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Teen Car Control Courses: Impact to Develop Safer Drivers?

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TEEN CAR CONTROL COURSES:

IMPACT TO DEVELOP SAFER DRIVERS?

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A big thank you to my friends and family who have put up with my love of driving and cars for all these years. A significant appreciation goes out to the Chippewa Valley Sports Car Club who volunteer countless hours to coaching at teen car control classes and make them affordable to everyone. Last, a thank you to my professors at Bethel University who have always encouraged me to think outside of the box in an attempt to make the world a better place.

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ABSTRACT

Background: Since the dawn of the automobile, crashes have resulted in significant morbidity and mortality. Unfortunately, in our modern era the novice teen driver population suffers the most. In an attempt to decrease crashes, government officials have mandated that all teen drivers take a driver's education course prior to having their driver's license. Even with this intervention teen drivers still suffer from the highest morbidity and mortality rates from their crashes compared to any other population group. Recognizing this public health tragedy, the government has sponsored multiple studies examining various ways of reducing these crashes. As a result of these studies, laws have been enacted requiring graduated licensing programs, prohibiting night driving and smart device allowances and limiting the number of passengers in the car. Unfortunately, these laws and restrictions have not solved the problem.

Purpose: The purpose of this critical literature review is to determine if there is significant evidence that shows that teen morbidity and mortality can dramatically decrease if the novice driver completes a defensive driving course that includes lecture and behind-the-wheel training of aggressive defensive driving maneuvers on a closed course.

Results: Using John Hopkin's literature review matrix method, eleven studies, level 1-4 ranked good to excellent studies were synthesized and informed by Piaget and Bandura's learning theories.

Conclusion: Review and synthesis of the current research highlighted two important concepts. First, current research is limited, inconclusive and qualitative in nature, therefore lacking enough information to drive public policy or nursing education.

Secondly, if quantitative research was performed it would allow for anecdotal information from car coaches and accurately highlight the benefit of the teen car control courses.

Chapter One: Introduction

Since the dawn of the automobile, it has been recognized that people in automobile crashes receive significant injuries and often die as a result of their crash. Because of this historical fact, scores of experts have attempted to reduce morbidity and mortality of those involved in a crash (Mayhew & Simpson, 2002). For example, local, state, and federal governments enacted more stringent laws which reduce crashes through regulating speed limits, creation of mandatory restraint laws, and mandatory driver's education (Vernick, Guohua, Ogaitis, MacKenzie, & Baker, 1999). In addition, automobile manufacturers have contributed to automotive safety through the development of car safety devices like seat belts, crumple zones, airbags, and most recently, driver assisted devices like automatic braking (Williams, Preusser, Ulmer, & Weinstein, 1995). Despite all the engineering advancements and government regulation, the National Trauma Data Bank 2014 data (2015) has shown that trauma from motor vehicle crashes is still the #1 cause of injury and death for the 1-44 year old age group, and statistics like those from the Wisconsin Department of Transportation (2013) continue to show that teenagers 16-19 years old are ten times more likely to be involved in an injury-related or fatal crash, compared to drivers over 19 years old. This is recognized by many to be a significant public health issue for this age group. As nurses, we are charged to take care of our communities in public health issues in conjunction with our own passions for public health promotion.

Need for Critical Review of a Nursing Problem

In response to these dismal statistics, several advanced defensive driving schools have sprung up, hoping to make early teen drivers safe drivers. One of these schools

began as a public health and injury prevention project eight years ago at Mayo Clinic Health System Eau Claire (MCHS EC). The MCHS EC course creators, myself included, was comprised of physicians, nurses and police officers with a career of caring for trauma patients and experience in advanced performance driving skills, either in an emergency vehicle operations course (EVOC) or performance driving school. During the first few developmental meetings, the designers felt that a teen course modeled after the EVOC course could teach teenage drivers the advanced driving skills that would help them avoid an accident and potential injury or death.

EVOC courses are state-regulated and consistent throughout the community colleges that teach them. Course content includes lecture, discussion, hands-on driving exercises and frequent debriefing. The lecture curriculum includes common risks, vehicle dynamics and the step-by-step instruction of various defensive driving techniques. The hands-on portion of the course occurs on a closed course with in-car and out-of-car coaches, which provide instant feedback for the student. Curriculum for the hands-on portion includes emergency braking, evasive handling, backing up techniques and skid pad work. Some courses also include aggressive pit maneuvers, which would not be part of the teen car control course. All the other elements of the EVOC course are found in some format through the various teen car control courses offered in the Midwest.

Conceptual Mode / Theoretical Framework

During the teen car control course development at Mayo Clinic Eau Claire, a question was proposed concerning the cognitive ability of teenagers to successfully complete a course of this nature. It was felt that Piaget's theory of cognitive development and Bandura's learning theories might help us determine if a teenager could learn cause-

and-effect, cognitive, and driving skills. Piaget described the learning stage of teenagers as the formal operations stage, which begins to develop at about the age of eleven and carries on through adulthood (Ginsburg, & Opper, 1988). In this stage, young adults begin to think about thinking and controlling their thoughts, connect reasoning with behavior and outcomes, and develop a formalized problem- solving ability through trial and error. The teen car control class works with students in this formal operations stage.

Bandura's (1989) learning theory states that people model their own actions after watching the outcomes of others actions. When one watches another individual complete a task and that task is successful, then the observer will also want to partake in the task. Conversely, when the observer notices a negative consequence to a behavior, then they will avoid that specific observed behavior.

When designing this course, the team wanted to tie in Piaget's and Bandura's learning concepts. First, according to Piaget, teenagers are learning how to control their thoughts. It is natural to be distracted while driving, so one needs to make an effort to focus on the road and the task ahead. We have a significant module on distracted driving, and the car control exercises are so intense that one must be completely focused. We reinforce focused attention over and over again in the course, in the classroom lecture, and on the track performing and learning defensive maneuvers.

Piaget's second concept of connecting reasoning with behavior connects to our accident avoidance exercise. In this exercise, the driver approaches a virtual intersection made of cones, and there is also a row of lights above. As the student approaches at 30 mph, an instructor flips a switch at the last second, turning on one side of lights. The goal is that the student must steer away from the lights. This exercise teaches students

that if a crash occurs in front of them, they must look away from the crash toward the safe path out of the situation. A driver's first response is always to follow the lights; hence we are teaching higher reasoning skills by teaching a student to go away from the lights.

Lastly, Piaget stated that those in this stage should be able to formalize their problem-solving ability by using trial-and-error techniques. In the course, we have use of a wet skid pad. On this very slippery wet surface, we have students corner their car fast enough to induce a slide, but not a spin. They learn how easy it is to slide and how hard it is to get out of a spin, all through trial and error.

Bandura also contributes to course curriculum using observational learning theory which is evident in the lecture videos and driving course activities. The lectures contain videos of actual students successfully completing the maneuvers. This allows students in the classroom to see success of the driving skills taught, and according to Bandura's theory, the students will be more motivated to complete the exercises. This is very important because of the aggressive defensive driving skills we are teaching the students. At first, most students feel very intimidated and fearful of aggressively avoiding an accident. However, with ongoing practice, they become proficient.

