**Cognitive Biases in Attitudes and Beliefs of Teenagers and Parents towards Practice Driving, Vehicle Choice, and Safety Technology.**

Theresa J. Chirles, PhD\*

Johns Hopkins Bloomberg School of Public Health

[tchirle1@jhmi.edu](mailto:tchirle1@jhmi.edu)

Andrew Hellinger

Johns Hopkins Bloomberg School of Public Health

[hellinger@jhu.edu](mailto:hellinger@jhu.edu)

Johnathon P. Ehsani, PhD

Johns Hopkins Bloomberg School of Public Health

[johnathon.ehsani@jhu.edu](mailto:johnathon.ehsani@jhu.edu)

Mitchell L. Doucette, PhD, MS

Johns Hopkins Bloomberg School of Public Health

[mdoucet3@jhu.edu](mailto:johnathon.ehsani@jhu.edu)

Christopher P. Rodman, MPH

Center for Construction Research and Training

[crodman@cpwr.com](mailto:johnathon.ehsani@jhu.edu)

Leland Brigham

Carleton College

[lelandhbrigham@gmail.com](mailto:johnathon.ehsani@jhu.edu)

Wendy Shields, PhD

Johns Hopkins Bloomberg School of Public Health

[wshield1@jhu.edu](mailto:johnathon.ehsani@jhu.edu)

\*Corresponding Author.

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**ABSTRACT – 160 Words**

Teenagers in the United States are at the highest risk of crash during the first year of independent driving. Graduated Driver Licensing (GDL) policies, vehicle choice, and safety technologies all have an impact on teenager safety, yet little is known about parent and teenager attitudes and beliefs that impact the choices and decisions surrounding these issues. We conducted six focus groups and used a grounded theory approach to qualitatively analyze the data. We found there were mixed perceptions about safety technologies, a consensus that logbooks did not accurately reflect the number of hours driven by the teenagers, and that overall parents believed older cars were safer and the more financially responsible choice. These attitudes and beliefs were heavily influenced by personal experiences and perceptions, rather than quantitative evidence, with many examples of *availability, substitution, and outcome cognitive biases.* By understanding the influence of cognitive biases on driving safety decisions, community-based educational outreach programs can more effectively improve teenager driver safety.

**Keywords:** Teenager Driving Safety, Qualitative Approach, Cognitive Biases, Focus Group

**1. Introduction**

*1.1 Crash Risk and Graduation Driving Licensing*

Teenagers have the highest crash risk in the United States1 and various policies, practices, and life experiences influence the decision-making and behavior of parents and teenagers as it relates to personal vehicle driving. An interdisciplinary approach recognizing the interdependency of life choices and human behavior2–4 is necessary when investigating the effectiveness of policies to improve young driver safety. One such type of policy that appears to have widespread support from parents5,6 of teenagers is Graduated Driver Licensing (GDL) laws that aim to reduce crash risk by adding additional restrictions and requirements for teenagers seeking to obtain their full-privilege license.7 The first of these requirements is typically a learner’s license or permit which allows teenagers to obtain practice driving experience under the supervision of an experienced driver. Once teenagers pass their driving test, they are commonly given a provisional license which allows them to drive independently but with restrictions that prevent them from driving in high-risk situations like at night 8 or with young passengers.9

In 1978, Maryland became the first US state to implement a GDL system, which required newly-licensed drivers under 18 to obtain a provisional license with driving restrictions.10 This was estimated to reduce daytime crashes by 5% among drivers with provisional licenses.11 Maryland later bolstered their GDL system with the addition of the learner license in 1999.12 Kirley et al. (2008) reported a 18% decrease in crashes involving 16-year-old drivers after the introduction of the learner license, and that further changes to Maryland’s GDL law led to significant decreases in crashes among 16, 17, and 18-year-old drivers.13 Since Maryland passed their first GDL law, all 50 states and the District of Columbia have followed. Nationwide analyses of state GDL laws demonstrate that these laws significantly reduce fatal crashes among 16 and 17-year-old drivers, and these reductions are shown to increase in states with stronger GDL laws.14

While GDL laws have been effective in reducing the burden of injury experienced by teenage drivers, their supervised practice driving requirements have shown mixed results. Recent research has shown that required practice driving hours for teenagers has little to no effect on teenagers’ fatal crash rates,15,16 which would seem counterintuitive. Increasing the amount of a teenager’s practice driving has been demonstrated to improve their driving skills,16 which would be expected to help decrease the teenager’s risk of crash. However, some research suggests the minimum of 30-50 hours required by many U.S. states17 is not enough to develop a mastery of driving skills.18 The state-required number of supervised practice driving hours appear to be enough to pass the driver skill test, and passing this test may confer an exaggerated confidence in driving skills on the new driver.19

