

Article

# Teenage Drivers' Views of a Classroom and Closed-Road Post-License Advanced Driving Program, Guard Your Life

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**Abstract:** In the US, teenage drivers have an increased risk of being involved in crashes. To address this, post-license advanced driving programs have emerged. This study gains teenagers' perspective of a post-license defensive driving program focused on a hands-on introduction to emergency braking, skid recovery and the dangers of distracted driving. The teenagers completed a survey immediately following the program and a phone interview three months later. The open-ended survey and phone interview items reflect the program's key concepts. During the follow-up phone interview, the majority of teenagers reported using the skills experienced and half of the participants who participated in the phone interview reported using skills that they learned to avoid a crash. Almost all teenagers reported anticipating or changing their driving behaviors, specifically by reducing distractions, having a heightened awareness and changing their driving position. The survey and follow-up phone interview results suggest that the teenagers benefited from the skills introduced and, from the teenagers' perspective, has helped them avoid crashes.

**Keywords:** teenage drivers; defensive driving; emergency braking; skid recovery; distractions

## 1. Introduction

In the US, teenage drivers are at a greater risk of being involved in a crash than any other age group. There are multiple industries working to improve teenage drivers' safety, especially through education and vehicle technologies. Post-license advanced driver training programs have emerged with the goal of teaching the skills needed to prevent and mitigate an emergency situation. The Guard Your Life Challenge program is a post-license advanced driving program focused on educating teenagers about proper use of the anti-lock braking system (ABS), the correction needed to recover from a skid, and the dangers of distraction.

### 1.1. Teenage Crash Statistics

Teenage drivers only account for approximately 5% of licensed drivers in the US [1] but make up a disproportionate number of fatal crashes. In the US, the leading cause of death for teenagers is motor vehicle crashes [2]. Driver error is the most common cause for teenagers to be involved in crashes. The most common types of errors by teenagers include recognition errors (visual scanning errors, distraction), decision errors (following distance, vehicle speed relative to conditions), and performance errors (losing control) [3]. Teenage distractions are commonly related to cognitive distractions (e.g., inattentive, lost in thought, and looked but did not see) and in-vehicle technology-related

distractions (e.g., cellphone use, audio and climate controls) in comparison to other age groups [4]. In addition, it is also documented that roadway-related factors (e.g., lane width, medians, and road curvature) as well as weather factors (e.g., visibility and road surface conditions) affect a driver's driving behaviors [5]. For teenagers, the most common single-vehicle crashes involve vehicles running off the road, both on straight roads and negotiating curves. The most common multiple vehicle crashes for teenagers include rear-end collisions and turning into the path of an oncoming vehicle in intersections [6].

Due to the number of crashes associated with teenage drivers, multiple industries have been working to address this problem. The government, at both the national and state levels, has updated laws and implemented a licensure process to promote the importance of teenage driver safety. Automotive companies and researchers have focused their efforts to make vehicles safer through engineering systems that help the driver avoid and mitigate dangerous situations.

### *1.2. License Requirements*

In the US, a graduated driver's license is typically required for a young individual to drive independently. With a graduated driver's license, there are various phases to help the driver gain experience before transitioning to an unrestricted license. The first phase is obtaining a learner's permit, allowing an individual to practice driving with a licensed adult. Typically, the permit can be obtained at age 15 and older, after passing a written knowledge test of the laws and policies, as well as a vision screening [7]. Most states require the individual to hold a permit for at least a six-month period but can be up to 12 months depending on the state, before taking the on-road driving test to earn a license [8].

In order to gain a license and drive independently, a driver must pass their state's on-road driving test. If the driver is under the age of 18, the individual may have to complete a driver's education course before taking the on-road driving test [7], or in states that do not require driver's education, the driver takes the on-road driving test when they feel that they are ready [8]. In some states, the driver is required to show documented supervised practice driving time outside of driver's education, which can vary, but on average consists of 50 h; some states also include 10 h of nighttime driving [8]. The on-road driving test varies by state but generally consists of being able to drive with regular street traffic, while maintaining appropriate speed and lane position. The test also includes basic vehicle maneuvers such as left and right turns, backing up and parking (e.g., [9–12]).

Once the on-road test is passed, if the driver is older than the age of 16, but younger than 18, a restricted license is granted. Restrictions vary by state but commonly restrict the number of passengers and/or a curfew [8]. Once the driver turns 18, the restrictions are removed. If the driver is over the age of 18 when the license exam is passed, there may be no restrictions, and they will have all the privileges of a full license.

### *1.3. Driver's Education*

Today's typical driver's education requirements include 30 h of classroom education, six hours of on-road instruction and six hours of in-vehicle observation [7]. On-road instruction refers to the teenager driving the vehicle, and observation refers to watching other teenage drivers receiving feedback from the instructor during their on-road instruction [7]. While driver's education courses aim to teach teenagers how to become safe on the road, the course mainly takes place in the classroom, and therefore the students' driving skills may not develop further than the basics [8].

Many studies have been conducted to evaluate the effectiveness of driver's education in the US. Williams and Ferguson [13] found that there were no differences in the crash records of drivers who had taken a driver's education course and those who learned to drive without taking the course. A review of the literature conducted by Peck [14] found that there was no conclusive evidence showing that driver's education reduces teenagers' crash rates. These studies suggest that driver's education in the US is tailored towards equipping young drivers with the necessary skills to operate a vehicle under normal driving conditions but may not teach skills needed to avoid or mitigate crashes.

Though there is speculation surrounding the effectiveness of driver's education, many still feel it is important in preparing young drivers. A survey conducted in the US showed that 86% of people considered driver's education courses to be "very important" in the training of new drivers [13] and many believe that they are instrumental in producing safe drivers [8]. Interestingly, another survey study found that approximately half of teenagers and parents did not feel that driver's education completely prepared teenagers for driving [15].

#### 1.4. Vehicle Technology

In order to help reduce the number of vehicle crashes, the automotive industry has developed multiple vehicle technologies to address some of the most common critical crash scenarios. In 2015, the National Highway Traffic Safety Administration (NHTSA) reported that for all drivers, 70% of all crashes were with another vehicle and 33% of all crashes were rear-end collisions with other vehicles [16].

Anti-lock braking systems (ABS) were developed to address single-vehicle crashes caused by skidding or loss of control during panic braking. The system operates by optimizing the brake pressure to prevent skidding caused by wheel lockup, which allows the driver to control and steer the vehicle [17]. The system quickly holds and releases the brake pressure, resulting in vibration feedback in the brake pedal when engaged. Though ABS has been incorporated into vehicles since the 1980s, ABS was not required until years later due to an increase in crashes involving vehicles running off the road [17]. In 1998, the NHTSA evaluated ABS to find that drivers did not understand the feedback from the pedal when ABS was engaged, which could have caused dangerous driver reactions such as releasing the brake pedal [18]. In 2012, ABS became required equipment for all new vehicles [19] as part of the Electronic Stability Control (ESC) system. In the US, drivers are not mandated to activate ABS during the graduated driver's licensure test (e.g., [9–12]). Drivers in some states may be asked to stop quickly, but there is no activation of ABS requirement (e.g., [9,12]).