Significance to Nursing

This course started not only as a public health project, but an injury prevention project as well. MCHS EC is a Level II regional trauma center and must perform injury prevention projects consistent with its trauma injury patterns. The trauma center ran the standard demographics report, which highlights the mechanism of injury, for 16-19 year old's in the NW Wisconsin region. The number one cause of injury for the last 10 years

of data was motor vehicle crashes. Thus, it made sense that as a trauma center, we had the responsibility to reduce teen crashes. Course developers believed that EVOC schools decrease crash rates of ambulance drivers and police officers, so it would follow that a teen school which modeled EVOC curriculum could decrease teen crash rates. Jump forward eight years, and the biannual course in Eau Claire, WI continues with full registration and significant waiting lists for the next course. Course directors and volunteers believe that this course improves driving skill in young drivers, but no longitudinal outcomes or same-day objective skills testing have been performed.

One should also note that teen car control course is being coordinated by internet tire sales companies, car manufacturers, car clubs and car dealerships. All the courses share the same lecture and driving format. In addition, the curriculum and driving exercises are remarkably similar even though the courses are not connected.

Statement of Purpose/Research Question

The practice question is as follows; Is there a difference between 16-18 year old teen drivers that complete a teen car control class and the general teenage population that has not taken the course, in relation to their number of accidents, near miss crashes, crashes with injury or moving violations? If one can prove that these courses do work, it would provide the basis for public policy changes. Policy changes that would include the requirement of teenagers to attend a teen car control course or require a significant enhancement to current driver's education course curriculum.

Chapter Two: Methods

Search Strategies Used to Identify Used to Identify Research Studies

The critical review of the literature for evidence began with PubMed, CINAHL and Mayo Clinic's library search engine, looking for other trauma centers that may have implemented this injury prevention activity. However, this produced no results. A search of journals through Google Scholar produced a significant amount of information, especially in arenas of safety, transportation, and pediatric injury prevention.

Criteria for Including or Excluding Research Studies

Articles for review were selected on their actually evaluating a teen car control course, inclusion of outcome studies, articles that linked teenage behavior with teaching techniques and multi-article literature reviews from drivers-training experts. A conscious decision was made to include articles from outside the United States, so as to include a significant divergence in thinking. Articles were excluded that were sole opinion of the author or showed a quality level, "less than good" as defined by Dearholt and Dang (2012).

Number and Types of Studies Selected

After the literature search, eleven studies were selected for review. Several studies were selected that examined the efficacy of motorcycle training for new drivers. Motorcycles are not cars, but the concepts are similar and should translate appropriately to young drivers. Several literature reviews written by experts in drivers' training were selected.

Several landmark studies will be discussed in detail, because their conclusions have significantly guided the teen drivers' curriculum. If the goal is to educate teenage

drivers to make them safer drivers, one needs to determine what has been effective in the past. Chen, Baker and Li (2006) performed a non-experimental correlational 10-year retrospective study trying to determine which portion of a graduated licensing is the most beneficial. The study examined 8,953 fatality crashes in 43 states, all involving 16 year old drivers. The authors correlated fatalities with bimodal graduated licensing program (GDL) and seven individual components of GDL. Fatalities decreased in states by 11% if they had a GDL program with a confidence interval of 95%. If states implemented five out of seven components of a GDL, fatality rate decreased by18%. Fatality rate dropped to 21% if all seven GDL components were in place. Results of the research showed that the greatest benefit to teen safety was gained by states with > 3 month waiting period on nighttime driving, passenger restriction, and > 30 hours of supervised driving with a confidence interval 95%. However, many states had not put these components into their GDL. The authors recommended that every state adopt a comprehensive graduated driving licensing program that includes a 3-month limitation on the number of passengers in the car, limit night time driving, a minimum age requirement, and at least 30 hours of supervised driving.

In light of probable GDL programs, one wonders if teenagers are in more crashes because of their perceived risky driving behavior. This is described by Ivers, Senserrick, Boufous, Stevenson, Chen, Woodward, and Norton, in the DRIVE study (2009). In this non- experimental, correlational, longitudinal study, the authors explored the correlation of risky driving behavior, risk perception and crash risk with 20,822 seventeen- to-twenty-four old drivers. In their survey, they found that high scores on the questionnaire related to risky driving were associated with a 50% increase in crash risk with a 95%

confidence interval. Additionally, high scores in risk perception were also associated with increase in crash risk. They concluded that over-representation of youths involved in injury crashes is a significant public health issue, and youths should be educated on the connection of risk and crashes.

One should then ask if teenagers are able to correlate risky behavior with significant consequences. Keating (2007) examined this teen development issue by comparing current GDL, drivers training and adolescent development through a systematic review of 53 articles. They concluded that since teenager's brains are not fully developed, teenagers need additional safeguards. These include significant supervised time behind the wheel, limiting internal and external distractions, and allowing one to fail in a safe environment. Additionally, he concluded that many drivers' education programs do not allow the teen to fail and learn from the experience. This includes emergency braking, skid control or evasive lane changes.

If driver's education programs are not teaching these advanced skills, what other helpful concepts are they not teaching? Lonero (2008) examined this issue by performing a meta-synthesis of 65 randomized controlled and quasi-experimental studies written by drivers' education experts. This research concluded that much of American driver's education is not scientifically based and therefore its curriculum is questionable. Lonero's (2008) opinion is that the majority of research has focused on outcomes of drivers' education rather than how to improve drivers' education itself. Most of this is due to lack of funding. They concluded that one should model driver's education programming after other nations' experience. The current "American" edition is not doing its job.

In light of this, Mayhew and Simpson (2002) asked what should be done to change driver's education programs to decrease teenage driver's mortality. These authors performed a systematic review and meta-synthesis of 20 randomized control trials (RCT) and quasi-experimental studies. They concluded that current drivers' education programs have failed in adequately training young drivers in accident avoidance. Most of the training is completed in controlled situations where the student does not need to navigate through a risky situation. Additionally, the driver's education skills taught and fostered overconfidence, which led to ongoing risky driving behavior. It was concluded that accident avoidance skills should be taught with every driver's education program.

In a landmark study funded by the state of Montana, Mueller, Stanley, and Manlove (2012) developed a teen car control course very similar in curriculum to Mayo Clinic Health system's course and followed students for two years after the course. This randomized controlled study of 347 participants not only wanted to evaluate effectiveness for decreasing crash rates, but also to look at potential increases in crash rates due to overconfidence of the trained students. Their research concluded that trained students had fewer near-miss crashes than the control group by 42% (CI=95%), but both student groups had the same rate of traffic citations, and both student groups had the same rate of single-vehicle crashes. The data did suggest that the multi-vehicle crash rate was higher in the trained group initially after training but by the end of the study was significantly less than the control group ($p=0.0204$). Anecdotally, the instructors felt that student drivers' skill improved as a result of the course.