# 1.2 Vehicle Choice and Safety Technology

The first car a teenager drives represents a unique opportunity for intervention. We know that teenagers tend to drive smaller, older cars which offer poor crash protection,20 and close to half of all teenagers will crash in their first two years of driving.21,22 Therefore, the vehicle that newly licensed teenagers drive could play an important role in minimizing their risk of injury or death. Newer vehicles have safety technologies that can warn drivers of a hazard, take corrective action to avoid or reduce the severity of a crash, and protect occupants in the event of a crash.23 These technologies can be divided into two categories: 1) those currently required in new vehicles by law, and 2) optional features, which can be purchased when buying a new vehicle. For example, Electronic Stability Control (ESC), has been required in new vehicles since 201224 and is installed in half of all registered vehicles.25 This technology has reduced single-vehicle crashes by 32%26 and fatal single-vehicle rollovers by 72%27 – crash types for which teenage drivers are overrepresented.28 In contrast, lane-departure and blind-spot detection systems are optional features that warn drivers when they're drifting out of their lane or changing lanes dangerously close to other vehicles. These have reduced injury crashes by 21% and total collisions by 11% 29 but are available in fewer than 10% of new vehicles.30

Parents are the primary decision-makers about the vehicle their teenagers will drive,31 but little is known about their decision-making process and motivation that leads most to provide older and, as shown by empirical data, less safe vehicles for their teenagers.20 Short of asking people to list the specific safety technologies in their vehicle, vehicle age becomes a useful proxy for determining their presence. In a 2014 survey, the majority of teenagers (60%) reported driving a vehicle that was 10 or more years old.32 Most parents (57%) said that they plan to provide their teenager with an existing vehicle from the household. In instances where a vehicle would be purchased for the teenager, 83% of parents intended to buy it used, and only a third (33.9%) of parents were planning to provide their teenager with a vehicle that was less than five years old.20 Interviews and surveys of parents and teenagers have demonstrated an agreement that safety technologies would improve crash risk, but that these technologies should be used after the learning period for novice drivers33,34 which appears to extend beyond supervised practice driving.

*1.3 Aims of this research paper.*

The goal of this paper was to increase the interdisciplinary literature investigating the reasons behind vehicle choice (including vehicle safety technologies) and parent and teen perceptions of the GDL policy requiring 60 hours of practice driving. We chose to focus on a convenience sample in suburban Baltimore, MD that was pursuing driver education as part of the driver licensure process. 70.58% of Maryland residents have their driver’s license35,36 which reflects the licensure rate of teenagers across the country.37 By using a qualitative focus group approach, our goal was to elicit responses from our participants that were not influenced by questionnaire formation or a predetermined theoretical model.38,39 By including perceptions of policies and rationale for choices, we present a view of complex human behaviors which illuminate issues that can be addressed in policies and practices to reduce the crash risk in new teenage drivers.

**2. Methods**

This study employed a qualitative research design to explore teenager attitudes toward licensure and vehicle ownership as well as parental expectations that might influence the teenagers’ outlooks. We recruited teenagers who were attending driver education classes and their parents/legal guardians to collect data prior to the start of the COVID-19 pandemic. This study was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health.

*2.1 Sample recruitment procedures*

Teenagers and their parents/legal guardians were recruited from a driving school in Maryland. At the start of our study, we purposefully sampled three driver education classes based on the number of students who were enrolled in the classes and their location in three different counties considered suburban areas of Baltimore, MD: Baltimore County, Howard County, and Anne Arundel County. While these counties range widely in their economic and social indicators, they are all above average for U.S. household income and education.40 Demographic information for these counties is presented in **Table 1**, but demographic information on actual participants was not collected due to time and location restraints. Eligible teenagers were between 16-17 years old, spoke English, and were enrolled in the driver education course. Parents of these teenagers were eligible if they also spoke English. Informed consent and assent forms were reviewed with the participants by the research team. Light refreshments were served during the focus groups, and each teenager received a $20 gift card.