Electronic Stability Control (ESC) systems were developed to reduce yawing or rotation caused by steering input that results in loss of traction that ABS cannot eliminate. ESC makes braking adjustments at the individual wheels and/or reduces the engine output by comparing information from the vehicle's movement (individual wheel speed, yaw rate and lateral acceleration) with the inputs from the driver (steering wheel angle) [20]. ESC has shown to be effective in reducing the number of crashes for drivers of all ages, especially single-vehicle crashes [21]. ESC relies on the available traction and cannot create more. If the road surface is slippery (low coefficient of friction), the ESC system may not be able to overcome the lack of tire grip to prevent loss of traction [22]. Situations such as emergency maneuvers to avoid another vehicle, sudden changes in environmental conditions, and road departures, especially on curves, can result in large losses of traction that can cause the car to skid unintentionally [23]. Knowing the appropriate actions to take to restore traction for both understeer (front wheel skid) and oversteer (rear wheel skid) are not skills required to pass the driving test (e.g., [9–12]).

#### 1.5. Post-License Driving Programs

Acknowledging that the licensing process, driver's education, and new vehicle technologies may not provide young drivers all of the skills or assistance needed to mitigate emergency situations, multiple post-license driving programs have emerged in the US. Different organizations ranging from non-profits [24,25], foundations [26], private driving companies [27,28], police/sheriff's departments [29], automotive manufacturers [30], etc., are offering driving programs. Skills taught at each of these programs vary based on location/facilities, instructors, and cost, but the goals commonly focus on how to use the vehicle's safety systems and the importance of understanding the impact of driver distraction. These programs emphasize behind-the-wheel experience, allowing the driver to make errors, receive feedback, and make the appropriate corrections, which is an essential learning process for retaining information in long-term memory [31].

Though many programs are believed to be effective in reducing the number of teenagers involved in crashes, there is limited data showing what teenagers believe they gain through a post-license driving program.

### 1.6. Guard Your Life Challenge Program

The Humphries family lost their teenage daughter, Victoria, in a single-vehicle crash in July 2012 after she lost control of her vehicle at night and ran off the road. The crash environment was all too similar to many single-vehicle teenager fatalities. This tragedy led the family to create a non-profit, post-license driving program, the Guard Your Life (GYL) Challenge program (<http://www.guardyourlifechallenge.com>). The half-day program is offered four times a year, with a maximum of 30 teenagers per session. Two sessions are offered each day, with a morning and afternoon session.

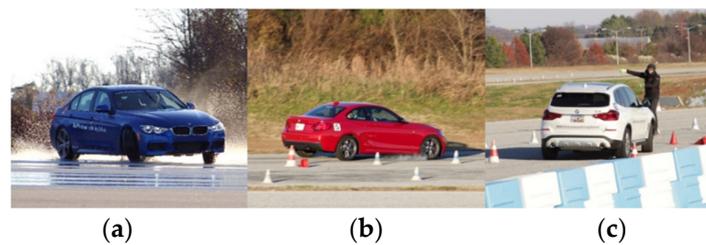
The program starts in a classroom setting prior to driving through the exercises on the closed-road track. Parents are encouraged to stay for the classroom portion and the majority of parents stay to watch the driving component. Each program starts with a video that includes the TV news clip that aired immediately after Victoria's crash along with interviews filmed a couple of years later with law enforcement officers and Victoria's family members (see <https://www.youtube.com/watch?v=WeGbD9-hchU>). Then, a spokesman from the state's Highway Patrol speaks about teenager crash and fatality statistics on a local and national level. The officer explains the physics of what happens to one's brain and body during a crash using Newton's laws of inertia and force in easily understood terms. Finally, the officer discusses distracted driving [32], explaining the visual, physical, and cognitive components using examples that are applicable to both the teenagers and their parents.

Next, the performance center's driving instructors provide short introductions, including a description of how many years of experience and what professional racing licenses each instructor has. Then, the lead instructor provides classroom instruction on diverse concepts including the importance of knowing where to look, proper hand and seating position for driving, and mirror adjustment for minimizing blind spots. The instructors also give an introduction to ABS, oversteer, understeer, and how to anticipate and make corrections in a loss of traction situation. Then, the instructor provides an overview of the track (see Figure 1) and the three practice exercises: emergency braking, skid recovery and the distraction exercise (see Figure 2).

The teenage drivers are divided into three groups of ten for the track exercises and have a short break when rotating between each of the three exercises. The teenagers use new (2016 model year and newer), identical vehicles on each track exercise during the GYL program.



**Figure 1.** Aerial view of the track with the locations of the (1) skid recovery, (2) ABS braking, and (3) distraction exercises indicated.



**Figure 2.** (a) A driver learning how to recover from a skid, (b) a driver activating the ABS brakes, and (c) a driver completing the distraction exercise with an instructor on the track providing feedback.

The teenage drivers practice understeer and oversteer skid recovery on a wet track. Understeer is where a driver has lost grip with the front tires and the vehicle will not respond to steering inputs (often happens when a driver is going too fast into a corner). In understeer situations, drivers are instructed to be patient, lift their foot from the accelerator, not add more steering and keep one's eyes on the intended path while waiting for the front tires to regain traction. In an oversteer situation, the driver has lost grip with the rear tires and the back of the car wants to essentially pass the front. To correct an oversteer situation, the "CPR" method is taught: correct, pause (wait to regain traction or grip), then steer to recover (see Figure 2a). At the beginning of this exercise, ESC is left on for a few laps for the teenage drivers to feel the system working to keep traction. Then, ESC is turned off to allow the teenage drivers to experience a skid while training the corrective actions. The instructors let the teenagers make errors, then give feedback to help them understand the difference in feeling and corrective action needed to be executed.

The emergency braking exercise allows teenagers to experience ABS in a controlled environment (see Figure 2b). The teenage drivers are instructed to stay relaxed, keep one's eyes up, looking where they want to go (rather than looking down inside the vehicle), stomp on the brake pedal, keep the brakes fully depressed until the vehicle comes to a complete stop and steer when necessary. This exercise begins with the vehicles going 30–35 miles per hour and continuously increases up to 55 miles per hour during each trial, so the teenagers gain an understanding of how braking distance changes with speed. The teenagers receive feedback on their performance after each trial.

The distraction exercise provides first-hand examples of visual, manual and cognitive distractions by requiring the teenagers to drive through a cone course while using their phone to text. During the distraction exercise, one instructor is in the vehicle with the teenage driver while additional instructors cause distractions outside of the vehicle (see Figure 2c).