Criteria for Evaluating Research Studies

The research supporting the teen car control classes is still variable, like the research behind the traditional driver's education. Many of the studies had pieces of helpful information like hands on instruction, advanced car control, and consequence training, but did not evaluate longitudinal outcomes. However, all the research selected for this review was well done, and ranked in quality as Good or Excellent according to the John Hopkins grading scale (Dearholt & Dang, 2012). The one Montana training program showed mixed results in its research, but gave those who do these programs a sense of hope for the benefit of their efforts, as there was a significant reduction in near-miss crashes. One will never know if those near miss crashes would have resulted in an injury crash. In addition, the Montana study was the only one that published a randomized controlled study on a specific teen car control class, and it is evident that generalizability may be possible but not certain.

As part of this project, course designers from the Mayo Clinic Health System (MCHS) teen car control class, Brainerd Street Smarts teen school, Morrie's Mazda Streets Smarts course and Gunderson Lutheran Hospital teen car control class were all interviewed to get a sense for why their programs were not conducting research. The common themes through all the programs were a lack of personnel to complete the study and a lack of expertise in order to accomplish the task. In addition, the course directors felt that their programs made a significant contribution to the safety of the novice teen drivers, as evidenced through anecdotal stories which happened either during the course or shortly thereafter. It would be ideal for all of these Midwest-spawned teen car control

courses to perform quantitative and qualitative longitudinal randomized control studies, and then compare outcomes to determine the most effective curriculum.

In conclusion, there is limited research available on teen car control courses, but these are isolated and there is little replication. This may be due to lack of statistical outcomes or lack of consistent funding. Significantly more research exists in the motorcycle driving courses, which take a hands-on approach to training like teen car control courses, but not in large numbers. The Montana study, published by Mueller, Stanley, and Manlove (2012), provides the best published description and outcome of a teen car control course, and should be reviewed by those attempting to design or research teen car control courses.

Table X.
Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommen-dations
			Methodology	Instruments (include reliability& validity)		
Chen, L-H, Baker, S., & Li, G. (2006). Graduated driver licensing programs and fatal crashes of 16-year-old drivers: A national evaluation. *Pediatrics, 118*(1), 56-62. DOI: 10.1542/peds.2005-2281. ISSN 1098-4275 Level: III Quality: Good	Determine which graduated drivers licensing programs were associated with the greatest reduction in fatal motor vehicle crashes involving 16 year old drivers.	16 year old drivers involved in fatal crashes in the USA from 1994-2004.	Non-experi-mental Correlational Using data from the federal fatality analysis reporting system and the US census bureau, the authors measured incident rate ratios of fatal crashes by state and year. Authors correlated fatalities with bimodal GDL and seven individual components of GDLs.	GDL and teen outcomes were controlled in 3 ways. 1.Dichotomous variables of state participation. 2.Each state requirement of GDL was characterized. 3.Liscencing systems were grouped on the combination of four GDLs not related to age. Incident rate ratio tables were constructed. Confidence interval of 95%.	Results: 8953 sixteen year old drivers were involved in fatal crashes in the 43 state studied. Fatalities decreased in states by 11% if they had a GDL program. Only if states implemented five out of seven components did fatality rate decrease (18%). Fatality rate dropped to 21% if all 7 were in place. Greatest benefit was gained by states with > 3 month waiting period on nighttime driving, passenger restriction and > 30 hours of supervised driving confidence interval 95%. Conclusion: Every state adopt a comprehensive graduated driving licensing program.	States need to institute a graduated driver's licensing program that includes a 3 month limitation on the number of passengers in the car, limits night time driving, age requirement, and at least 30 hours of supervised driving. Current driver's education programs are ineffective in reducing teen mortality significantly.

Table X.

Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/ Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments (include reliability& validity)		
Chung, Y., (2014). Seemingly irrational driving behavior model: The effect of habit strength and anticipated affective reactions. *Accident analysis and prevention.* 82. DOI:10.1016/j.aap.2015.05.003 Level: III Quality: Excellent	Risky teen driving behavior is learned through a deliberate decision making process. Does the risky driving behavior become a habit and if so is it because of an emotional response generated during the behavior.	286 19 year old college students in north Taiwan were in wave one. Wave two consisted of 75 students from the first group.	Subjects were given a series of scenarios with Likert scales ranking themselves on how likely they would perform the action described. Additional demographic information and miles driven was collected.	The sampling adequacy of the three-factor structure was satisfactory KMO = 0.844; Bartlett's test significant $p < 0.001$. CFA ($\chi 2 = 74.698$ [$p < 0.001$]; $\chi 2/df = 2.334$; CFI = 0.983; NNFI = 0.976; RMSEA = 0.068; SRMR = 0.032); in addition, all standardized path coefficients > 0.7 (range: 0.787–0.975), indicating good convergent validity. Cronbach's α values for the three factors (i.e., attitudes, APR, and ANR) were 0.883, 0.939, and 0.946.	Results: Speeding becomes a habit after it is learned due primarily to emotional arousal during the event. Conclusion: Yong drivers require education on the emotional aspects of risky driving behavior and how it reinforces in habit development.	Young drivers require education on predicting outcomes, positive and negative of risky driving behavior to increase situation awareness. Additional research needs to be done in the social reinforcement of driving behavior.

Table X.

Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/ Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments (include reliability& validity)		
Ivers, R., Sakashita, C., Senserrick, T., Elkington, J., Lo, S., Boufous, S., & De Rome, L., (2016). Does an on road motorcycle coaching program reduce crashes in novice drivers? A randomized control trial. *Accident Analysis and Prevention*. 86. DOI:10.1016/j.aap.2015.10.015 Level: II Quality: Good	The authors wished to determine if a driver's training program would reduce crashes, injury rates and mortality associated with motorcycle use.	2399 new motorcycle drivers in Victoria, Australia were randomized into a intervention group (n= 1232) and control group (n=1167). The study lasted 12 months with study mortality control n=1036 and intervention n=1066.	Randomized control study. Intervention group received a pre-ride evaluation of braking, cornering and obstacle avoidance followed by 4, 1 hour rides which included post ride debriefing with coach. Outcome measure included police and self-reported crashes at 3 & 12 months. Specifics were time to first crash, self-reported near crashes, safety attitudes, riding behaviors, traffic incidences riding motivations and riding exposure.	Cronbach's alpha scores greater than 0.7 showing reliability of self reporting. The incidence of crashing was the same for both groups CI 95%. The intervention group showed lower incidence of near crashes at 3 months(CI 95%), raw data showed fewer crashes and road more at 12 months (p = .0385).	Results: New motorcycle riders who have an advanced training program have fewer(not statistically significant) crashes and fewer near miss crashes. Conclusion: A course of this nature benefits new riders in their first year of riding.	Even though many conclusions were not statistically significant a course of this nature is required by all to prevent inexperienced drivers from morbidity and mortality related to lack of driving experience.

