

Motorcycle Mentorship Module 22

Dynamics of Cornering and Traction Management





Warning: Incorrect or inaccurate information could lead to tragic results on the road. If a question arises that is not covered in the guide and you don't know the answer from your own experience and training, simply state, "That is a great question, I'll get back to you with the answer."

Your Service Safety Center will help with these types of questions should they arise. Their numbers are as follows:

US Army Driving Directorate: **334.255.3039**

USMC Safety Division: **703.604.4459**

US Navy Shore Safety: **757.444.3520 x7165**

US Air Force Safety Center: **505.846.0728**

USCG Safety Division: **202.475.5206**



Preface

About: The Defense Safety Oversight Council (DSOC) Motorcycle Mentorship Modules are a set of thirty six (36) facilitation modules designed for the purpose of increasing rider knowledge on various aspects of riding and providing additional capability for self-policing within peer groups. The modules are intended as a mechanism to further decrease motorcycle related mishaps and fatalities within Department of Defense (DoD) by encouraging riders to talk, live, and think about the topic.

Using the Module: The module content enclosed is intended as a facilitation guide to assist you with discussing the topic. However, it is still critical to use your skills and talent to engage participants and develop “buy-in” on this subject from your group. To maximize this, motivate and moderate your participants, control the accuracy of participant feedback, and be mindful of their time.

| Page | Section |
|------|--|
| 2 | Facilitation Guide – A brief overview on conducting a facilitated discussion of a topic |
| 3 | Module Overview – This section provides the facilitator a synopsis of the topic, learning objectives, and the suggested environment, props, and handouts for conducting the module |
| 4 | Module Discussion Introduction – This section provides guidance to the facilitator in opening up the discussion and getting participants talking about the topic and their relevant experiences |
| 5 | Discussion Areas – This section provides various discussion topics, sample facilitation questions, and factual information for the facilitator to lead the discussion |
| 7 | Wrap-Up – This section provides guidance to the facilitator on wrapping up the topic discussion |
| 8 | Feedback Form – A feedback form to be given to all participants for their feedback on the module discussion |
| 9 | Resources – Additional resources and definitions to assist the facilitator in preparing for and conducting the topic facilitation |
| 10 | Handouts – Figures, pictures, diagrams, etc. to assist the facilitator to better demonstrate a topic idea |

Facilitation Guide for DSOC Mentorship Modules

It is recommended that this Mentorship Module be conducted in a facilitation style. Using the information provided in this Mentorship Module, you, as the facilitator, will lead a discussion on the subject. *You should not be conducting a lecture!* The facilitator's role is to help with how the discussion is proceeding. Participants will have much more "buy in" and connectivity with the information if they have input. One of your roles as the facilitator is to control the accuracy of the input and control the time. From the Mentorship Module, generate questions which will lead to group discussion. The more you let the group participate, the more success you will have.

Competencies of a Facilitator:

- Prepare prior to the event
- Make sure everyone gets a chance to participate and help members to express themselves
- Ask rather than tell
- Honor the group, display respect for the members, and acknowledge participant contributions
- Ask for others' opinions
- Listen without interrupting
- Demonstrate professionalism and integrity

The key characteristic distinguishing facilitation from other types of leadership, like scripted training, is that the outcomes are never predetermined in a facilitative setting. Although the background information provided with this Module remains the same, the result will depend on the participants, the knowledge and experience they bring, and the information that they feel they need to take away. The group uses the activities provided by the facilitator to unlock expertise, ensure thorough discussion, stay focused and reach decisions that are better than those any individual could come up with alone.

At the beginning of each Mentorship Event, discuss why the participants are there and what they will receive as a result of participating. Adults have limited time and they want to know "What's in it for me?" A facilitator should make training fun. Encourage humor and laughter in your Mentorship Event.