**Table 1: 2010 US Census Focus Group County Location Demographics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **County** | **Baltimore** | **Howard** | **Anne Arundel** | **Nation** |  |
| **Household Income** | 71,810 | 115,576 | 94,502 | 56,516 |  |
| **Educational Level** |  |  |  |  |  |
| High School Diploma | 91.1 | 95.3 | 92.0 | 90.0 |  |
| Bachelor's Degree | 37.8 | 61.2 | 40.1 | 33.4 |  |
| **Racial Demographics** |  |  |  |  |  |
| White | 61.4 | 57.3 | 74.7 | 76.6 |  |
| African American | 29.2 | 19.5 | 17.5 | 13.4 |  |
| Asian | 6.4 | 18.9 | 4.1 | 5.8 |  |
| Household income is the average household income reported in US dollars. Education level is the percentage of residents with the degree indicated or higher. The Nation column has the averages for the United States of America. (US Census, 2010) | | | | |

*2.2 Data collection*

At each of the three locations, we conducted one focus group with the teenagers and one separate, concurrent focus group with their parents, for a total of six groups. All focus groups occurred within a four-month period. Parents were asked open-ended questions about the licensing process for teenagers, vehicle choice and safety, and teenager motivation to drive. Teenagers were asked similar open-ended questions. The focus group guide was designed to address several research inquiries, and the questions had been pretested for initiating discussion with a convenience sample of parents of teenagers prior to the study. Questions that elicited the content used for this study are listed in **Table 2**. TJC facilitated the discussions with the teenagers, and JPE facilitated the discussions with the parents along with WS and MLD. The facilitators alternated between asking all participants to respond to questions and hearing voluntary responses to minimize dominance of a few. On average, focus groups lasted around 40 minutes. Focus groups were audio-recorded by the facilitator and transcribed verbatim by a professional transcription service and research assistants. In situations where the audio file or transcription were not clear, authors JPE and AH reviewed the audio files together to assess accuracy.

**Table 2: Focus Group Guide Selected Questions**

|  |  |
| --- | --- |
| **Parents:** Tell us about your teen: | Is this your first teen driver? |
| What is one fear/concern that you have? |
| What is one hope you have as they begin learning to drive? |
| **Teens:** Tell us about yourself: | Are you driving yet? |
| Why do you want to learn to drive? |
| What is one fear/concern that you have? |
| **Common Questions:** |  |
| General Questioning: | How important is the issue of safety? |
| What should be done to improve teenage driver safety? |
| After initial training and licensure, what ongoing monitoring or training should take place? |
| Parental Role in Driving: | Who is most responsible for training teenagers to drive safely? |
| Who is involved in recording the amount of practice driving the teenager is accumulating? |
| Where do you and your teen record your supervised practice driving hours? |
| Would you use an app to measure practice driving were it available? |
| Introduction to App for Measuring Practice Driving: | Have you ever heard about these apps? |
| Are you currently using or considering something like this? |
| If you are using them, please describe some of your thinking behind why you decided to use them? |
| Are they specifically for driving/safety or do they have other features? |
| How did you have the conversation with your teen/your parent about using these? |
| Vehicle Selection: | Describe the age and features of the vehicle that you/your teen will drive as their first car. |
| Can you tell us your thinking behind that choice of vehicle and the factors you are considering? |
| Describe the safety features these vehicles have (if any)? |
| What do you mean when you say safety? |

*2.3 Data analysis*

Focus group data were stored, managed, and analyzed using Microsoft Excel and Word. We employed a thematic analysis technique using grounded theory as a guideline to examine the content.41 Authors TJC, CPR, and AH read all transcripts for immersion, then they independently developed codes and corresponding themes using the six focus group transcripts. Following this, authors TJC, CPR, and AH conferred on codes and themes to develop a consensus codebook. The codebook offered the theme name, description of the theme, theme-related codes, and contextual excerpts for each code. Authors CPR and AH recoded all transcripts per the codebook. Quality assurance was conducted by TJC who reviewed the codes and transcripts. Each of the few discrepancies that arose were discussed and resolved through consensus among the authors.

# **3. Results**

Six focus groups (3 teenager groups, 3 parent groups) consisted of a total of 35 participants (teenagers: 11 males, 8 females; parents: 5 males, 11 females). Two major topics were discussed during the focus groups: A) Vehicle selection for new teenage drivers, and B) Graduated Driving Licensure (GDL). The themes that emerged at the first focus group sessions were present in the subsequent focus groups and are presented in Table 3. Quotes in this report were edited for readability (removing extra words such as “like” and minor grammatical edits) but without changing meaning.