Table X.
Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments (include reliability& validity)		
Ivers, R., Senserrick, T., Boufous, S., Stevenson, M., Chen, H., Woodward, M., & Norton, R., (2009). Novice drivers' risky driving behavior, risk perception, and crash risk: Findings from the DRIVE study. American Journal of Public Health, 99(9), 1638-1644. DOI: 10.2015/AJPH.2008.150367 Level: III Quality: Excellent	Authors explored the correlation of risky driving behavior, risk perception and crash risk with a driver cohort of 17-24 year olds.	Provisional USA drivers aged 17-24 years old. 20,822 survey respondents.	Survey created and distributed that asked about risk behaviors, and perception of risk behaviors. 2 years following recruitment survey data was linked to licensing, police crash data.	Poisson regression models adjusted for multiple confounders. High scores on the questionnaire related to risky driving were associated with a 50% increase in crash risk. 95% confidence interval = 1.25, 1.18.	Results: High scores in risk perception were also associated with increase in crash risk however it was not as much of a risk as driving behavior. Conclusion: Risky driving behavior is strongly linked to crash risk. Risk perceptions were not as conclusive.	Since over-representation of youths involved in injury crashes is a significant public health issue, system wide intervention and licensing reform is warranted.

Table X.
Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments (include reliability& validity)		
Kardamanidis, K., Martiniuk, A., Ivers, R., Stevenson, M., & Thistlethwaite, K., (2010). Motorcycle rider training for the prevention of road traffic crashes., Cochran database of systematic reviews. (10). DOI: 10.1002/14651858 Level: I Quality: Good	Authors wanted to determine if any outcome studies or research was available for studies related to motorcycle training.	Nine major databases were searched for relevant research articles. 23 were included in the review.	Methodology: Two authors independently analyzed the 23 research articles for design, interventions, quality data and outcomes.	Differences in researcher findings were resolved by third party author.	Results: Most studies were not randomized controlled studies and suffered from significant methodological weaknesses including poor outcomes measure tools of police records or self-reporting. Conclusion: No conclusions can be made due to poor quality of studies. Some sort of drivers training is required for rider safety but rigorous research is needed.	A series of well-designed randomized control studies needs to be performed looking into the effectiveness of drivers training. Results should not include self-reported measures.

Table X.
Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommen-dations
			Methodology	Instruments (include reliability& validity)		
Keating, D. P. (2007). Understanding adolescent development: Implications for driving safety. *Journal of Safety Research, 38*(2), 147-157. DOI: 10.1016/j.jsr.2007.02.002 Level: V Quality: Good	Since crash rates of early drivers remains unacceptability high the authors wish to compare current graduate licensing programs drivers training and adolescent development	Literature review of expert articles.	Systematic review of expert based guidelines.	53 articles were used to examine best practice interventions and known adolescent behavior development.	Results: The current graduated licensing programs do reduce early driver crash mortality but more should be done. Conclusion: When one compares youth cognition and driving trends surface. Key components to safe driving include supervised time behind the wheel, limiting internal and external distractions, allow one to fail, providing a safe environment until the brain more fully develops.	No programs allow early drivers to make mistakes and learn from their errors. Simulation and hands on skills would be an enhancement to current training. Best practice would be to allowing students to practice to failure in a safe and controlled environment.

Table X.
Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommen-dations
			Methodology	Instruments (include reliability& validity)		
Loeb, H., Kandadai, V., McDonald, C., & Winston, F., (2015). Emergency braking in adults verses novice drivers: Response to simulated sudden driving events. *Transportation Research Record.* 2516. DOI: 10.3141/2516-02 PMID:26709330[PubMed] Level: III Quality: Good	This research tested the emergency braking responses of adult 5 year experienced drivers vs. novice <2 year inexperienced drivers in a simulation environment. Attempted to answer the question; who has the ability to brake to avoid a significant crash.	21 teen drivers 16-17 years old with 90 days of provisional drivers licensing and 17 25-50 year olds with at least 5 years of driving experience, drove at least 100 miles per week and had no self-reported crashes in the last 3 years.	Quasi-experimental after only design.	Descriptive statistics including means, standard deviations, medians, interquartile ranges, ranges, frequencies, and proportions were used for all results. Independent T-tests were used to assess differences in means for normally distributed data and Wilcoxon Rank Sum tests were used to assess distributional differences for non-normally distributed data.	Results: 3 teen crashes (16%) and 2 adult crashes (13%) were observed. The mean value for pre-encroachment time (PET) for the teen group is 0.40 seconds while the mean value for PET for adult group is 0.82 seconds (p=0.04), indicating less near-crashes for the adults. Conclusion: Since adults brake faster and harder than teenagers they concluded that teenagers do not have situational awareness, and prediction skills which lead do crashes in emergency situations.	Situational awareness training needs to be part of every drivers training program until al level of experience is attained that the young driver can truly be aware of their surroundings.

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Evidence Synthesis Matrix

Citation in APA/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommen-dations
			Methodology	Instruments (include reliability& validity)		
Lonero, L. (2008). Trends in driver education and training. *American Journal of Preventative Medicine.* 35(3s). DOI: 10.1016/j.amepre.2008.06.023 Level: I Quality: Good	This article provides a brief overview of trends in pre-licensure of driver's education programs and their implication.	65 expert articles reviewed and summarized.	Meta-synthesis	Systematic review of RCT and quasi-experimental studies. Author examined 65 articles to determine best practice of driver education courses, interventions and their outcome.	Results: Much of American drivers education is not scientifically based and it outcomes are questionable. The majority of research has focused on outcomes of drivers education rather than how to improve drivers education. Additionally significant research has evaluated the effectiveness of GDL programs without focus on pre-driving training. Conclusion: Limited research is completed due to lack of funding.	One should model driver's education after other nations experience and then use federal grants to evaluate the American approach. Significant work is needed for an evidenced based program.

Table X.
Evidence Synthesis Matrix

Citation in	Purpose of	Sample/Setting	Design	Results	Authors'

APA/Level & Quality	Study		Methodology	Instruments (include reliability& validity)		Recommendations
Mayhew, D. & Simpson, H., (2002). The safety value of drivers education and training. *Injury Prevention*, 8(ii3-ii8) DOI: 10.1136/ip.8.suppl_2.ii3 Level: I Quality: Good	New drivers have extremely high crash rates. Author evaluates programs and identifies ways to improve results.	20 reference articles examined and summarized.	Systematic review of RCT and quasi-experimental studies.	Author examined 20 articles and the cultural approach to American driver's education programs.	Results: Most of the training is completed in controlled situations where the student does not need to navigate through a risky situation. Additionally the driver's education skills taught foster overconfidence which leads to risky driving behavior. Conclusion: Mandatory graduated licensing programs and multistage drivers' education where crash avoidance is taught are necessary to reduce crash risk and mortality.	Current drivers' education programs have failed in adequately training young drivers in accident avoidance. Courses need to put young drivers in risky situations so they can learn how to navigate out of them.