Principles of Adult Learning:

- ➔ Adult Learners want material that is relevant to them. "What's in it for me?" "What will I get out of this that will make a difference to me?"
- ➔ Adult Learners come to training events with varying amounts of experience. They like to share their experiences. If you have minimal or no motorcycle experience, you can still draw from your group.
- ➔ Even if you have motorcycle experience, you should draw from your group because people tend to remember what "they" said longer than what you said. Information that they "own" is more valuable to them.
- ➔ Facilitators are not always subject matter experts; nor do they need to be. Facilitators may draw on the existing knowledge of the participants and the information provided in these Modules.

Section I: Module Overview

Time Frame: One 20-40 minute facilitator-led discussion

Level of Prior Knowledge: Participants should have basic to experienced level competency in operating a motorcycle and are familiar with motorcycle operations.

Synopsis: In this module we address key elements associated with proficient cornering, motorcycle dynamics and traction management. To achieve a higher level of skill, a rider must be aware of the various complicating factors involved in traction management, and willingly practice and maintain a strong commitment to improvement and better riding. Sixty percent of single vehicle crashes occur on curvy rural roads. By improving one's craft, acquiring advanced skills, and increasing rider knowledge the rider can reduce their personal risk of a crash.

Learning Objectives:

- Introduce basic knowledge and participant recognition of traction management related to cornering and turning.
- Participants understand the relationship of speed, lean angle, and acceleration in cornering and turning.
- Participants discuss and understand how different roadway factors are important to rider decision making while cornering.
- Participants explore the relationship between rider's visual gaze and directional control.

Suggested Environment/Props/Handouts:

Any comfortable environment, such as classroom, conference room, auditorium, or stadium seating, is appropriate.

- **Handout 1: The Contact Patch** may be used to illustrate tire contact patch.

Section II: Module Discussion

Introduction: Facilitate discussion: What are Dynamics of Cornering and Traction management?

Many motorcycle riders believe that a straight road is only good for getting the rider to the next winding road or curve, and the essence of motorcycle riding is cornering. Successfully and skillfully riding through curves is the life blood of many riders. Putting together proper techniques and pairing them with purposeful practice will enable every rider, new or seasoned, to skillfully negotiate any curve, anytime.

- **Definition of Dynamics:** The science of the motion of the motorcycle, its components, and the forces acting on it.
- **Definition of Cornering:** Cornering on a motorcycle is loosely defined as the ability to successfully negotiate a turn with many variables, such as: positive camber, off camber, and no camber. Also, included is turn radius, such as constant radius, increasing radius, and decreasing radius turns.
- **Definition of Traction:** For motorcycles, traction, or friction is the rubbing of two items together i.e. motorcycle tires and the road which creates adhesion between the tire and road surface.
- **Definition of Traction management:** Understanding and using the forces that act on the tire that affect traction such as driving force, side force, and braking force; additionally we consider, accelerating, deceleration, tire wear, proper air pressure, and road conditions as part of the total equation.

Open discussions with participant-centered activities. Have attendees introduce themselves (or each other) and describe to their groups their current motorcycle make and model. All activities should encourage participant interaction and develop camaraderie and a willingness to participate in discussions. Ask for and encourage participant sharing of experiences related to the module topic.

Sample questions may include:

- What is traction and what can affect traction.
- What forces affect traction – discuss “Traction reserve.”
- Discuss cornering and ask what affects the ability to properly negotiate a corner/curve.
- Discuss how these forces of traction might affect lean angle during cornering.

Suggested Discussion Areas:

Discussion Area 1: Traction

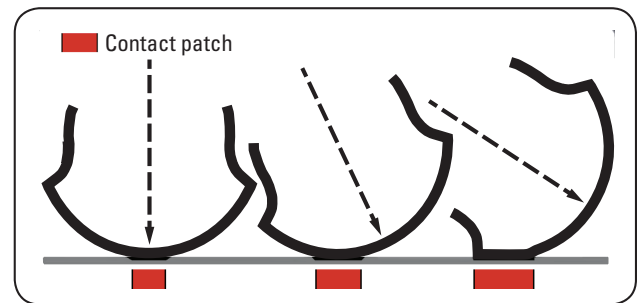
Introduction: Ask for an explanation of what traction is and what can affect traction. Traction is the friction or rubbing of the tire on the road. Other things that can or may affect traction include simple things such as tire pressure, tire wear, the environment, and road conditions.