*3.1 Vehicle Selection for New Teenage Drivers*

Most parents said they would provide a vehicle for their teenager, either by giving them access to an existing household vehicle or purchasing one. Parents were asked detailed questions about how they would decide which vehicle their teenager would drive, and teenagers were asked more general questions about which features are important to them when choosing a vehicle.

Three overarching themes emerged: (1) The likelihood that teenage drivers will crash and the associated financial costs; (2) Misconceptions about vehicle safety; and (3) Mixed feelings toward safety technologies. Most parents drew from their personal experience of learning to drive as a teenager to inform their approach towards vehicle selection for their own children.

*(1) The likelihood that teenage drivers will crash and the associated financial costs:*

Many parents reported crashing a vehicle as teenagers and knew of other teenagers who crashed their first vehicle. This led them to believe their teenager would also crash their first vehicle. As one parent stated, “I know I did [crash my first car]. Most teenagers crash their first car…” Alongside this belief, many parents intended to provide their teenager with an older, less expensive vehicle. Most parents stated they would either provide their teenager with the oldest vehicle they already had or would purchase an inexpensive car for their teenager. One parent remarked, “I was thinking, look for a little [cheap car]. Get something out there just a beater, where if she dings a pole or something, no big deal.”

Several parents expressed that purchase price and damage repair expenses were the most important factors in deciding which vehicle their teenager would drive. Among this group, there was a tendency to downplay or underestimate the risk of injury that teenage drivers face in the event of a crash. One participant stated, “…and if something were to happen, hopefully it’s not serious, they get in a car accident or something like that…hopefully it won't be too much damage to the car.” Discussing the vehicle they would provide, another participant said, “[It] is a Honda Accord and it’s a bigger car… going on 12 years old. So, she’s going to get that car because it’s still running technically, and if it gets messed up, we just don't care.”

Some parents also mentioned concerns about the costs related to vehicle insurance. When discussing the impact of adding a child to an existing automobile-insurance policy, one participant stated, “Don’t forget, when you start adding your children on insurance… woah! It costs a lot. So, if you have an older car… [it is cheaper.]”

*(2) Perceptions about vehicle safety:*

Most parents emphasized the importance of large vehicle size and strong build quality over safety technologies such as airbags or blind spot detection systems. One participant explained, “Yeah, the bigger, older car, my '69 Impala, I had like seven eight feet behind me before the other car got to me. So… I felt a lot safer. You know?” Another participant remarked:

“I think about my little Chevy Chevette, that was like a steel drum. And if somebody hit me, I might have felt something, but… I didn't get hurt… And the cars they make lately, they say, ‘Safety, safety, safety,’ but some of their stuff is a hindrance more than it is a safety feature.”

Parents also felt that vehicles with good visibility of the roadway were objectively safer: “We had an extra car that I purposefully kept, it’s a little bit older and has really good visibility all the way around and that was really the reason that I kept it.” Several parents perceived older vehicles to be stronger and therefore safer than the newer vehicles. One parent stated, “You know, nowadays I've seen so many accidents on the road now. The plastic car just scrunches up. It's like a comic.” Apart from vehicle size, some parents equated mechanical reliability with safety. For one parent, since their vehicle was “working fine,” it would be a safe vehicle for their teenager to use.

*(3) Mixed feelings toward safety technologies*

Most parents were skeptical about assistive safety technologies, such as blind spot monitoring or lane departure warning systems, while a minority of parents had a positive view of these technologies. Most teenagers recognized the importance of safety technologies in the vehicle they drive.

The main cause of parents’ concern was often over-reliance on safety technologies. Parents expressed concern that safety technologies might make their teenage driver complacent: “I don’t want him to get too comfortable with all the bells and whistles so that he doesn’t feel like he has to think for himself.” Another parent followed up, stating, “The thing that concerns me a bit is, is the car doing the driving or is my son doing the driving?” One participant went as far to say teenagers should learn to drive without any assistive safety technologies, comparing learning to drive to learning mathematics: “They tend to … rely on [the safety features] …You know it’s like being able to do the math handwritten on the paper before you get to use a calculator…” These parents felt the overreliance on advanced vehicle safety features would be detrimental for their teenage driver’s learning experience. As one participant elaborated, “We weren't brought up with all of this stuff, computers. And so, I feel like if they could learn that and build their confidence off [the basics], that’s as much safety as you can get. Rather than rely on a computer.”