All teenagers and parents return to the classroom after the driving portion. The instructors give a summary of the primary concepts introduced and emphasize that if one is in an imminent crash situation, it is best to stomp on the brake to slow down the vehicle as much as possible.

While the GYL program and performance driving center have received anecdotal feedback on the effectiveness of the program, no formal evaluation was previously completed. The purpose of this study was to gain the teenagers' views of the Guard Your Life Challenge program by surveying participants immediately after the program and then conducting a phone interview three months later.

## 2. Methods

### 2.1. Participants

To be part of the Guard Your Life (GYL) Challenge program, teenagers must be between 15 and 19 years old and have a restricted or regular driver's license. During the one-year study timeframe, eight half-day GYL sessions were offered and a total of 200 teenagers completed the program; see Figure 3. From this group, 134 teenagers completed the survey immediately after the program; participants included 72 males and 62 females, with an average age of 16.42 years ( $SD = 1.01$ ). Of the 134 participants, 103 volunteered to be contacted for the follow-up phone interview. Fifty participants

completed the follow-up phone interview, including 25 males and 25 females who ranged from 15 to 20 years, with an average age of 16.72 years (SD = 1.01).

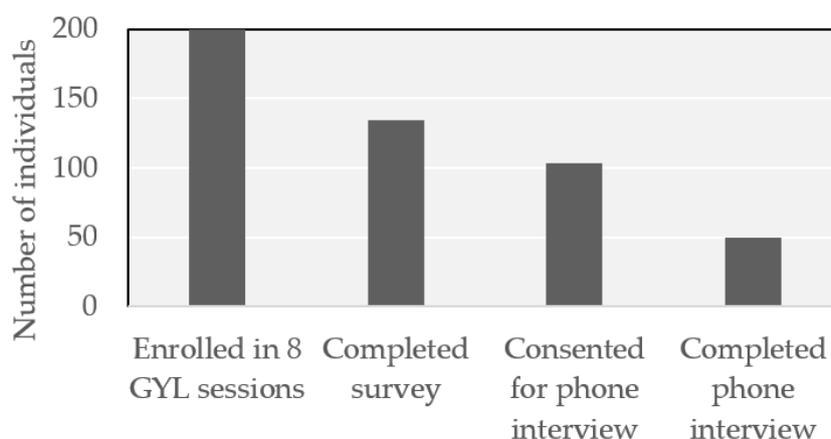


Figure 3. Survey and phone interview participants.

## 2.2. Procedure

All subjects read the consent form and provided their written approval prior to participating in this study. Since many of the participants were teenagers, all participants under the age of 18 years had written permission from a parent. This study was conducted in accordance with the Declaration of Helsinki and the protocol was approved by the Ethics Committee at Clemson University (IRB2015-258).

### 2.2.1. Survey

Immediately after the driving portion of the program, the group returned to the classroom for closing remarks and to complete the survey. It took approximately 10 to 15 min to complete the survey. See Table 1 for an overview of the survey items. With the exception of yes/no questions, all questions were open ended.

Table 1. Survey and follow-up phone interview questions. The words in italics were used for the follow-up phone interview.

Survey	Interview	Questions
X	X	What is your age?
X	X	What is your gender?
X	X	What are the top five things you got out of ( <i>remembered from</i> ) the program?
X	X	Describe the program in 3 words.
X	X	What is the most important or interesting thing you learned?
X	X	Do you think you will use ( <i>have you used</i> ) any of the skills you learned?
	X	<i>Did using these skills help you to avoid a crash?</i>
X	X	Do you think you will change ( <i>have you changed</i> ) any of your driving behaviors?
	X	<i>Rate on a 1–5 scale where 1 is not at all and 5 is extremely, how helpful and informative the program was.</i>

### 2.2.2. Follow-Up Phone Interview

Each participant was called up to three times, approximately three months after the program. The phone interview consisted of similar questions to the survey and took between 10 and 15 min to complete; see Table 1. With the exception of yes/no questions, all questions were open ended.

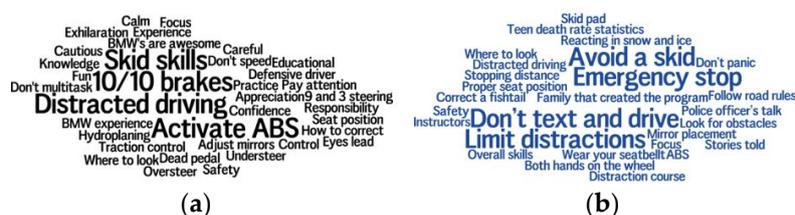
### 2.2.3. Data Organization

For each open-ended question, all of the participants' responses were combined and sorted by grouping similar responses together, forming categories. These categories turned into topical areas—for example, the topical area of ABS braking contained responses such as brake hard, stomp on the brake and emergency braking. The number of responses for each topical area were tallied to determine the most common responses. There were often more topical areas from each question than what is represented in the most common response figures. To represent all topical areas and actual response language from the participants, word clouds were used. Word clouds are visual representations of large text-based data sets, where importance is represented by size [33]. All relevant words or phrases that participants responded with were entered into word clouds to present a visual representation of all topical areas, with the more frequent responses being larger.

## 3. Results

### 3.1. Top Five Things from the Program

On the survey, the participants listed the top five things they got out of the program. All 134 participants responded to this question, resulting in 639 responses. The average number of responses provided was 4.8, ranging from 1 to 5 responses ( $SD = 0.7$ ). Figure 4a shows the most common responses in a word cloud, with the more frequent responses being larger. During the phone interview, participants named the top five things they remembered from the program. All 50 participants responded to this question, resulting in 219 responses. The average number of responses was 4.38, ranging from 2 to 5 responses ( $SD = 0.97$ ); see Figure 4b.



**Figure 4.** Word cloud of the top five things from the program: survey (a) and interview (b).

The data categorization revealed that responses fell within six topical areas. The topical areas in order of frequency were braking, distractions, skid/drift, sight and safety. For the braking topic, participants provided answers such as “the ABS system and how it works” as well as “stopping distance”. For the distractions topic, typical answers included “distracted driving is unsafe driving” and “understanding that what you think isn’t a distraction, is”. For the skid/drift topic, responses included “correct, pause, recover” and “how to correct over/under steer”. For the sight topic, responses were “look where you want to go” and “every second of eyes off the road is like a football field”. For the safety topic, responses were “safe habits” and “think before you do”.

The graph comparing the survey and phone interview topical areas shows that three months later, distractions were the most commonly reported topical area followed by braking and skid/drift, followed by sight, safety and facts/stories; see Figure 5. When comparing the similarities of the types of responses between the survey and the phone interview, the participants provided similar examples for both time periods, with the exception of the facts/stories topical area, which were more frequently reported during the phone interview. Examples of facts/stories responses included how frequently teenage driving deaths occur and the story about the fatality that inspired the class.