Facilitation Questions:

- What is the contact patch?
- How does tire composition contribute to motorcycle traction?
- Why do motorcycles seem to lose traction more often in turns and not while upright?
- How does a motorcycle lose traction when upright?
- What are the elements that comprise total effective traction?

Facilitator Facts:

1. The contact patch, for our purpose of discussion, is the portion of a tire in direct contact with the roadway surface. The contact patch is dynamic and can change in size and shape as the motorcycle is ridden. Weight and weight shift, tire pressure, tire composition, and motorcycle lean will vary the size and shape of the contact patch.



2. Tire manufacturers use different formulas when blending tire compounds. Generally speaking, more durable tire compositions are less “sticky” than race compounds. Most touring tires are formulated for durability and 8 to 12 thousand miles of tire life are typical. Conversely, race compounds are very pliable and mold to minute roadway irregularities very easily—some riders describe race compound as pencil eraser soft. The trade-off for increased traction availability of a soft tire compound is limited tire usability—the softest DOT compliant tires may yield only one thousand miles of use. In the middle of the two extremes are soft and durable compounds and the multi-compound tires. The soft and durable tires are made of a compound that wears longer and still provides some aggressive “stickiness” and many riders consider these tires as general purpose. The multi-compound tires come from race technology and the tire is manufactured with both highly durable and very pliable compounds but each compound is located on the tire to maximize the compound attribute—sticky on the side and durable at the center.

3. Tire pressure can adversely change the geometry of the tire and reduce the contact patch surface area—under or over pressurized tires reduce the tires’ overall traction availability and the remaining traction is easily consumed during normal riding.



Discussion Area 2: Motorcycle Dynamics that Consume Traction

Facilitation Questions:

- What are some different factors that require more traction than riding in a straight line?
- How does the roadway surface affect available traction?
- How is lean angle related to speed in a corner?
- What can be done when a rider is going too fast for a given curve?

Facilitator Facts:

1. Turning, accelerating, and braking (forward weight transfer) all complicate available traction.
2. Roadway surface and composition (and the presence of debris) are factors that strongly affect traction management. Regardless of a tire's overall traction reserve, a motorcyclist can easily exceed the tire friction threshold creating a complete loss of traction—loss of traction results in skidding.
3. For a motorcycle to travel through a curve at a faster speed, lean angle must increase. Increased lean angle uses more of the available traction and must be taken into account when managing traction reserve.
3. In cornering, everything concerning the corner is important. Some questions to ask yourself: how will you look through the curve before entering, how is the throttle used throughout the curve, and what are your traction management actions for the curve? These are only a few of the questions that a rider must ask of themselves when negotiating curves and turns.
4. A way of simplifying traction management is to think in terms of a budget: There is never more than one hundred dollars' worth of traction available. If you are using 65 dollars (65 percent) of the traction currently available to you, and you ask your tires for another 40 dollars of traction, do you have that much (traction reserve) available? Obviously this adds up to over 100% and is physically impossible.
5. Another complicating factor in motorcycle dynamics is called “Visual Directional Control”. Most Motorcyclists are aware of the principle that a motorcycle goes where you look. What many fail to understand is that a basic human instinct is to focus on a threat. If you're in a curve, going a little too fast, and suddenly realize that the roadside guardrail or those big oak trees are potential threats, you cannot focus on them. *Motorcyclists must train themselves to look away from the threat and re-focus on where they want to go.*

