Brake Assist

You're driving through the downtown core of a big city on a bright, sunny day. The sidewalks are lined with people, buses are making their way through traffic, pedestrians are eagerly awaiting a chance to dash across the road, and cyclists are zipping past you. As you come to a stop behind a line of cars at a red light, a cyclist overtakes you and stops at the front of the line. The light turns green and traffic accelerates, but just as you approach the cyclist she hits a small patch of gravel left behind from previous road work. You see the front tire of the bicycle turn sharply towards the front of your car as the cyclist loses her balance. In a panic, you move your foot to the brake and push down, but you don't push hard enough. Finally, you push the brake pedal to the floor and come to a stop, but the outcome is not good: the extra second it took you to apply enough pressure to the brake made it impossible for you to avoid colliding with the cyclist. Brake assist can help prevent the consequences of this situation and many others like it.

What is brake assist?

Brake assist is a vehicle safety feature designed to help you come to a stop more quickly during an episode of emergency braking. Studies show that when making emergency stops, about half of all drivers do not press the brake fast enough or hard enough to make full use of their vehicle's braking power (NHTSA, 2010; Page et al., 2005).

There are several reasons why drivers tend not to apply enough brake force to stop in emergencies. Lighter or shorter people may have trouble pushing down on the brake pedal with enough speed and force. Studies also show that drivers take time to assess the danger level of unanticipated obstacles and hesitate to apply the brakes as firmly and quickly as needed (NHTSA, 2010). The few seconds it takes to gauge whether a hazard warrants emergency braking can make the difference between stopping in time and being involved in a collision. Brake assist systems are designed to recognize the signs of panic braking and increase the stopping power of your brakes.

There are two key indicators of panic braking that, when combined, trigger brake assist systems: how fast your foot moves from the gas to the brake, and how far down you push the brake pedal. Hitting the brake pedal fast enough and pushing it down far enough prompts your brake assist to engage by increasing your brake force to help you reduce your speed and stop safely.

Brake assist is called by a few different names, including Emergency Brake Assist (EBA) and Predictive Brake Assist (PBA). These different names are significant, because even though all brake assist systems share the same goal – to help you achieve the most braking power possible when panic braking – some are designed differently. To find out more about what kind of brake assist system you have, consult your vehicle owner's manual.

When would brake assist be helpful?

Brake assist would be helpful whenever you hit your brakes in an emergency. It usually works in combination with ABS to make your brakes work as efficiently as possible. There are plenty of relatively common situations you may face as a driver that would prompt you to brake hard:

- A bicyclist loses her balance, veers in front of your vehicle and you need to stop fast.
- A motorist opens his car door into traffic and you have to hit the brakes to avoid striking it.
- A large animal runs out in front of you and you must make an emergency stop.
- Cresting a hill, you notice a line-up of stopped cars in the road ahead and you have to hit the brakes hard to avoid rear-ending another driver.

Your brain is your vehicle's most important safety feature.

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Hard braking is required any time you are in danger of colliding with someone or something in front of you. In these cases, brake assist can help make your emergency braking as efficient and effective as possible.

How does brake assist work?

According to the National Highway Traffic Safety Administration (NHTSA), brake assist systems fall into two categories: electronic and mechanical. The main difference between the two types of systems is in the way each one recognizes an episode of panic braking. Mechanical brake assist systems have pre-set thresholds that indicate panic braking. Electronic systems, on the other hand, use thresholds that can adapt to your particular braking style.

Electronic brake assist systems include an electronic control unit that senses when panic braking occurs by comparing how fast and far down you push the brake pedal with typical signs of panic braking. If your actions meet or exceed that threshold, then brake assist kicks in to give you extra braking support. Many of these systems are adaptable. This means that over time they can compile information about your braking habits in emergency and non-emergency situations, and develop a panic-braking threshold that works best for you. The adaptability of electronic systems is a significant advantage; however, electronic systems have some disadvantages compared to their mechanical counterparts. Electronic systems tend to be more expensive and take up more space in your vehicle (except in vehicles already equipped with ABS, where adding brake assist results in a very marginal increase in space occupation). Additionally, not all vehicles are designed to support the advanced electronics that make up these brake assist systems.