Many parents distrusted safety technologies such as forward collision warnings or adaptive cruise control and expressed concerns that they may fail and result in a crash. One participant explained: “So, for myself I don’t trust the sensors and the technology.” Another participant stated, “[Newer cars have] more safety features, but it kind of gives you a false sense of security.” Many parents expressed skepticism about the safety of airbags. One parent asserted, “Airbags are not safe” and another parent stated, “The airbags and stuff won't do a whole lot.”

A small group of parents raised concerns about distractions from safety technologies and other vehicle systems. One parent explained that their blind spot detection system aggravates them while driving on the highway. Only a minority of parents believed that safety technologies help improve safety. For example, just one parent expressed that blind spot monitoring was a useful safety feature:

“We also have a minivan…those are pretty safe. It tells you, ‘Hey, there's a car right next to you in the blind spot.’ So it's got that little light. I like that because yeah, I can't see the car, but hey, it says it's there.”

Another parent was concerned that their teenager would be more vulnerable when driving an older vehicle without modern safety features: “When he wants his own car...he’ll probably get an older vehicle. So then I would be more worried about safety features that might not be up-to-date.” One parent described researching the safety ratings of different vehicles, prioritizing vehicles that held good safety ratings:

“So, I started looking, okay, what are the cars out there? And started going to Consumer Reports and test ratings…I'm like, ‘Okay, when we're ready for a car, that's what we'll do. Look at like the safest cars and see what I can afford.’”

This was the only instance of a parent describing their use of reliable, external information sources to guide their decision making in selecting a vehicle for their teenager.

Most teenagers expressed that safety features would be an important factor when deciding which vehicle to drive, with one teenager stating, “I probably would think about what safety features are in the car before I get it.” One teenager dismissed the importance of safety features in the vehicle they were given from their parent, however. The teenager believed that, since their parent has been driving the car for a while without crashing, they would also be safe driving the car: “I'm not really looking for safety features because I'm confident in the driver [my parent]...So if he hasn't gotten in a car crash, I think the car is pretty good.” Some teenagers were more focused on features which make it more convenient to drive: “Well, I just think that a lot of the features that my mom's car has seem pretty nice...you can move the mirrors with just a button on the side.

# *3.2 Graduated Driving Licensure*

When asked about the process of recording practice driving hours in paper logbooks, both parents and teenagers agreed that this process is the teenager’s responsibility. Teenagers explained that other teenagers tend to be untruthful when filling out their logbooks. Parents expressed that an app would be helpful in more accurately recording hours.

*(1) Documentation Responsibility*

Both parents and teenagers reached a consensus that recording hours in the logbook should be the teenager’s responsibility. One teenager remarked, “I think it's my responsibility to remember to log stuff because, if I don't show responsibility with this, how can I show responsibility for driving in a car?” while another teenager echoed the same sentiment. They admitted that their dad usually tries to help them remember how many hours they had driven but insisted that it is “not really [your parents’] responsibility to write it down or remind you” as you should take on your “own responsibilities and less of [your] parents” as you get older.

Interestingly, while most teenagers believe it is their responsibility to manage their logbooks, many also described that they don’t record their practice driving hours consistently. A common mistake teenagers mentioned was not recording their hours immediately after driving and then later forgetting how many hours they completed. One teenager stated, “when [you] finish practicing driving... [you] should write it down ... because if you don’t remember to do it, then you’re not gonna be able to get the time.” Another stated, “I haven’t done anything with the logbook yet.”

Another common concern mentioned by teenagers is the truthfulness of the recorded practice hours. Most teenagers knew at least one other person who had lied on their logbook or at least believed that teenagers may do this. One teenager described, “From what I’ve heard, or from what I’ve seen, some people do an extra 5 minutes just to get the extra 15 or 30 minutes consistently.”. Another teenager said they knew of “parents so protective... that they’ll fill out their [teenager’s] log for them, whether it’s real hours or not”. Teenagers blame this inaccuracy on the high number of required practice hours. “This is just too much,” one teenager stated, while another commented, “you need so many [hours].” Yet another teenager stated , “Yeah, I definitely think the ideal situation would be someone who has their permit, and they fill out their log responsibly, and they get all 60 hours and they get their license, but I’m sure that’s not the case.”