Typically, over application of the brakes while the motorcycle is upright will cause one or both tires to skid. If the skid continues, the total lack of directional control may cause the bike to crash. When a motorcycle is in a turn and leaning, traction forces are consumed at a higher rate and very little traction reserve is available – typically an abrupt change in acceleration, deceleration, or lean angle will consume what little traction is available and a crash will occur. A danger associated with overwhelming traction forces in a corner is either a low-side or high-side crash. A low-side crash occurs in a corner when the front tire is no longer able to generate sufficient friction to support the steering or braking inputs of the rider. The front tire will then slide in a relatively straight line towards the outside of the turn, causing the motorcycle to tip over to the side that the rider was already leaning. As the rider is falling a relatively short distance to the ground, this is considered the lesser of two evils. A high-side crash occurs in a corner when the rear tire loses traction and slides towards the outside of the turn as the front tire continues to track as expected. Should the rear tire regain traction while out of alignment with the front tire, it will snap violently back in line with the front tire. This force effectively launches the rider from the motorcycle as the motorcycle follows the rider's trajectory. A rider must understand and manage all of the elements that affect traction and avoid demands that consume all of the tire's traction.

Wrap-Up:

Suggested Wrap up discussion:

- Ask for, and discuss various aspects of the dynamics of traction and traction management.
- Have a participant explain how one might manage traction; reduce forces that consume traction, and why one avoids consuming all traction while performing cornering maneuvers.
- Ask participants to identify and describe different conditions, elements, and materials that improve or reduce tire traction.
- Ask the participants how they would apply the knowledge they gained from today's discussion to their lives.

Distribute copies of the DSOC Motorcycle Mentorship Module Evaluation form to all participants and request that they deliver or mail the completed form to the Command or Command Safety Office for processing.

Remind everyone to ride safe, and see you at the next Mentorship Meeting.

DSOC Motorcycle Mentorship Feedback Form

Presenter Name:

Date:

Topic/Title:

Unit Number:

Please review each statement below and check the response that closely matches your experience in the Mentorship Module today:

1. Please rate the presenter's performance:

☐ Prepared ☐ Not Prepared ☐ Engaging ☐ Not Engaging ☐ Led Discussion ☐ Lectured

Comments:

2. I was given opportunities to participate in the module's discussion

☐ Never ☐ Only Once ☐ 2-4 Times ☐ Many Times Throughout Discussion

Comments:

3. With regard to my personal riding experiences, this discussion was:

☐ Relevant ☐ Not Relevant ☐ Interesting ☐ Not Interesting

Comments:

4. This discussion topic has provided me with specific learning points that I can use to be a safer, better informed rider

☐ None ☐ One Idea or Fact ☐ 2-4 Learning Points ☐ 5 or More

Comments:

5. I would be interested in participating in other Motorcycle Mentorship Module discussion topics

☐ Never Again ☐ Willing to Try Another Module ☐ Would Like to Do Modules Regularly

Comments:

Thank you for your participation. Please make note of any other suggestions or comments below (continue on the back if needed):

Deliver or mail this completed form to the Command or Command Safety Office for processing. Please do not return this form directly to the Module Presenter.

Resources

Continued Reading:

Code, Keith (1983) *A Twist of the Wrist* (Vol. I and Vol. II). Glendale, CA: California Superbike School, Inc.

Ienatsch, Nick (2003). *Sport Riding Techniques: How To Develop Real World Skills for Speed, Safety, and Confidence on the Street and Track*. Phoenix, AZ: David Bull Publishing

Ibbott, Andy (2006). *Performance Riding Techniques – The MotoGP Manual of Track Riding Skills*. Newbury Park, CA: Haynes North America, Inc.

Parks, Lee (2003) *Total Control – High Performance Street Riding Techniques*. St. Paul, MN: Motorbooks International

Pridmore, Reg (2003) *Smooth Riding the Pridmore Way*. Santa Barbara, CA: Whitehorse Press.

Spiegel, B. (2010) *The Upper Half of the Motorcycle*. Stuttgart, Germany: Whitehorse Press

Internet:

The Sad Truth About Motorcycle Crashes:
www.webs4racers.com/crash

Definitions: (As defined for purposes of this module.)

Dynamics: Dynamics is the science of the motion of the motorcycle, its components, and the forces acting on it.