Mechanical brake assist systems are cheaper than electronic systems, take up less space in your car, and are more easily accommodated in lower-priced vehicles. Unlike electronic systems, mechanical brake assist systems do not have an electronic control unit. Instead, mechanical systems include a locking mechanism that activates when the valve stroke –which is directly related to how far the brake pedal is depressed - passes a critical point. Once a critical threshold is passed, the locking mechanism switches the source of braking power from the brake piston valve (which is exposed to the depression of the brake pedal) to the brake assist booster: a vacuum that increases brake force by allowing atmospheric pressure to enter the booster. Mechanical systems run on the assumption that depressing the brake pedal down far enough is a reliable sign of panic braking. Where the locking threshold lies in a mechanical system is determined in advance according to studies on driver emergency braking behaviour. The potential downside of mechanical systems is that the threshold that indicates emergency braking does not change, and so it cannot adapt to your braking style.

Is brake assist effective?

The expected benefits of brake assist are substantial, particularly given the kinds of situations these systems are designed to minimize. The Insurance Institute for Highway Safety (IIHS) has determined that the kinds of collisions relevant to brake assist technology are those where the driver saw a hazard, braked, but did not stop in time. Given this, IIHS estimates brake assist is relevant to 417,000 crashes per year in the United States, 61,000 which resulted in injury and 3,080 which were fatal.

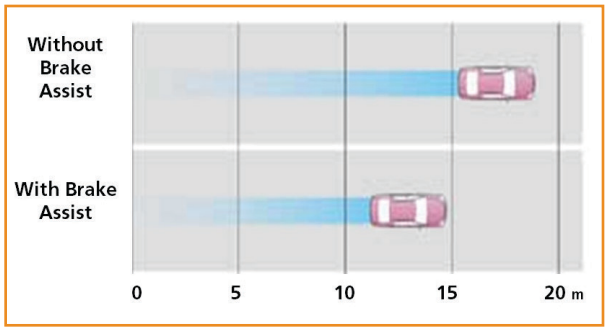
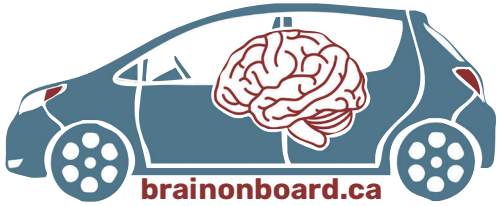


Image courtesy of Toyota Canada

Brake assist is designed to help reduce the distance required to come to a complete stop. In cases where a collision is unavoidable, brake assist helps reduce your speed at impact. This reduction in speed is extremely helpful in worst-case scenarios because minimizing vehicle speed at impact reduces overall damage resulting from a crash. Vehicle speed also has a significant influence on the scale of any injuries sustained. Even if the vehicle does not sustain much damage, the effects of being thrown forward inside a vehicle at a higher rate of speed can be damaging to the human body.



Tests conducted by the NHTSA showed drivers who were able to activate brake assist during an emergency stop saw a reduced stopping distance of up to ten feet (NHTSA, 2010). One French study showed brake assist would reduce overall injuries by 19% for crashes where braking was a major contributor, and reduce overall injuries in 11% of all crashes (Page et al., 2005). In terms of fatalities, it was shown brake assist would reduce the total number of crash fatalities by between 6.5% and 9%. The same study also estimated that brake assist could potentially reduce pedestrian fatalities by between 10% and 12% (Page et al., 2005).

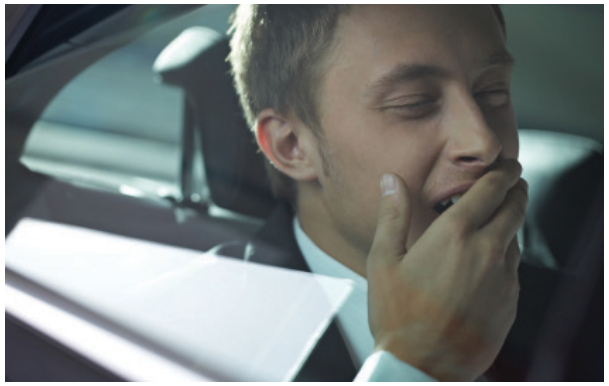
Brake assist is expected to be particularly helpful when packaged with other safety features, including anti-lock brakes, electronic stability control, and forward collision warning systems. Currently, brake assist systems are most commonly combined with anti-lock brake systems (ABS).