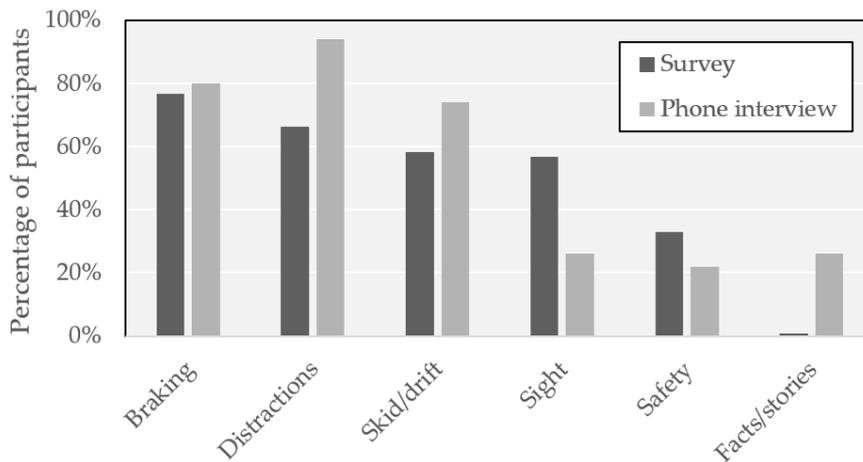


Figure 5. Topical areas for the top five things from the program: survey vs. phone interview.

3.2. Key Words

Next, participants described the program in three words. All 134 participants responded to the question, resulting in 394 total responses. The average number of responses per participant was 2.9, ranging from 1 to 3 (SD = 0.3). Figure 6a shows the most common responses in a word cloud. During the phone interview, participants described the program in three words. All 50 participants responded, giving a total of 144 responses, ranging from 1 to 3 responses per participant with an average of 2.9 responses (SD = 0.4); see Figure 6b.



Figure 6. Word cloud of key words: survey (a) and interview (b).

The top five key words were very similar between the survey and phone interview. Though the answers overlap, the survey responses reflected the raw emotions the teenagers experienced during the program including fun, exciting, and awesome. The interview responses focused more on the underlying meaning of the program such as informative and helpful. The graphical comparison between the survey and phone interview key words is shown in Figure 7.

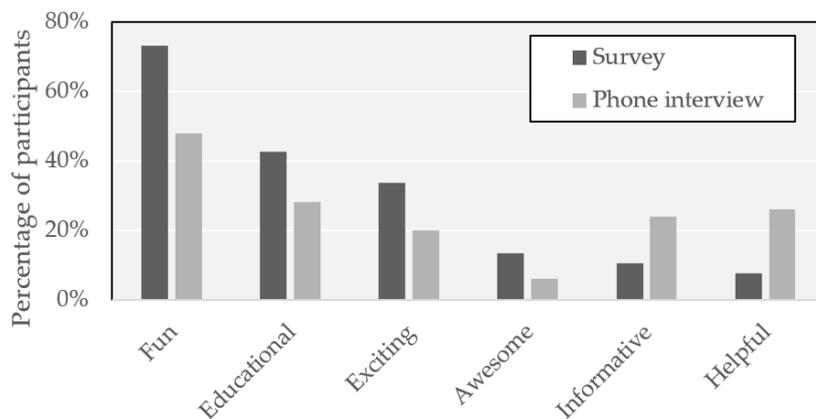


Figure 7. Key words: survey vs. phone interview.

### 3.3. Most Important Thing Learned

On the survey, participants reported the single most important thing they learned during the program. Of the 134 participants, 130 gave a response. Figure 8a shows the most common responses in a word cloud, illustrating that the skid control task was important to the participants. During the phone interview, participants were asked what the single most important thing they learned was and all 50 participants provided responses. The skid recovery skill was the most common response for both the survey and the phone interview (Figure 8b).



Figure 8. Word cloud of the most important thing learned: survey (a) and interview (b).

The data organization revealed that participants’ responses fell within eight topical areas, shown in Figure 9. The most frequent topical areas were skid/drift, sight, and braking. The most frequent topical areas from the phone interview were skid/drift, braking, and distractions. The survey responses were more focused on the technical aspects of driving such as “where to look” and “keeping control of the vehicle.” The phone interview responses focused more on the cognitive aspects of driving such as “knowing the dangers of driving” and “knowing how to deal with yourself in high-risk situations.”

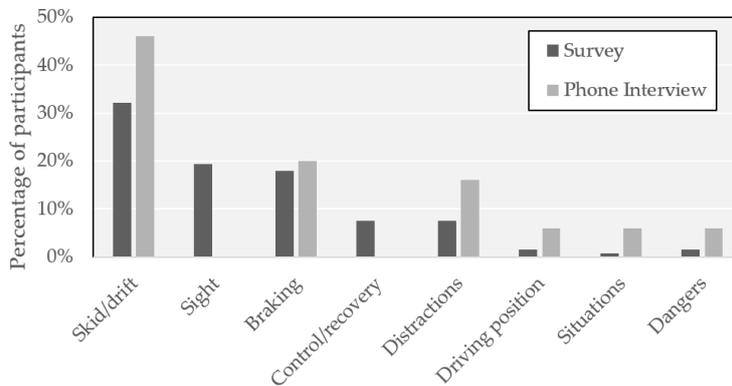


Figure 9. Most important thing learned: survey vs. phone interview.

### 3.4. Use of Skills Learned

The participants were asked on the survey whether they think they will use the skills that they learned in the program. Of the 134 responses, 132 (99%) responded “yes” and 2 (1%) responded “no”. During the phone interview, participants were asked whether they had actually used any of the skills that they learned in the program. All 50 participants responded and 72% had used the skills that they learned in the program on the road in the past three months.

For those who responded with a “yes” on the survey or phone interview, follow-up questions asked for a description regarding what skills that they anticipate they will use (on the survey) or which skills that they actually used (on the phone interview). On the survey, when predicting future skills that they anticipate using, the responses fell into seven topical areas. One topical area was emergency situations, and responses included “being prepared and knowing what to do”. Another topical area was everyday situations, and an example response for this area included “using them anytime on the road.” Skid/drift responses from the survey predicting future use focused on knowing how to drive in the rain and respond appropriately when hydroplaning or sliding. The responses from the

phone interview were about skills that they actually used since the program including recovering from a skid. Similar responses occurred with braking, where the survey indicated responses such as not being afraid to brake hard while the phone interview included specific instances of needing to brake suddenly on the road. Distraction responses from the survey focused on not being distracted in the future, while the phone interview responses provide more detailed examples of changes participants made to be less distracted, including ways of preventing others in the car from distracting them such as turning down the music. The topic of safety increased in frequency from the survey to the phone interview, where participants reported being more careful/cautious, and provided a greater distance to the vehicles in front of them. Sight or “looking where you want to go” was also a consistent response on both the survey and the interview. The topical areas for the responses on the survey and phone interview are displayed in Figure 10.