Table X.
Evidence Synthesis Matrix

Citation in	Purpose	Sample/Setting	Design	Results	Authors'

APA/Level & Quality	of Study		Methodology	Instruments (include reliability& validity)		Recommendations
Mueller, J., Stanley, L., & Manlove, K., (2012). Multi-stage novice defensive driver trainer program: Does it create overconfidence? *Open Journal of Safety Science and Technology,* 2(4). DOI: 10.4236/ojsst.2012.240 Level: I Quality: Good	Will 16 year olds who participate in the Montana State University teen car control course become safer drivers than 16 year olds who do not take the course. Additionally, does the course create drivers who are more aggressive than drivers in the control group.	16 year olds were selected from 15 Montana high schools. The 347 of them were randomly assigned into a control group of 182 participants and a subject group of 165 participants.	Randomized control trial	Analyze the effects of training on four variables: DMV citations, near-miss crashes, single-vehicle crashes and multiple-vehicle crashes. A qua-si-Poisson regression model was fit for each response variable, with the response treated as a function of driver gender, year, an indicator for trained/control status, and a trained/control—year interaction term, to account for differences in driver performance.	Results: No difference in the number of citations received. Trained students (42%) had fewer near miss crashes than the control group (58%). (CI=95%) No significant difference in single vehicle crashes between groups. The rate of multiple vehicle crash rates was higher in the trained group for the first 2 years post training. P=0.0204 Conclusion: Risk benefit should that young drivers would benefit from an advanced driving course even if it meant them developing a sense of overconfidence.	Early drivers who participate in hands on defensive driving course, which is much more aggressive than typical driver's education courses, had significantly fewer near miss crashes thus avoiding potential injuries. The authors also felt that the potential of a perceived higher risk of aggressive driving was offset by the crashes avoided by the student in their early driving career. Student should be required to take an advanced driving course.

Table X.
Evidence Synthesis Matrix

Citation in	Purpose of	Sample/Setting	Design	Results	Authors'

APA/Level & Quality	Study		Methodology	Instruments (include reliability& validity)		Recommendations
Roman, G., Poulter, D. Barker, E., McKenna, F., Rowe, R., (2015). Novice drivers' individual trajectories of driving behavior over the first three years of driving. *Accident analysis and prevention*. 82(61-69) DOI: 10.1016/j.aap.2015.05.012. Level: III Quality: Good	Authors wanted to ascertain: what is the learning of early driving behavior, is it helpful to identify specific driver groups and their development patterns, is it helpful to identify demographic qualities that correlate to crash risk.	12,012 first time drivers in the UK. 1148 subject completed all the surveys over the course of the study.	Subjects received a 27 item survey at 6, 12, 24, and 36 months after licensure. All information for the study was self-reported. Survey included questions on driving behavior and miles driven.	Missing data assessed through Chi-squared in Little's MCAR X2=1951.21, p=0.94 Latent growth curved models >= 0.90, comparative fit index and the Tucker Lewis index >=.95 and root mean square error of approximation of <= .06. CI 91% on all measures.	Results: No factors were associated with a decrease in crashes. Males had more risky driving behavior but the same number of violations at 7%. Younger drivers reported more incidences. Conclusion: Positive relationships exist between interventional programs aimed at preventing ordinary driving violations and positive long term consequences in safer driving behavior.	Further research is needed to determine if drivers become more selective in locations and timing of risky driving behavior. This may aide in accident and violation avoidance.

Chapter Four: Discussion, Implications, and Conclusions

Before further discussion can occur about a teen car control course (TCCC), one should understand the key components to the curriculum as gathered from interviews with TCCC course directors. All of the courses had a lecture component, focusing on vehicle dynamics during aggressive driving maneuvers and how to perform these maneuvers successfully in the event of an impending crash. The lectures also included scenario-based learning via PowerPoint to help the student think through a variety of situations and use the potential solutions of stay, stop, steer, or do nothing.

The second part of the TCCC included closed-course student driving with a trained adult car coach. Students practice braking and steering maneuvers on a variety of surfaces at progressively higher speeds to mimic dangerous situations that they will probably experience in their early driving career. These speeds become high enough that some students will lose control of their vehicles and spin out. This hands-on portion provides students with the opportunity to learn how their car handles in a limited-risk environment. Therefore, when one examines the research, one should remember that a TCCC is not the same as the state-mandated driver education courses. Even though the driver education courses include lecture and supervised behind-the-wheel time, the student is driving in normal traffic in normal conditions and does not have the freedom to practice aggressive defensive driving skills. The two courses are fundamentally different.

After reviewing the literature, it is evident that the studies identified in Chapter 3 contribute significantly to answering the practice question about the effectiveness of a TCCC. In addition, the selected articles obviously incorporate ideas from both Piaget's

cognitive learning theory and Bandura's social learning theory, which contribute greatly to their information on the topic, even if their outcomes were not significant. Unfortunately, this review also highlighted that there are few TCCC performing outcome studies. Thus, very little direct evidence pertains to TCCC, forcing us to extrapolate conclusions from the research to answer the practice question, and this provides significant information.

The first article for discussion focuses on which elements of a teen graduated-license program are effective in reducing teenage driving morbidity and mortality (Chen, Baker & Li, 2006). The authors concluded that states which adopt a graduated-licensing program including a three-month waiting period on nighttime driving, passenger restrictions and greater than 30 hours supervising driving experiences, will experience a much lower team morbidity and mortality rate. The concept of greatest interest is the +30 hours of supervised driving experience. This supervised driving experience in driver's education is defined as the teenager driving with a parent or guardian coaching them. During the teen car control class, students are coached 1:1 with a trained adult in the passenger seat while performing defensive driving maneuvers. This coaching technique is successful because it models Piaget's cognitive learning theory and the teenager's formal operation stage of development, specifically problem-solving (Ginsburg & Opper, 1988).

During the hands-on portion of the TCCC, the students, with the instructors being in the passenger seat, practice aggressive defensive driving maneuvers. One of these maneuvers is the evasive lane change on a wet skid pad. While the students complete this exercise, they will often spin out due to their driving inexperience and being too

aggressive with their steering inputs. The coach will then help them problem-solve the 'why' behind the spin, so that on subsequent practice sessions, they will gradually better control their automobile. The eventual goal is for the students to tell the coach why the car spun out, so that students can problem-solve. This is an excellent example of Piaget's learning theory, specifically problem solving, where one uses trial and error to discover a solution to a problem (Ginsburg & Opper, 1988). The trials are the repetition on the course, increasing speed with each lap. When the error or spin occurs, the student learns how to prevent it from happening again and how to correct the spin once it occurs. It is an excellent way to teach novice teen drivers. In addition, one can surmise that a successful TCCC will have trained adult coaches in the passenger seat to aid in the training of the teenage drivers. This is evidenced by the use of Piaget's learning theory and Chen, Baker and Li (2006) research on graduated driving programs.

The next article of interest examined risky driving behaviors in young drivers and how those behaviors developed into habits (Chung, 2014). Speeding became a habit due to the driver's emotional arousal during the speeding event. The authors further commented that the students in the study were never exposed to potential negative consequences of their behavior or any negative social ramifications for speeding, and this provided a positive reinforcement to the behavior. Chung (2014) concluded that social influence is necessary to encourage and learn responsible driving behaviors.