To fix this issue, some suggested decreasing the required number of hours. “Maybe if you made it 10 hours, that means kids are getting 10 hours of meaningful, honest, actually experiencing driving and stuff.” One teenager offered, “But when you make it 60, 100 [hours], that’s when they’re like ‘This is just too much, I’m just gonna [lie]’.” One teen called the use of a logbook an “[unfair] judgement,” believing that teens' attitudes toward their logbooks are not indicative of their attitudes toward driving. Another explained that, since there is a 9-month waiting period before teens can obtain their full-privilege license, it does not matter whether teens lie on their logbook since teens “ have to wait 9 months, so you could get those 60 hours which are required, or you could just BS them, but you’re still gonna get [your license] no way faster (sic) if you BS them or if you actually do them” Other teenagers said they disregarded the importance of logging practice hours because other teenagers do not take it seriously.

However, there were also teenagers who argued that honesty is very important when recording practice hours. “[The DMV is] trusting us to fill [the logbook] out truthfully,” one teenager stated, with another mentioning that “it’s… [our] responsibility to be truthful.” Another teenager believed that teenager’s honesty when recording practice driving hours will “show the type of driver that you might be or the type of person you’re gonna be.” One teenager also suggested the need for a system to help solve these accurate recording issues, as determining "which kids are actually doing it and are doing it themselves… is the most important thing.”

*(2) Improving Documentation Accuracy*

When parents were asked about a smartphone app which would record their teenager’s practice driving hours, some parents responded that such an app would be useful and would help improve the accuracy of the tracked hours. However, other parents described concerns that the app would invade their privacy and would distract their teenager from driving.

Many parents seemed enthusiastic about the idea of a smartphone app which would help them track their teenager’s practice driving hours. One parent exclaimed that they would “love” such an app. Another parent explained that their teenager would prefer to record their hours in the app over the logbook:

“I think my teen would prefer it, because… he doesn't like to write stuff down. So if he had an app to track, and he could hit start, put his phone down, and then drive… He'd be more for the app than the logbook.”

Some parents were concerned that such an app would be intrusive, since the app would contain detailed data about the teenager’s practice driving history: “I think I would find it a little bit intrusive. I don’t think I would like it.” Other parents dismissed these concerns, with one parent stating, “I don’t see it being a problem. Me, I wouldn’t use it, but it might be good for a teenager.”

A small group of parents were also concerned that the app might be distracting to teenagers and would encourage phone use while driving: “It would be hypocritical, because you don't want them to use… technology as it is… a distraction. I would rather them use a simple pen and paper and track it that way.” Other parents did not believe that the app would be distracting, as they assumed the parent would be the one handling the app while the teenager is driving: “I don’t think it’s the kid doing it though… I can’t make the assumption that it’s going to distract them because it could be a parent or it’s just a logging thing.”

*(3) Motivation for licensure*

Universally, teenagers stated that they wanted to have their license and be able to drive independently. Their motivations for seeking a driver’s license were mobility freedom and the ability to travel conveniently to work and school. These sentiments were expressed in statements such as, “I want to learn to drive so I can take myself places.” Interestingly, while teenagers consistently expressed a desire to not have to rely on parents for transportation, the parents had a very different view of the motivation levels of the teenagers. Parents described that their teenagers were content to use them as chauffeurs and felt it was up to them to motivate their teenagers to reach licensure. Consistent with the teenagers’ responses, parents also expressed that life situations, such as college and employment, were valid reasons for teenagers to have a license.

# *3.3 Cognitive Biases and Implications for Teenage Driving Safety*

While the content of the focus groups was informative for evaluating the efficacy of current policies and forming future guidelines and policies, what we found most interesting was the emergence of cognitive biases and the effect these biases have on safety outcomes. Cognitive biases are a natural, well-documented factor at play in all human decisions and attitudes. We analyzed our data to better understand the influence of cognitive biases and inform practices and policies that could leverage these biases to *promote better safety decisions.* 42**Table 4** presents three cognitive biases illustrated in our data, short explanations, and safety implications.