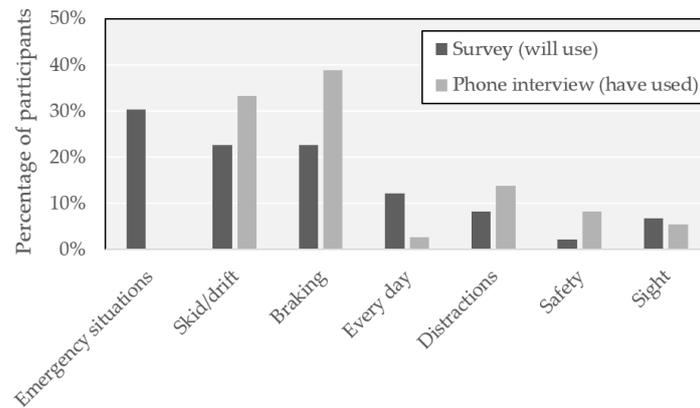


Figure 10. Topical areas for the use of skills learned: survey vs. phone interview.

### 3.5. Did Using the Skills Learned Help You to Avoid a Crash?

During the phone interview, participants were asked whether using any of the skills that they learned in the program helped them to avoid a crash. Of the 36 participants that said they used the skills that they learned in the program, 69% of those participants reported using the skills to avoid a crash.

Those who reported using the skills that they learned to avoid a crash were then asked to describe the skills that they used. Braking was the most frequent topical area, with responses such as “a car stopped right in front of me” and “a deer walked out in front of me.” Skid/drift was the second most common topical area with responses such as “letting off the gas” and “getting control of the car while hydroplaning.” Steering was the third most frequent topical area with responses, such as “someone veered into my lane on the interstate”. Other responses included “increased awareness” and “keeping control of the vehicle”. These topical areas are shown in Figure 11.

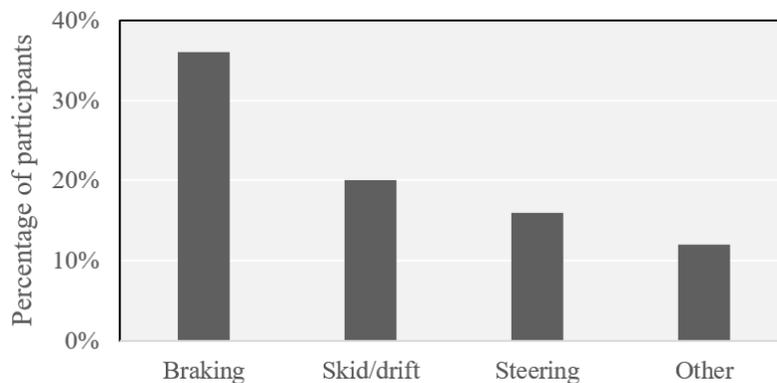


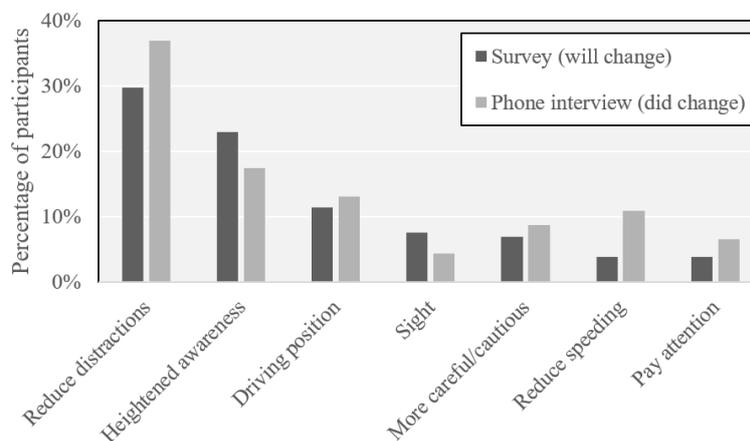
Figure 11. Topical areas for skills used to avoid a crash: phone interview.

### 3.6. Changes in Driving Behavior

During the survey, participants were asked whether they thought they will change their driving behaviors as a result of the program. Ninety-eight percent of the 134 participants felt that they would change their driving behaviors as a result of the program.

During the phone interview, participants were asked whether they changed any of their driving behaviors as a result of the program. Ninety-two percent of the 50 participants reported changing their behaviors as a result of the program.

Those that responded “yes” were asked to describe which behaviors they will change on the survey and which behaviors they did change during the phone interview. Response patterns from both the survey and phone interview were similar; see Figure 12. Reducing distractions was the most common topical area, followed by heightened awareness and driving position for both the survey and phone interview. Driving position included responses about seat adjustment, how to properly hold the steering wheel, and the process of getting prepared to drive a vehicle. Concerning the final four categories, there were differences observed between the survey and phone interview, where the survey responses focused more on the topical areas of both sight and being more careful/cautious, while the phone interview responses were focused on reducing speeding as well as paying attention.



**Figure 12.** Topical areas for the change in driving behaviors: survey vs. phone interview.

### 3.7. Rating the Program

During the phone interview, the participants were asked to rate the program based on how helpful and informative it was using a 1 to 5 rating scale, where 1 is “not at all” and 5 is “extremely”. All 50 participants provided responses ranging from 3 to 5, with an average response of 4.5. Fifty-two percent of the participants responded with a 5, 46% of participants responded with a 4, and 2% responded with a 3.

## 4. Discussion

The goal of conducting this study was to gain the teenagers’ perspectives of the half-day post-license advanced driver training program, Guard Your Life (GYL). This program begins in the classroom with an introduction to the professional driving instructors. The classroom portion includes instruction on the importance of knowing where to look, proper hand and seating position, mirror adjustment to minimize blind spots, oversteer and understeer corrections, the purpose of the anti-lock braking system (ABS), and the dangers of different types of distraction. The teenagers then get behind-the-wheel experience on a closed-road course with ABS braking, skid recovery and distracted driving. The teenagers complete a survey directly after the class and participate in a follow-up phone interview three months later.

The emergence of post-licensure driving courses (in the US), such as GYL, or multiphase driver's education (in Europe and Australia) have shown variation in effectiveness. Many international studies, particularly in Europe, before 1990 have shown adverse outcomes, suggesting that advanced driver training may cause higher crash rates [34–36]. In order to address these findings, many European countries revised their respective programs to focus on insight and awareness training rather than skill mastery training to improve actual skills and shift perceived skills to match the driver's skill level [37]. In some European countries, including Sweden, Finland, Austria, Luxembourg and Norway, post-renewal training is required anywhere from 6 to 24 months after becoming licensed [37]. Post-licensure training focuses on giving drivers an opportunity to learn their limits as well as the vehicles' limits by experiencing loss of control in the vehicle in order to develop necessary anticipation skills after becoming comfortable with driving basics. The benefits of implementing these programs resulted in a 9% reduction in overall crashes among teenagers in Austria over a five-year period, a 7% reduction in at-fault novice drivers in Finland over a six-year period, a 13% reduction in crashes among novice drivers in Luxembourg, and a 7% reduction in crash risk among first-year novice drivers in Denmark [37].