This social reinforcement behavior clearly models Bandura's (1989) social learning theory, where one observes the positive or negative consequences of others around them and adjusts their own behavior to allow for a positive outcome. Combining

these ideas, one can imagine that if a speeding driver were to witness another speeding driver in a horrible life-threatening crash, the driver observing would then tame their own behaviors.

Chung's (2014) idea of students observing other students is incorporated into the curriculum in two venues. First, there is a series of videos during the TCCC lecture that show different car handling techniques which result in drivers navigating the course successfully or the cars going out of control. Students can then model their own driving behavior after watching the video outcomes. Secondly, while the students are on the driving range, they are given the opportunity to watch the cars in front of them complete the exercise. While watching, the in-car coach is helping them to understand the vehicle dynamics that they are observing. All this information allows the student to learn from the previous student and then complete their own driving circuit successfully.

When one considers how Chung's (2006) theories of risky driving behavior are applicable to a TCCC, it is evident that the lecture and the skills section of the course directly apply. A significant role of the in-car coaches is to provide feedback to the students while they are learning how to complete the evasive maneuvers. Coaches can then provide feedback to the teens, telling them that they are going too fast or simply allowing them to spin out and experience the loss of control. The loss of control is not looked on favorably by any of the instructors or coaches, and students are gently provided corrective action so they do not lose control of their cars again. This negative consequence to risky driving behavior significantly contributes to the potential success of the TCCC. In addition, the TCCC uses Bandura's social learning theory and allows

students to observe other drivers' success and failures while waiting for their own turn. Again, this contributes to the potential success of a TCCC.

Even though there is little literature relating to teen car control classes, the efficacy of a motorcycle defensive training program has been well studied (Kardamanidis, Martiniuk, Ivers, Stevenson, & Thistlethwaite, 2010) and is quite similar in design to a TCCC. These motorcycle programs include classroom instruction, closed course experiences and real-life driving experiences involving an instructor. A recent example of the benefit of a training program is found in a study published by Ivers et al (2016) in which they examined the three-and-twelve-month outcomes of motorcyclists involved in such a course. The author's conclusion was that there was no statistical difference in morbidity and mortality, but the raw numbers still reflected a decrease in potential injury-causing events. The success of the author's coursework can be attributed to the varied approach of teaching styles, which included classroom verbal learning, hands-on instruction via simulation and concluding with real-world experience with one-on-one coaching. This is a beneficial curriculum because some students learn best through verbal communication and some learn best through hands-on experiences (Keating, 2015). This motorcycle safety course included both styles of learning and thus was very influential to the students, significantly decreasing near miss crash rates, morbidity and mortality.

This defensive driving motorcycle course has a very similar design to that of the TCCC. Lecture is followed by practice on a closed course with instructor feedback. One can surmise that the success of the motorcycle course, because its curriculum is very

similar to the TCCC. Unfortunately, the motorcycle course was not statistically significant in outcomes. This lack of statistical success does not mean the course is a failure, and thus a TCCC can model it for success.

In addition to hands-on instruction in a car control class, there is a significant need for students to understand the significant risk associated with being a novice driver. Ivers et al, (2009) explored the relationship between a student's understanding of risky driving and their actual rates of crashes. The authors concluded that there is a direct correlation between risk perception and crashes. This fact highlights the need for teen car control classes to discuss risk using Piaget's cognitive learning theory of abstract-thought to help students understand the consequences of their driving actions. This can be accomplished by taking an abstract story and translating it to a potential real-world event (Ginsburg & Opper, 1988). For example, in the TCCC an instructor can share a story of a novice driver who participated in a risky driving behavior such as speeding, which resulted in them crashing their car and injuring their friends. Piaget tells us that this approach to teaching can help the student comprehend the full gravity of their driving behavior. This enforces the fact for teenagers that they are all at risk and crashes can happen to them at any time. It is a necessary component to any curriculum TCCC.

Ivers et al, (2009) also noted that teenagers need to be taught what is considered risky driving behavior because 'risky' has different definitions to different novice drivers. Some think that going the speed limit at all times is not risky. However, when roads become slushy or the car has instability without the skid, that is considered a risky

behavior by many. The situational concept of risk and its consequences is taught in the TCCC surveyed and will contribute to the success of these courses.

Some would argue that teenagers are unable to fully comprehend the consequences of their risk-taking behavior despite Piaget's cognitive learning theory. This is not true as evidenced by Keating's (2007) literature review where 53 articles were examined to determine the best method to instruct adolescent defensive driving skills. Keating (2007) determined that most driving schools have a fatal flaw, in that they do not allow students to drive to the point of failure in an uncontrollable car. This gives the perception to students that they can drive however they want without knowing the limits of their skill or their car. Keating's (2007) primary recommendation suggested that the students be allowed to drive at high enough speeds during their hands-on training that the car spins out uncontrollably. This uncontrollable situation provides two critical learning factors. First, is the realization that the car can actually spin out of control and that this driving is not a video game, but has real consequences. Secondly, this allows the students to ascertain how close they are actually driving to the functional limits of the car on a day-in and day-out basis. The eventual goal would be the student's ability to drive within that margin thus allowing for defensive driving maneuvers without losing control of the car. This recommendation by Keating's (2007) work models Piaget's cognitive learning theory of abstract thought. The student will take an abstract theory of a car spinning out of control during a lecture sentiment and put it into a reality on the closed course. This out-of-control driving behavior should only be allowed to occur on a closed

course in the venue of a well-supervised driving school, and it appears to contribute significantly to the student's learning.

The concept of allowing a student to fail is very evident in the TCCC. In-car coaches will often initiate a slight tap of the emergency brake or encourage the student to drive faster on certain sections to allow a student to feel a slide for the first time. The coach will then instruct the students how to correct the slide and regain control of the car. This is a crucial aspect to the TCCC and will contribute to the long-term success of the student's driving career.

Additional critics of TCCC base their arguments on the physical development of a teenager, surmising that teens do not have the coordination required to make their hands and feet complete the necessary tasks for an aggressive defensive driving maneuver. Loeb, Kandadai, McDonald, and Winston (2015) performed a physical study comparing the braking times between a novice and adult driver with significant experience. This study occurred in a simulated environment using a driving simulator and stopwatch to time reactions. While reaction times were not significantly different in the groups, the researchers did surmise that there was a significant difference in situational judgment before a potential crash between the two groups. The novice drivers required double the time to react or realize that there was a high-risk situation in front of them. This study does highlight the concept that learning is an experience over time rather than learning occurring like an on-off switch. Piaget in his formal operations stage of the cognitive learning theory describes progressive steps in an individual's learning progress while developing as a mature learner. All learners do not reach the formal operations stage

during their teen years but rather take additional time to develop these skills (Ginsburg & Opper, 1988).

