) detects dangerous situation when applying the brakes while cornering turns in adverse conditions. CBC detects oversteer, understeer and drifting and redistributes brake pressure to wheels separately to regain control and prevent an accident.

Evasive Steering Assist

Evasive steering assist detects slower or stopped vehicles ahead, and provides steering assistance if the collision cannot be avoided by braking alone.

Adaptive Headlights

Adaptive headlights allow for better vision at night, the headlight beams adapt to the roadway, on bends in the road adaptive headlights can bend with the roadway whereas conventional headlight will face straight ahead.

Forward Collision Warning

Forward collision warning (FCW) system is an advanced safety technology that monitors a vehicle's speed, the speed of the vehicle in front of it, and the distance between the vehicles. If vehicles get too close due to the speed of the rear vehicle, the FCW system will warn that driver of an impending crash. It's important to note that FCW systems do not take full control of the vehicle or keep the driver from operating it.

Reverse automatic braking

Reverse automatic braking is a feature which allows autonomous braking of the vehicle, while working in reverse direction, to avoid a reverse collision.

Supporting documents

IDP Candidate Evaluation/Progress Forms

Niagara Region PCA HPDE Instructor and School Evaluation

Niagara IDP Candidate Information

PCA Skills Ratings

Suggested reference materials

Ross Bentley's Instructor Manifesto, Speed Secrets Weekly,
Facebook Group "HPDE Instructors"

Sources

Porsche Club of America National Drivers' Education Instructor Training Program; E. Paul Dickinson; Ross Bentley; Allegheny Region Porsche Club of America; Peter Argetsinger; Dave Scott; Niagara Region Porsche Club of America, including Ken Buschner, Jim Tulloch, Dick Cott, Rich deAsis et al; Wikipedia; Genesee Valley Chapter BMW Car Club of America, including Bill O'Neil, Dorothy Ochs et al; Connecticut Valley Region Porsche Club of America, Jim Adelman.