Though there has been some success with post-license advanced training courses, there is still much hesitation due to the claims that these courses increase young drivers' overconfidence. Training programs that only focus on maneuvering skills have been shown to increase driver's confidence further than their abilities. Though these drivers may know how to make the correct maneuvers, they may not know when to use the skills appropriately or what situations will require use of these skills [38]. This can be associated primarily with skid or slippery condition training. Gregersen [39] performed a study comparing confidence between students who received skill-based training and those who received insight training in Sweden. The results showed an overestimation in slippery driving abilities from the skill-trained group not seen in the insight group, though both groups had similar performance on the task.

Though there is little evidence linking adverse effects of post-license advanced training due to overconfidence, it is possible that this contributes to the reason why many of these post-license advanced driving programs have not seen overwhelmingly positive effects. Katila, Keskinen, Hatakka, and Laapotti [40] concluded that after participating in skid training, students showed increased confidence levels in their ability to drive in slippery conditions though there was no connection to changes in crash rates. In 1990, Finland introduced two-phase training, which included a skid-training course in the second phase. This course put more emphasis on anticipatory skills, making the maneuvering skills less important. When comparing the old curriculum (pre-1990) with the new, two-phase training (post-1990), the results indicate that drivers with the two-phase training had higher confidence levels in their slippery driving skills even though there was no difference in slippery crashes between the groups.

There have not been many post-license advanced training course evaluation studies conducted in the US. There are significant differences between licensing in Europe and the US. In Europe, there are several countries that have made the post-renewal training required. One of the biggest differences between the US and Europe is the licensing age. In Europe, the age to obtain a license is 18 years old, where in the US, the age a teenager can obtain a license varies, but is typically 16 years old. The requirements for passing an on-road driving test in the US focus on basic skills, not what a driver will do when confronted with an emergency situation when a crash is likely to occur [8]. Many other countries' process for obtaining a license requires a much deeper understanding and evaluation, such as the hazard perception test used in the UK, Netherlands and Australia, which have been shown to predict the crash risk of novice drivers [8].

A recent US study from the Insurance Institute for Highway Safety (IIHS) [41] evaluated a post-license course that consisted of skid avoidance and vehicle control. The course began with an explanation of vehicle dynamics and then the students got behind the wheel in a vehicle that allows for varying levels of reduced traction. The emphasis of the behind-the-wheel portion was to avoid the skid

instead of making corrective actions to recover from it. The 234 students who took this post-license course were compared with a control group, and there were no significant differences in crash rates and moving violations between the groups. Both groups completed surveys that assessed confidence levels and perceived risk. The students were asked to rank their own driving skills and there were no significant differences in overall confidence between the groups. Another portion of the survey had the participants rank perceived risk associated with different situations, such as hard braking in snow and driving after dark. Participants that took the post-license course perceived driving in bad weather at higher risk than the control group, but they did not rate their own abilities as being higher than the other group.

For the survey and phone interview, the participants were not asked questions that specifically targeted overconfidence, but the survey completed immediately after the program showed that teenagers self-reported that they thought their most common changes in behavior would include reducing distraction, driving with a heightened awareness, and changing their driving position. The phone interview, completed three months later, showed that the most common self-reported changes in behavior were reducing distractions, having a heightened awareness, reducing speeding and changing their driving position. These changes suggest that the participants had an increased understanding of the dangers of driving both directly after the program and three months after the program—especially two of the greatest causes of crash fatalities of young drivers, speeding and distractions.

One of the critical differences between the studies mentioned [34,35] and the GYL program is the emphasis on the Electronic Stability Control (ESC) system. There is little evidence that the ESC system is discussed and used in the other driving programs. During the GYL program, this system is discussed during the classroom portion and the teenage drivers experience the skid pad with the ESC system engaged before it is turned off to allow the drivers to feel the difference. This may help to discourage drivers from turning off the ESC system and understand what is happening with the ESC when it is engaged. In many of these other programs, it is unknown whether the vehicles used are equipped with ESC, especially in many of the earlier studies, because ESC was not required on vehicles in the US until 2012 [19] and 2014 in Europe [42]. Having teenagers use new (2016 model year and newer), identical vehicles on each track exercise during the GYL program was beneficial because the teenagers all experienced the same vehicles with the same safety systems.

There are even fewer studies showing the effectiveness of ABS training. Petersen, Barrett, and Morrison [43] conducted a study training students to use a two-phased braking strategy, where the students initially depress the brake pedal quickly, then steadily increase the pressure until the pedal is fully depressed. Though the students who received the training had smoother brake profiles and were less reliant on the ABS system, they took one car length longer to stop compared to the untrained drivers. A study by Mollenhauer, Dingus, Carney, Hankey and Jahns [44] used a low-cost method of ABS training to evaluate whether that had any effect on ABS performance. A four-page pamphlet was read before driving on an icy track. The students who read the pamphlet had shorter stopping distances and more often used the correct activation technique. Unlike these two studies, the GYL program does not teach a two-phased approach—instead, GYL teaches teenagers to press the pedal as quickly and hard as possible in order to stop in the shortest distance possible.

Results from the phone interview show that ABS braking was the most used skill and the most used skill that helped participants to avoid a crash. Though ABS braking was not the most important skill that participants reported, it was the most frequently used skill after the program. Though the phone interview indicates that this skill was helpful to the participants, it does not indicate how effective the participants are at activating their ABS after the program.

### 5. Conclusions

The Guard Your Life (GYL) Challenge program is a non-profit, post-license teenage driving program founded by a family who lost their teenage daughter in a single-vehicle crash. The half-day driving program is taught by performance driving instructors, which includes both classroom and hands-on instruction on a closed-road track. In the classroom, the students and parents are introduced to topics ranging from different types of distractions, knowing where to look, proper hand and seating position, how to make corrections for oversteer and understeer, the purpose of ABS, etc. On the track, the students practice defensive driving skills including skid recovery and emergency braking as well as gain first-hand experience driving distracted.

The goal of this study was to evaluate the teenagers’ views of the GYL program both immediately after the program using a survey as well as approximately three months later through a phone interview. During both the survey and phone interview, participants’ responses reflected the overarching concepts that the teenagers were introduced to during the program, suggesting that participants of the Guard Your Life Challenge program gain the knowledge and skills introduced in the program both immediately upon completion and retain it up to three months later.

There are important differences in the participants’ responses between the survey and phone interview (Table 2). When examining the key words used to describe the program, there was a shift from the survey results revolving around the emotional experiences of the program to the specific knowledge needed for safe driving in the phone interview. Sight or knowing where to look had a large presence on the survey results but was mentioned less frequently in the interview. The importance of understanding the implications of distractions increased from the survey to the interview.