**Table 4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bias | Description of Bias | Issue | Example | Safety Implications |
| Outcome Bias43 | Judging decisions by outcome, not by whether the process was sound. | Choice of decisions that yielded successful outcomes in the past, regardless of the (possibly better) success probabilities of alternate choices. | “I’m not really looking for safety features because I’m confident in the driver [my parent]…So if he hasn’t gotten in a car crash, I think the car is pretty good.” | Relying on safety features and methods of learning to drive that ‘worked’ for a parent driver despite better options available. |
| Availability Bias44 | Relying on information that is easily accessible from memory to guide thinking and decision-making. | Statistical importance may not match mental availability, leading to sub-optimal choices. | “I’ve **seen** so many accidents on the road now. The **plastic car** just **scrunches up**. [bold emphasis added].”  “I know I did [crash my first car]. Most teenagers crash their first car…” | Physical traits of vehicles, especially in the context of car crashes, may be available to parents45,46 Perhaps this contributes to an emphasis on vehicle size as a safety feature.    Abstract statisticsabout safety features and crashes *avoided* will naturally be less available. |
| Substitution Bias47 | Tendency to subconsciously substitute challenging questions for ones that can be answered with little mental effort. | Important elements of the challenging question are ignored when answering the easier question. See below\* | There is evidence of question substitution in the focus group results (see below). | Parents simplify difficult decisions related to safety, leading to poorer decisions that don’t consider all relevant factors. |

One theory of the source of these cognitive biases is that the human brain favors the least effortful way to process and draw conclusions from information in the environment, avoiding the “unpleasant” experience of cognitive effort.48 For example, individuals rely on *availability* of cognitive information (what is easily accessed from memory) and its emotional intensity over statistical weight when determining the importance of data.44 The media coverage of the Takata airbag recall49 may explain why several parents expressed skepticism about the effectiveness of airbags, despite their long record of improving safety.50

Additionally, open-ended decisions are computationally challenging by nature and subconscious efforts to simplify the decision limit the cognitive processing demands. This technique involves subconsciously swapping the target question to a simpler question that participants may answer quickly, confidently, and automatically using a *substitution bias.*47 When we asked parents “Can you tell us your thinking behind the choice of vehicle for your teenager and the factors you are considering,” our data implies that the question was substituted for an easier, much straightforward question along the lines of “What would be the cheapest cost for me if my teenager gets into a crash?” This led to our finding that the financial costs associated with providing a vehicle for their teenager and repairing it following a crash were the primary reasons why parents selected older vehicles for their teenagers.

Our data also revealed parental knowledge of vehicle safety ranged widely, with some notable gaps about the relationship between vehicle age and occupant protection in the event of a crash that seemed to be rooted in an *outcome bias.*43Few parents sought safety information from reputable and objective sources, instead drawing primarily on their own knowledge and experiences of driving as a teenager. While they correctly recognized that larger vehicles are likely to be safer than smaller ones during a crash,51 they also conflated older vehicles with offering superior crash protection. This latter point is contradicted by epidemiological data indicating that occupants in newer vehicles are far less likely to be fatally injured than occupants of older vehicles.52

# **4. Discussion**

This study describes the attitudes and preferences of parents and teenagers enrolled in driver education in suburban Baltimore, MD, USA towards vehicle choice, safety technologies, and elements of GDL. By gathering unstructured responses from participants via focus groups, we were able to gain valuable information that is often missing when using predetermined survey response options.38,39 Additionally, by conducting separate focus group sessions for teenagers and their parents, we were able to discover interesting similarities and differences between their attitudes.

One example of an apparent disconnect between parents and teenagers arose during a discussion of motivations surrounding licensure. Many parents expressed the belief that their child was not motivated to drive and needed parental insistence to initiate the licensing process and complete the practice driving requirements. While we were not able to make direct parent/child comparisons, teenagers consistently expressed a desire to drive motivated by a need for independence. It may be that parents misinterpreted their teenager’s nervousness about driving, or that the teenagers’ aspiration for independence did not match their motivation for completing the rigorous practice requirements that GDL demands.53

Our findings indicate that parents tend to draw from their own experiences when deciding which vehicle their teenager will drive and are likely to be influenced by misconceptions about and distrust for vehicle safety technologies. Most parents appeared to minimize the possibility that their teenager might be injured in a future crash and instead worried about the financial costs associated with such a crash; thus, financial concerns supplanted their consideration of safety features during their decision-making process. Interestingly, optional safety features were described as a nuisance by some parents and something that might impede the development of their teenager’s driving skills. Both of these findings concur with previous research that found a large percentage of parents underestimated the crash risk of novice drivers,60 and that driver assistance systems should only be used by teenagers after the basic driving skills are learned.33 These findings highlight the need to develop a better understanding of parental sources of driving safety knowledge, which appeared to be based on personal experience and observations, and point to an opportunity for continued education efforts by the automotive industry and safety groups to address these misconceptions.