Given this fact, the teen car control curriculum requires some allowance for variation in developmental stages of learning in order for the student to be successful. This may require that coaches slowdown the student, keep directions simple or give additional practice sessions to students learning at slower rate compared to their peers. Some of the TCCC surveyed allow for these learning differences primarily through the expertise of the coach in teaching. Some of the schools were fortunate enough to have healthcare professionals or licensed teachers as instructors, and instructors were given these tentative students once they were identified. This matching of instructors to students would greatly allow for a student course and future driving success.

In addition, coaches should be instructed on the limitations of some students and their reaction times. It should never be the expectation that a student will have mastery of defensive driving skills on their first experience of an aggressive defensive driving course. This is exactly why the courses are designed like schools. If a "special needs" student is identified before the beginning of class, an effort is made to pair that student with a coach who is either a credential teacher or other healthcare professional that would understand the learning situation of that student. By doing so, one can surmise that it will increase the overall effectiveness of the TCCC training.

Even though there are critics of TCCC, there are many who are in favor of increasing the current driver's educational programming to include crash-avoidance techniques. Mayhew and Simpson (2002) completed a systematic review of multiple

studies trying to determine if current programming could be improved to decrease teen car crashes. They concluded that the primary weakness of current driver's educational training is the lack of accident-avoidance instruction. The teenagers simply are never faced with challenging situations where they have an instructor in the car. Currently, driver education courses drive with mostly normal types of everyday experiences. Though this appears to be of benefit, the authors claim that there needs to be something more. Mayhew and Simpson (2002) recommendation was to include accident avoidance in all driver's education courses.

In order for accident avoidance training to be successful, curriculum should include an overarching philosophy of Piaget's cognitive learning theory as it focuses on problem-solving. Problem-solving is a normal component of a teenager's cognitive developmental stage (Ginsburg & Opper, 1988). To operationalize accident-avoidance training, the curriculum ideally would include instruction on vehicle dynamics followed by hands-on driving, and learning accident avoidance techniques. These skills include hard stops, fast turns and navigating one's way through coned courses, which are only gained through problem solving and repetitive practicing.

Mayhew and Simpson's (2002) research indicates that accident-avoidance training decreases morbidity and mortality; thus their research supports the need for teen car control courses. Curriculum of the TCCC highlighted in this discussion does in fact contain a primary focus of accident avoidance both in lecture and in hands-on driving. In addition, this accident-avoidance training presents scenarios and real-world application of the skills being taught.

Mayhew and Simpson (2002) are not alone in their opinions on this topic. In fact, many are searching for the course work which will dramatically increase a novice driver chance of survival during their first two years through accident avoidance. Mueller, Stanley, and Manlove (2012) published a study funded by the State of Montana on teen defensive driving schools, focusing on answering two questions. First, they asked if advanced defensive driving school reduces the incidence of teen morbidity and mortality related to crashes. Secondly, they wanted to determine if defensive driving schools cause an increase in risk-taking behavior due to overconfidence in one's driving ability. The curriculum of the course included lecture and hands-on driving that resembled TCCC described in this discussion. Therefore, this article is an excellent comparison study and potentially reflects outcomes of the TCCC Midwest.

The intriguing part of Mueller, Stanley, and Manlove's (2012) work is that they incorporated components in their curriculum of Piaget's cognitive learning theory of abstract reasoning (Ginsburg & Opper, 1988). This is evidenced by the coaches instructing the students on the correlation of risk-taking behavior and mortality, and the relationship between vehicle inputs and dynamics. Specifically, when one is distracted while driving on the highway at 75 mph there is a pretty good chance that they will crash and become injured. In addition, when one's car is sliding sideways and the driver turns away from the skid, they will correct the car's course, whereas a turn into the skid will create a spin and potentially a crash. This study included the lecture concepts, like skid control, and followed it with the hands-on closed course driving skills. As part of the

lecture, the students were allowed time to question various concepts of defensive driving techniques and how that translates onto the skid pad, with the instructor.

Mueller, Stanley, and Manlove's (2012) curriculum also uses Bandura's social learning theory in their curriculum. Bandura (1989) states that people will model their own behavior after observing the outcome of others' behaviors This theory directly applies to the course development in the Montana study. For example, when a student first approaches a driving exercise, the coach will drive the car through the exercise, modeling correct techniques. The student is able to watch the instructor and see the outcome of the aggressive defensive driving, especially noting the car did not flip over or was able to rapidly stop. Therefore, in this course, students will see the successful behavior of the coaches and model their successful driving techniques.

The second question Mueller, Stanley, and Manlove (2012) attempted to answer was whether or not defensive driving courses encourage risky driving behavior in teenagers. The authors collected this information via a take-home survey of risky behavior, to be completed by the student. The survey asked several questions, utilizing a Leichardt scale in order to quantify results. Questions focused on number of crashes, near misses, speeding events and risk-taking behavior. The survey showed mixed results that were not statistically significant. The authors question the outcome of this part of the study due to a lack of confidentiality in their survey because parents were given full access to their child's responses, which may have inhibited teenagers telling the truth. Additionally, responses were not confirmed with objective information like police databases. Therefore, students may be overestimating their risk-taking behavior.

This survey concept only works if the students had developed abstract reasoning as described by Piaget's learning theory (Ginsburg and Opper, 1988). The teenager must take their concepts of what is risky driving behavior, their actual driving behavior and their concept of what is actually risk, and then answer the question. The authors did not control for cognitive reasoning ability, but thought this was not an issue for the teenager's cognitive level development.

The Montana study is extremely beneficial for curriculum creation for teen car control courses, even though their outcomes showed mixed results. The benefit occurs because of the author's sharing of detailed curriculum, which includes a description of lecture content and hands-on driving exercises. Therefore, when one wants to create a course, the building blocks for a potentially successful course are present, and one does not need to come up with a unique curriculum.

The Montana study, by Mueller, Stanley, and Manlove, (2012) was not isolated in its attempt to determine how well trained teenage drivers become aggressive and risky drivers. Roman, Poulter, Barker, McKenna and Rowe (2015) in England surveyed teenage drivers over a 36-month period to determine their driving behavior and determine their understanding of consequences to their behavior. Results of their survey showed that teenagers, over time, would learn that their risky driving behavior was safer at some locations. They concluded that risky behavior continues, despite consequences, at the same rate as before, but the behavior would be moved to a perceived safer location. This conclusion emulates Bandura's social learning theory where, one learns from watching others in similar situations and adjusting their behavior to avoid a negative outcome

(Bandura,1989). The students would simply continue risky driving behavior at a place of less risk, which is determined by watching their peers consequences.

The concept of risky driving behavior is a difficult one, because a TCCC does not want to support risky behavior. Yet the closed course curriculum, with in-car coaches encourage the student to drive faster and faster through lane change maneuvers, often generating significant lateral gravitational forces. For many students, this is the first time they have ever driven this way, and it is surprising how many find it enjoyable. Therefore, as part of the TCCC a discussion focusing on the appropriateness of this aggressive driving behavior and suggestions on where this can occur safely, like at a local autocross tournament is necessary. All of the TCCC classes described in this paper are connected to either a local car club or racetrack. This allows the students to make connections and develop an outlet to safely and legally drive their car aggressively.