**Table 2.** Summary of the five most common responses for questions on the survey, which took place immediately after the program, and the interview, which took place approximately three months later.

Question	When?	Most Common Responses for Each Survey and Interview Question				
Top five things you got out of the program	Survey	Braking	Distractions	Skid/drift	Sight	Safety
	Interview	Distractions	Braking	Skid/drift	Sight	Facts/stories
Key words to describe the program	Survey	Fun	Educational	Exciting	Awesome	Informative
	Interview	Fun	Educational	Helpful	Informative	Exciting
Most important thing you learned from the program	Survey	Skid/drift	Sight	Braking	Control/recovery	Distractions
	Interview	Skid/drift	Braking	Distractions	Driving positions	Situations
Use of skills learned in the program	Survey	Emergency situations	Skid/drift	Braking	Every day	Distractions
	Interview	Braking	Skid/drift	Distractions	Safety	Sight
Skills to avoid a crash after the program	Interview	Braking	Skid/drift	Steering	Other	
Changes in driving behavior from the program	Survey	Reduce distractions	Heightened awareness	Driving position	More careful/cautious	Reduce speeding
	Interview	Reduce distractions	Heightened awareness	Driving position	Reduce speeding	More careful/cautious

The key “take away” from both the survey and the phone interview was the overall positive effect that the program had on the teenagers. The teenagers were introduced to defensive driving techniques that are not traditionally part of driver’s education. In the US, driver’s education courses rarely have the ability to practice ABS braking, skid recovery and driver distractions because, in order to practice these skills, a closed-road track with a large, wet surface is needed. Moreover, 72% of the interview participants reported using these skills within three months after the program. Of the teenagers that used the skills, 69% reported those skills helped them avoid a crash. The interview results suggest that participants benefitted from the defensive driving skills introduced in the Guard Your Life Challenge program.

## 6. Study Limitations

This study gave insight into the teenagers' views of the GYL program, but there were limitations. This study was a self-report survey. No performance data was collected, so it is unknown how well the teenagers were able to perform on each of the exercises and how performance during the program affected their driving and skills used after the program. It is also unknown when in that three-month period the teenagers reported using the skills that they were taught. The teenagers reported using the skills introduced in the class to avoid a crash. It is difficult to conclude whether the use of these particular skills was in fact due to an emergency situation. The GYL program is a half-day event, so only three different exercises were included. Full-day programs have the opportunity to offer additional exercises.

## 7. Future Research

Future research should aim to gain insight into parents' views of the class. Most of the parents stay for the entire program, but are very attentive during the classroom portion of the program. Gaining parents' views could help to better understand what their teenagers got out of the class as well as whether they took anything away from observing. Future research should also explore teenagers' views from full- and multiday programs that include additional exercises.

As the automotive industry incorporates new technologies such as autonomous features, electrification, connected automated vehicles, vehicle infrastructure integration, etc., educational programs will need to prepare young drivers or passengers to use and understand these technologies. Future research should incorporate how to include these new technologies in teenage driving programs.

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## References

1. NHTS Administration. *Traffic Safety Facts—2016 Data: Young Drivers*; Report No. DOT HS 812 498; National Highway Traffic Safety Administration's National Center for Statistics and Analysis: Washington, DC, USA, 2018.
2. Centers for Disease Control and Prevention's National Centers for Injury Prevention and Control. *Leading Causes of Death Reports, National and Regional, 1999–2016*; Centers for Disease Control and Prevention's National Centers for Injury Prevention and Control: Atlanta, GA, USA, 2017.
3. Curry, A.E.; Hafetz, J.; Kallan, M.J.; Winston, F.K.; Durbin, D.R. Prevalence of teen driver errors leading to serious motor vehicle crashes. *Accid. Anal. Prev.* **2011**, *43*, 1285–1290. [[CrossRef](#)] [[PubMed](#)]
4. Qin, L.; Li, Z.R.; Chen, Z.; Bill, M.A.; Noyce, D.A. Understanding driver distractions in fatal crashes: An exploratory empirical analysis. *J. Saf. Res.* **2019**, *69*, 23–31. [[CrossRef](#)] [[PubMed](#)]
5. Hamdar, S.H.; Qin, L.; Talebpour, A. Weather and road geometry impact on longitudinal driving behavior: Exploratory analysis using an empirically supported acceleration modeling framework. *Transp. Res. Part C Emerg. Technol.* **2016**, *67*, 193–213. [[CrossRef](#)]
6. McDonald, C.C.; Curry, A.E.; Kandadai, V.; Sommers, M.S.; Winston, F.K. Comparison of teen and adult driver crash scenarios in a nationally representative sample of serious crashes. *Accid. Anal. Prev.* **2014**, *72*, 302–308. [[CrossRef](#)] [[PubMed](#)]