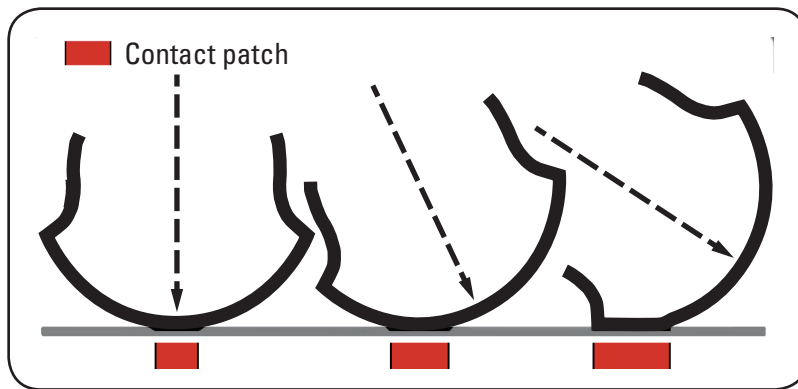
Cornering: Cornering on a motorcycle is loosely defined as the ability to successfully negotiate a turn with many variables, such as: positive camber, off camber, and no camber. Also, included is turn radius, such as constant radius, increasing radius, and decreasing radius turns.

Traction: For motorcycles, traction, or friction is the rubbing of two items together i.e. motorcycle tires and the road which creates adhesion between the tire and road surface.

Traction management: Understanding and using the forces that act on the tire that affect traction such as driving force, side force, and braking force; additionally we consider, accelerating, deceleration, tire wear, proper air pressure, and road conditions as part of the total equation.



Handout 1: The Contact Patch



The contact patch, for our purpose of discussion, is the portion of a tire in direct contact with the roadway surface. The contact patch is dynamic and can change in size and shape as the motorcycle is ridden, weight and weight shift, tire pressure, tire composition, and motorcycle lean will vary the size and shape of the contact patch.



Tire pressure can adversely change the geometry of the tire and reduce the contact patch surface area—under or over pressurized tires reduce the tires overall traction availability and the remaining traction is easily consumed during normal riding.

Appendix 1: Do You Know Your Motorcycle's Traction Limits?

By Arthur Albert

On a clear and sunny morning ride to work, I witnessed a motorcycle accident that made me re-think my riding skills and the limited traction patch keeping me up-right on my motorcycle.

As I left my neighborhood, my neighbor, on his motorcycle, was directly in front of me. We were both traveling between 7 and 10 mph. He started a right-hand turn out of our housing area and applied throttle to take him through the corner. There was a small amount of sand on the road, this combined with the throttle, was enough to cause the rear tire to lose traction and wash-out forcing the rider to straighten the motorcycle and launch head-on into a six-inch curb. The rear tire lifted off the ground, rotated to the left, high-sided, and came to rest on the cycle's left side. The rider was ejected and thrown forward toward a concrete retaining wall. Luckily, he came to rest short of the wall, otherwise he would have struck his head and he wasn't wearing a helmet. The rider had no serious injuries. Another foot and he might have suffered a permanent brain injury or become another statistic leaving his family and friends grieving over his loss. His bike didn't fare so well. The customized cruiser received significant damage to the forks and left side.

By assuming the road was dry and clean I have had my motorcycle wash-out on a curve. I failed to recognize the potential hazard and how a small amount of dirt, dust, sand or gravel would limit my motorcycle's traction patch. The size of the traction patch will vary depending on the size of the tires, weight of the motorcycle and specific lean angles. When an additional traction-limiting source – such as over-powering in a lean – is added, the risk of a mishap increases. So the question is: How do we properly manage and offset this potential hazard? Riders have enough hazards already that can take us out.

First, as riders we need to be aware of our motorcycle's traction limitations. There are two main factors that will determine whether you'll carve that corner like a laser beam or slide out and hurt yourself: the coefficient of friction and the tire's side force. All these forces are applied to that little traction patch. How little? Sit on your motorcycle, holding it up straight and have someone assist you by making an outline of the tire patch that makes contact with the road with a pencil or some chalk. Note the small size of this area. Next, lean the cycle slightly to the left or right and again have your assistant outline the patch touching the ground. By now you will start to see how limited your traction zone is and how small a tire area you are relying on to keep you upright and stable.