One would be naïve to say that a controversy does not exist in the effectiveness of any type of driver's education, whether it is for motorcycle drivers or novice car drivers. Completing a Google Scholar search reveals countless articles and blogs highlighting the effectiveness and ineffectiveness of any novice driving course. However, there seems to be some significant reasons why some studies find driver's training ineffective. Kardamanidis, Martiniuk, Ivers, Stevenson, and Thislethwaite (2010) argue that most of the driver's education studies are flawed for two reasons. First, is that the studies lacked randomization and a succinct control group, which results in poorly definable statistic outcomes. Secondly, the authors argue that most long-term outcomes of crash results

were dependent on self-reported data. This allowed students to either overestimate or underestimate their near misses or real events, thus skewing the outcome data.

One must also consider the lack of supporting studies, which could be due to several reasons. First evidence shows that drivers' education programs do not make new drivers safer. Rather it provides a sense of overconfidence, an increase in risk taking behavior, and a high crash rate as compared to the teenage population (Vernick, Guohua, Ogaitis, MacKenzie, & Baker, 1999). If the ineffectiveness was proven and published, it could have detrimental effects on future funding for these courses, and that may be the reason why there is little research. One must also consider that research is expensive and time-consuming, and thus may not be completed due to lack of significant and consistent funds. Lastly, the process for performing longitudinal research with teenagers is difficult due to the significant regulations required by internal review boards as teenagers are considered pediatrics. Internal review boards are necessary for the pediatric human subject protection, but their regulatory processes can be onerous, consuming researcher energy and project funding.

In conclusion, in light of the discussion and literature review, one must ask the original practice question; Does participation in a teen car control course develop teenagers into safer drivers? The answer is yes, because the overall consensus of studies reviewed show that an advanced defensive driving course will allow a novice driver to avoid fatal or near-fatal crash. It is also important to note that the studies factored out driving under the influence as a risk factor, focusing primarily on driving skill development. After taking into consideration the dismal statistics of current teenage

morbidity and mortality in vehicular crashes and the positive influence of TCCC, it would make sense that a focused effort be made to develop and require a TCCC for all new drivers.

Identify Implications for Nursing Practice

Even though there is no direct evidence showing that a TCCC is helpful in reducing teenage mortality and morbidity rates, one can surmise after reviewing the related data, that TCCC would be of benefit and is worth one's time. In fact, an article by Lonero (2008) examined the research behind driver's education and concluded that the previous studies on the effectiveness of driver's education were flawed because their primary focus was on the concept of graduated driver licenses. Therefore, there is hope that these driver's education courses truly make a difference. Additionally, it is a requirement of the American College of Surgeon's (2014) for trauma centers to coordinate significant injury prevention projects that reflect data in the trauma registry. With motor vehicle crashes being the number-one cause of injury and mortality in the teenage population, it would be prudent to actively address this issue.

Since novice teen mortality remains a significant public health issue, and the literature supports the effectiveness of defensive driving courses, nurses at all levels of practice should connect to organizations with teen car control classes. This would not be a normal public health project. Therefore, nurses with an affinity to teach, drive and connect with teenagers are probably the most likely ones to enjoy this experience.

When one considers involvement, the highest level of engagement should be the trauma program managers and injury prevention specialists at trauma centers. These

health care providers are mandated by the American College of Surgeons to match injury prevention efforts to current trauma registry data. Though these people may not be experienced defensive driver instructors, they are ideal course coordinators.

A subsequent level of nursing practice would include participation as either a classroom lecturer, car coach or course worker. Each of these positions not only requires someone who cares about novice driver safety, but also has the background necessary to teach at the level of cognitive and psychomotor functioning of a teenager, and coach them through the driving experience. Instructing at the appropriate developmental level is fairly straightforward due to the broad educational background of all nursing programs. As far as teaching the fundamentals of defensive driving behaviors, it would behoove one to take an emergency vehicles operations course and learn the techniques themselves. The techniques are not complicated but do require practice to become proficient. Once this driving proficiency is obtained, it would be fairly easy to communicate that with the student.

Lastly, if a nurse does not want to participate in the course, it would be beneficial for them to refer team drivers to a known course. Many of these TCCC run on limited budgets with little funding for media advertising so word-of-mouth advertising is very important. For example, if a nurse has connections with a high schooler who's been involved in crashes, a referral from that nurse might prevent another crash in the future.

Recommendations for Nursing Research

After reviewing the current research, it is evident that ongoing investigation needs to be accomplished to determine the effectiveness of team defensive driving programs. There is a long history of quantitative research which has extensively focused on driver's education programs, which include lecture material and real-world hands-on driving. Unfortunately, this research into this type of driver's education has mixed results in showing reduction in team motor vehicle crash statistics. These weaknesses in the research could be for two reasons. First, drivers' education curriculum and information delivery has changed little over the last 50 years. An instructor presents a lecture, and then students experience driving time in limited-safe situations. Students are never given the opportunity to learn and practice aggressive defensive driving maneuvers even as simple as a panic stop. Secondly, most of the research completed on the effectiveness of driver's education courses or teenage defensive driving courses use quantitative data to determine results. These quantitative results are ideal for grant applications and statistical analysis, but do not always tell the whole story, the personal experiential story. In addition, the lack of efficacy of current studies could be due to a limited number of funds for such study which limits the ability to track students over time and obtain accurate crash statistics. One must also consider that many of the studies are small and are therefore subject to bias and difficult statistical analysis, which makes conclusions problematic.

In light of this information it is evident that it is time for a change in philosophy of the drivers' education research. First, studies need to examine qualitative and

anecdotal data to determine a project's success. For example, Mueller, Stanley, and Manlove (2012) provided indeterminate results for their well-designed and state-sponsored teen course, yet there may have been one student who learned a maneuver that could help them to avoid a crash and potentially save their life. No one knows, because this information was never collected.

Secondly, a standardized curriculum of a teen car control course should be designed using the best-currently available information, including lecture, didactic involvement and instructor training. The student's outcomes should then be tracked over time. Once a baseline is established, individual components of the course should be edited one at a time, while student outcomes are being tracked. Eventually, one will be able to establish a best practice curriculum and share with other course designers. Though this would take considerable time and effort, it is well worth the time and effort even if just one life is saved.

In conclusion, the national statistics tell us that teenagers are involved in more crashes and more severe crashes than the adult population. This occurs due to lack of experience. Multiple studies have been completed over the years, trying to determine if a driver's education program benefits those who take it. Unfortunately, many of the studies on this topic are inconclusive for multiple reasons, most of which include statistical limitations. But since this public health issue has such dire consequences to teen drivers, something must be done. The solution could potentially be the advent of multiple teen car control courses across the country, which mimic emergency vehicle operations courses. The coordination and instruction of these courses could easily be accomplished by

nurses, due to their broad education base. In addition, these courses could be developed by trauma centers coordinating with local car control clubs and community colleges. Cars are not going away and automated driving systems are not on the imminent horizon. Therefore, something should be done, and the teem car control course is the best idea.

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