7. NHTS Administration. *Novice Teen Driver Education and Training Administrative Standards (NTDETAS) 2017 Revision*; National Highway Traffic Safety Administration: Washington, DC, USA, 2017.
8. Fisher, D.L.; Caird, J.; Horrey, W.; Trick, L. (Eds.) *Handbook of Teen and Novice Drivers: Research, Practice, Policy, and Directions*; CRC Press: Boca Raton, FL, USA, 2016.
9. Florida Department of Highway Safety and Motor Vehicles. *The Official Florida Driver License Handbook*; Florida Department of Highway Safety and Motor Vehicles: Tallahassee, FL, USA, 2018. Available online: <https://www3.flhsmv.gov/handbooks/englishdriverhandbook.pdf> (accessed on 19 June 2020).
10. Georgia Department of Driver Services. *2018–2019 Drivers Manual*; Georgia Department of Driver Services: Conyers, GA, USA, 2018. Available online: <http://www.eregulations.com/wp-content/uploads/2018/07/18GADM-LR.pdf> (accessed on 19 June 2020).
11. State of California Department of Motor Vehicles. *Preparing for Your Driving Test (FFDL 22)*; State of California Department of Motor Vehicles: Sacramento, CA, USA, 2017. Available online: [https://www.dmv.ca.gov/portal/dmv/detail/pubs/brochures/fast\\_facts/ffdl22](https://www.dmv.ca.gov/portal/dmv/detail/pubs/brochures/fast_facts/ffdl22) (accessed on 19 June 2020).
12. Texas Department of Public Safety. *Texas Driver Handbook*; Texas Department of Public Safety: Austin, TX, USA, 2017. Available online: <https://www.dps.texas.gov/internetforms/Forms/DL-7.pdf> (accessed on 19 June 2020).
13. Williams, A.F.; Ferguson, S.A. Driver education renaissance? Why we need evidence based highway safety policy. *Inj. Prev.* **2004**, *10*, 4–7. [[CrossRef](#)] [[PubMed](#)]
14. Peck, R.C. Do driver training programs reduce crashes and traffic violations?—A critical examination of the literature. *IATSS Res.* **2011**, *34*, 63–71. [[CrossRef](#)]
15. Is Driver's Ed Failing America's Teens? News Report from Michelin North America. Available online: [https://michelinmedia.com/drivers-ed-failing-americas-teens/#\\_ftn3](https://michelinmedia.com/drivers-ed-failing-americas-teens/#_ftn3) (accessed on 19 June 2020).
16. NHTS Administration. *Traffic Safety Facts 2015 a Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System*; Report No. DOT HS 812 384; National Highway Traffic Safety Administration's National Center for Statistics and Analysis: Washington, DC, USA, 2017.
17. Kahane, C.J. *Preliminary Evaluation of the Effectiveness of Antilock Brake Systems for Passenger Cars*; Report No. DOT HS 808 206; National Highway Traffic Safety Administration: Washington, DC, USA, 1994.
18. Mazzae, E.N.; Garrott, W.R.; Snyder, A. *NHTSA Light Vehicle Antilock Brake System Research Program Task 2: National Telephone Survey of Driver Experiences and Expectations Regarding Conventional Brakes versus ABS*; Report No. DOT HS 809 429; National Highway Traffic Safety Administration: Washington, DC, USA, 2001.
19. NHTS Administration. *Federal Motor Vehicle Safety Standards; Electronic Stability Control Systems; Controls and Displays*; Federal Rule, FMVSS 126; National Highway Traffic Safety Administration: Washington, DC, USA, 2007.
20. Dang, J.N. *Preliminary Results Analyzing the Effectiveness of Electronic Stability Control (ESC) Systems*; Evaluation Note No. DOT HS 809 790; National Highway Traffic Safety Administration: Washington, DC, USA, 2004.
21. Sivinski, R. *Crash Prevention Effectiveness of Light-Vehicle Electronic Stability Control: An Update of the 2007 NHTSA Evaluation*; Report No. DOT HS 811 486; National Highway Traffic Safety Administration: Washington, DC, USA, 2011.
22. Papelis, Y. Determining Loss of Control as a Means of Assessing ESC Effectiveness in Simulator Experiments. *SAE Tech. Pap.* **2006**. [[CrossRef](#)]
23. Ferguson, S.A. The effectiveness of electronic stability control in reducing real-world crashes: A literature review. *Traffic Inj. Prev.* **2007**, *8*, 329–338. [[CrossRef](#)] [[PubMed](#)]
24. Doug Herbert's BRAKES Be Responsible and Keep Everyone Safe. Available online: <https://putonthebrakes.org/> (accessed on 19 June 2020).
25. Teen Driving Solutions. Available online: <https://teendrivingolutions.org/course/> (accessed on 19 June 2020).
26. Teen Crash Avoidance Skills. Available online: <http://www.southmetrofoundation.org/136/Teen-Crash-Avoidance-Skills> (accessed on 19 June 2020).
27. Drive Safer Basic Car Control and Defensive Driving Course. Available online: <https://www.drivesafer.com/courses/drive-safer-basic-car-control-and-defensive-driving-course/> (accessed on 19 June 2020).
28. Street Smarts. Available online: <http://www.birperformance.com/streetsmarts/> (accessed on 19 June 2020).
29. Teen Driver Challenge. Available online: <https://www.flsheriffs.org/law-enforcement-programs/our-programs/teen-driver-challenge> (accessed on 19 June 2020).
30. Ford Driving Skills for Life. Available online: <https://www.drivingskillsforlife.com/> (accessed on 19 June 2020).

31. De Groot, S.; Ricote, F.C.; De Winter, J.C.F. The effect of tire grip on learning driving skill and driving style: A driving simulator study. *Transp. Res. Part F Traffic Psychol. Behav.* **2012**, *15*, 413–426. [[CrossRef](#)]
32. Policy Statement and Compiled FAQs on Distracted Driving. Available online: <http://www.nhtsa.gov/edgesuite-staging.net/Driving+Safety/Distracted+Driving/Policy+Statement+and+Compiled+FAQs+on+Distracted+Driving> (accessed on 19 June 2020).
33. Seifert, C.; Kump, B.; Kienreich, W.; Granitzer, G.; Granitzer, M. On the beauty and usability of tag clouds. In Proceedings of the 2008 12th International Conference Information Visualisation, London, UK, 9–11 July 2008; IEEE: Piscataway, NJ, USA, 2008.
34. Katila, A.; Keskinen, E.; Hatakka, M. Conflicting goals of skid training. *Accid. Anal. Prev.* **1996**, *28*, 785–789. [[CrossRef](#)]
35. Lund, A.K.; Williams, A.F. A review of the literature evaluating the defensive driving course. *Accid. Anal. Prev.* **1985**, *17*, 449–460. [[CrossRef](#)]
36. Mynttinen, S.; Gatscha, M.; Koivukoski, M.; Hakuli, K.; Keskinen, E. Two-phase driver education models applied in Finland and in Austria—Do we have evidence to support the two phase models? *Transp. Res. Part F Psychol. Behav.* **2010**, *13*, 63–70. [[CrossRef](#)]
37. Washington, S.; Cole, R.J.; Herbel, S.B. European advanced driver training programs: Reasons for optimism. *IATSS Res.* **2011**, *34*, 72–79. [[CrossRef](#)]
38. Beanland, V.; Goode, N.; Salmon, P.M.; Lenné, M.G. Is there a case for driver training? A review of the efficacy of pre- and post-licence driver training. *Saf. Sci.* **2013**, *51*, 127–137. [[CrossRef](#)]
39. Gregersen, N.P. Young drivers' overestimation of their own skill—An experiment on the relation between training strategy and skill. *Accid. Anal. Prev.* **1996**, *28*, 243–250. [[CrossRef](#)]
40. Katila, A.; Keskinen, E.; Hatakka, M.; Laapotti, S. Does increased confidence among novice drivers imply a decrease in safety?: The effects of skid training on slippery road accidents. *Accid. Anal. Prev.* **2004**, *36*, 543–550. [[CrossRef](#)]
41. Farmer, C.M.; Wells, J.K. *Crash and Citation Records of Young Drivers with Skid Avoidance Training*; Insurance Institute for Highway Safety: Arlington, VA, USA, 2015.
42. European Parliament and Council. *Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 Concerning Type-Approval Requirements for the General Safety of Motor Vehicles, Their Trailers and Systems, Components and Separate Technical Units Intended Therefore*; Official Journal of the European Communities: Brussels, Belgium, 2009.
43. Petersen, A.; Barrett, R.; Morrison, S. Driver-training and emergency brake performance in cars with antilock braking systems. *Saf. Sci.* **2006**, *44*, 905–917. [[CrossRef](#)]
44. Mollenhauer, M.A.; Dingus, T.A.; Carney, C.; Hankey, J.M.; Jahns, S. Anti-lock brake systems: An assessment of training on driver effectiveness. *Accid. Anal. Prev.* **1997**, *29*, 97–108. [[CrossRef](#)]



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