Once you understand the bike's limited traction patch, you must also be aware of how vigilant you must be in identifying obstacles or contaminants in the road – obstacles that could further limit this small traction patch's ability to keep the wheel from sliding. Sand, ice, water, gravel, etc. will dramatically decrease the coefficient of friction and make it easier to slide. You either need to increase the turn radius to decrease the side force or, like my neighbor did, add a little throttle. Don't make the assumption that just because the road where you are currently riding is obstacle free, that this will be the case around the corner or on the other side of town.

Powering out of a corner changes the velocity vector and decreases the relative side force, which in turn decreases the amount of traction necessary and may be enough to overcome a slip. On a dry surface, it'll allow a sharper turn with more lean than would be possible without any acceleration. However, if you add too much throttle, the wheel will lose grip and traction will decrease dramatically, so this is a "practice before you try it for real" maneuver. Mastering or applying power will keep you at the top of your game and put you well on your way to preventing a mishap like the one my neighbor experienced.

Finally, if all your preparation and understanding of your motorcycle's traction patch fail and you do lose traction and wash-out, wearing all the proper personal protective equipment – helmet and body armor –

will improve your chances of walking away to ride another day. The rider I helped was lucky – lucky he wasn't riding fast enough to be thrown head-first into the concrete wall. Wearing the proper PPE helps reduce your chances of a permanent or partial disability from what could have been just a minor incident. While all riders like to look cool while riding, I want to arrive alive at the end of my ride so I take all the precautions listed. I realize even with all this I am still vulnerable and at risk. Riding a motorcycle is inherently dangerous and as riders we should continually look for ways to minimize our chances of being involved in a mishap.

Ride cool, ride smart and arrive alive. Be sure to manage your risks; adjust your speed to conditions; wear all your PPE and ensure your helmet is DoT approved. Remember the Right Skills, the Right Training, and the Right Attitude.



ACKNOWLEDGMENTS

This module was developed collaboratively through the Defense Safety Oversight Council's (DSOC) Private Motor Vehicle Accident Reduction Task Force (PMV TF), Service Safety Centers, Line Leaders, Military Riders, National Safety Council, and the Motorcycle Safety Foundation. The DSOC wishes to recognize the organizations and the Service Men and Women who made this Motorcycle Mentoring Module possible.

Some of the principal contributors to this effort include the following:

Mr. Joseph J. Angello, Jr., DSOC Executive Secretary
Major General Margaret Woodward, USAF, PMV TF Chair
Colonel John "Odie" Slocum, USAF, PMV TF Vice-Chair
Major Alejandro Ramos, USAF, PMV TF Executive Secretary
Mr. Jerry Aslinger, DSOC Program Manager

Captain Richard D. Jones, US Naval Safety Center
Mr. Walter Beckman, US Army Ground Driving Task Force
Mr. Peter Hill, HQMC SD, PMV-2 Working Group Chair
Mr. John Waltman, HQMC SD
Mr. Dave Kerrick, US Naval Safety Center
Mr. Don Borkowski, US Naval Safety Center
Mr. Bill Parsons, USAF Safety Center
Mr. Mark Erpelding, USAF Safety Center
Mr. William Walkowiak, USAF Safety Center
Mr. Arthur Albert, USAF Safety Center
Mr. Dale Wisnieski, USCG Traffic and Recreational Safety
Ms. Wendy Medley, US Joint Bases Subject Matter Expert
Ms. Debra Ann Ferris, National Safety Council
Dr. Ray Ochs, Motorcycle Safety Foundation
Ms. Karen F. Nelson, Concurrent Technologies Corp.
Mr. Robert A. Gardiner, Concurrent Technologies Corp.
Mr. Steve Kurtiak, Global Support Services
Mr. Zack Sionakides, Cape Fox Professional Services