Does brake assist have any limitations?

Yes. As with other vehicle safety technologies, enjoying the benefits of brake assist systems requires that you understand the design limits of the technology, its intended function, and the proper way to use the feature in order to achieve the best results. Brake assist in particular works off your braking commands.

If there are signs of panic braking then brake assist provides you with extra braking support. However, if your braking actions are inappropriate, unclear, or delayed, then your brake assist system either will not activate at all, or fail to work as well as it could.

The first thing to remember is that brake assist has no way of seeing obstacles ahead: it cannot scan for potential hazards, and does not warn you in any way of potentially dangerous situations. It is always up to you to notice hazards in the road and assess the type of avoidance action required. As such, anything you do before or during your drive that affects your reaction time or ability to notice hazards can seriously undermine the benefits of brake assist. Excessive speed, intoxication, distraction, and fatigue can all negatively influence your reaction time, affect your ability to be aware of potential hazards, and reduce your chances of being able to avoid obstacles safely.



In addition, brake assist has design limitations which affect its use by the driver. Every brake assist system – both mechanical and electronic – is triggered only after certain thresholds are met or exceeded. In other words, your brake assist system only provides you with extra stopping power if it thinks you are in an emergency situation.

NHTSA studied brake assist thresholds of five popular American vehicle models, and found that in order to activate brake assist, drivers had to push down the brake pedal an average distance of 2.25 inches (5.7cm), at an average speed 22.4 inches (56.9cm) per second (NHTSA, 2010). NHTSA also found only 28% of drivers were able to activate brake assist, even after being given a tutorial about how it works (NHTSA, 2010).

The force required to activate brake assist is considerable, and studies suggest not all drivers are used to applying the brakes in this way. Adaptable electronic brake assist systems can help ease the amount of force required to initiate brake assist, but the threshold that signals the need for brake support must remain high in order to ensure

it only engages when it is designed to (i.e., in emergency situations). If you need to bring your brake-assist-equipped vehicle to a stop as soon as possible, you should immediately press the brake pedal down as fast and as hard as you can.

How can I get the most benefit from my brake assist system?

Knowing how and when your brake assist system works gives you the power to get the most benefit possible from it. The process of braking can be broken down into roughly four steps:

- First, you detect an object on or near the road.
- Second, you assess the object to decide what kind of braking is appropriate and initiate a response. Braking responses after object recognition usually involve the application of moderate, modulated pressure to the brake pedal.
- Third, you modify your brake pressure in response to how successful your initial braking was, how fast you are still going, and how close you are to the object in your path.
- Fourth, you come to a complete stop – hopefully before a collision.

The time it takes to decide whether an unexpected road hazard requires an emergency stop can make the difference between stopping safely and crashing. This explains the results of studies showing improved effectiveness of brake assist technology when the driver expects to have to come to a sudden stop. Researchers studying the effectiveness of brake assist noted that when participants were told they would have to hit the brakes and come to a complete stop, they were able to activate their brake assist systems sooner and with improved effectiveness (NHTSA, 2010). This is most likely because warning drivers ahead of time that they will encounter a hazard eliminates the second step of the braking process (i.e., deciding whether avoiding a collision requires immediate heavy braking). The second step introduces two potential problems:

- First, you may apply the brakes lightly at first since you are still unsure of whether you will have to come to a complete and sudden stop. Light, modulated brake force is not a sign of panic braking. Your brake assist system does not consider you to be in an emergency, and therefore will not engage.
- Second, by the time you decide that you need to stop completely, you will have wasted precious seconds coming to this decision. If you have already been applying some brake force, your brake assist system will not engage to help you stop, since the signs of panic braking are not present.

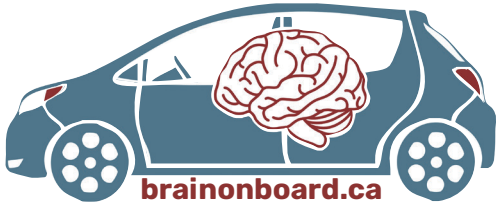
You will not always know whether an obstacle will require you to stop quickly and completely. The best you can do is to pay close attention to the road ahead of you; maintain a good sense of what is going on around your vehicle; avoid engaging in unsafe driving behaviours that undermine your ability to react quickly or appropriately to unanticipated events; and, be ready to make quick, confident driving decisions.

Can I turn brake assist off?

Brake assist engages automatically when you start your car and is designed to work undetected until you show that you need braking support. Like the anti-lock brake systems that brake assist is usually combined with, there are ways to turn brake assist off. However, turning off brake assist is much more complicated than disengaging ABS, and should only be done by a professional mechanic. Attempting to turn your brake assist system off yourself may leave you with less overall braking efficiency, and may hinder your ability to brake when needed.

How prevalent is brake assist in today's vehicles?

Brake assist was first introduced on high-end European vehicles in 1996. Since then, brake assist has become very popular in Europe and Australia, and is available as either standard or optional on the majority of new vehicles. In North America, brake assist was slower to reach the economy vehicle market and was initially only available for luxury makes. However, brake assist has since become more common and can often be found in safety packages offered for economy and sport utility vehicles. In addition, some manufacturers offer brake assist as a standard feature. If you are unsure of whether or not your vehicle has brake



assist, you can consult your owner's manual for the answer.

How much does brake assist cost?

Brake assist is still a relatively new technology, and is most often offered as either a standard or optional feature packaged with other safety features like ABS and electronic stability control (ESC). Brake assist costs approximately $1,000 when included in a package deal combining several complementary vehicle safety features.

References

Visit **brainonboard.ca/program-resources/references** for a full list of references.

Want to learn more?

Visit **brainonboard.ca** to learn more about vehicle safety features:

- Active Safety Features
- Passive Safety Features
- Driver Assistance Technologies
- Safety Technologies in Development

Driving instructors, road safety educators, car dealers and service providers can download and order program resources and materials through the Brain on Board website: **brainonboard.ca/program-resources**.

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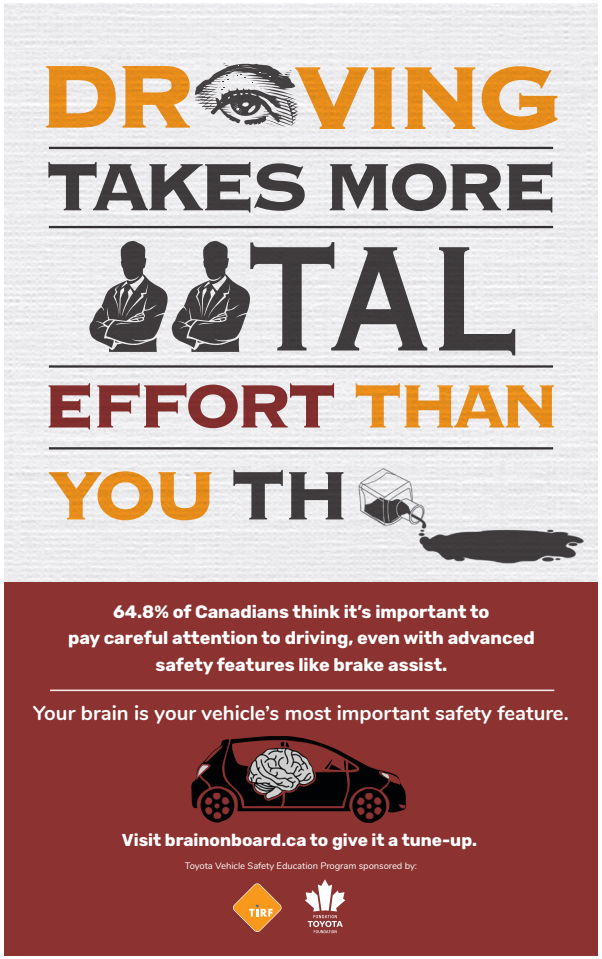

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