Findings from our analysis of these focus group sessions also suggest that teenagers believe that others do not properly record practice driving hours in their paper logbooks, but there was no direct evidence of this supposition. As discussed in the results section, many teenagers reported knowing of others who did not accurately record or recorded extra practice driving hours on their logbook to reach the required amount of hours; however, no teenager admitted to it themselves. Interestingly, this reflected the findings of a study conducted in Australia where parents believed their teenager’s logbook was accurate, but had doubts on the accuracy of logbooks completed by others.54 It is possible that some teenagers and parents are not actually completing the required amount of practice driving, despite claiming so at the Department of Motor Vehicles (DMV). This may explain the mixed results when comparing teenagers’ fatal crash risk with the number of practice driving hours they are required to complete.13,16 However, another explanation may be that these practice driving sessions are of poor quality and without much variation, preventing teenagers from gaining the valuable driving experience that policymakers and public health officials expect. An intervention study providing guidance to parents who facilitate practice driving sessions16 helped transform these required practice sessions into a time of skill learning and training rather than a bureaucratic requirement to be met before licensure. Teenagers and parents in our study expressed the belief that filling out the logbook was the teenager’s responsibility, framing the required practice driving hours as a way to measure the responsibility and character of teenagers rather than a time to be developing and learning complex driving skills and maneuvers. This focus on general concepts rather than specific skills has been reported in previous qualitative studies of parental perceptions of the learning to drive process.19

While overall GDL policies have reduced the crash risk of novice drivers and are highly supported by parents of young drivers,5,6 the quality and diversity of supervised practice driving hours is an area in need of further investigation. Encouragingly, recent research efforts have focused on improving the quality and quantity of practice driving using a smartphone application to monitor driving behavior.55,56 In-vehicle data acquisition systems are useful for understanding the particulars of supervised practice driving,57,58 but the scalability and accessibility of smartphones,56 with built-in GPS and accelerometer data collection, would allow for tracking of driving duration, distance, route, and conditions to understand the variety present in each teenager’s practice driving routes. The parents and teenagers in our study expressed an openness to using a smartphone application, with some concerns of distraction by the application while driving, and reflect previous findings of a willingness to incorporate smartphone technology to improve young driver safety.59

A limitation of this research is that it relies on self-reported behaviors and perceptions among a convenience sample recruited from a driving school. Participants in our study were also recruited from a limited geographic area, and therefore the findings are not generalizable to the larger U.S. population. While qualitative research has the potential for imposed investigator bias, 61 the focus group format allowed parents and teenagers to articulate their concerns in a more open and nuanced way than surveys allow, and our key findings may be specific to this sample of participants or may be illuminating attitudes and perceptions that are not captured through typical quantitative measures. While we have presented data on the racial composition and socio-economic and educational status of the focus group school locations, we did not collect demographic information on the participants. However, as the suburban Baltimore counties we sampled from each had above-average household incomes and the majority of 16 and 17-year-olds in the U.S. who receive their license come from affluent households,62 it is likely that our study participants were from households with above-average incomes.

The concerns raised by parents about assistive safety features impacting driving skill development for their teenagers reflect a belief that a certain set of core skills are fundamental to driving safely and that these cannot be replaced by technology, which is a view expressed by parents in previous focus group studies33 While this may feel intuitively true, evidence that a certain group of skills confers a safety benefit for teenage drivers has proven to be elusive.63 Studies from aviation suggests that over-reliance on safety systems can lead to a loss of skills,64 yet there is also ample evidence that safety technologies can prevent crashes or minimize their severity.29 The question of when certain types of advanced safety technologies should be introduced to novice teenager drivers is an important area for future work.

*Conclusion*

Parent and teenager attitudes and decisions related to these safety topics impact teenage crash risk by affecting whether safe or unsafe practices are employed during this stage of driving. Our data suggest that these attitudes and decisions are heavily influenced by a range of cognitive biases, resulting in a systematic undervaluation of evidence-backed safety practices and technologies. However, this may not be a deliberate discounting of evidence, but rather the research-backed safety practices may not be in their cognitive realm and thus alternate, often successful, strategies (cognitive biases) are utilized in decision making. While cognitive biases may be helpful when data is limited, it is possible these biases act in combination to increase error – or, in this case, when data related to crash safety exists, decrease the safety of teenage drivers. Future research examining the cognitive biases present in the attitudes and decisions of various stakeholders (parents, teenagers, driving instructors) may help to better understand how unsafe driving practices persist. Addressing misconceptions about vehicle age and crashworthiness in population-based education campaigns could be a further opportunity to increase the safety of teenage drivers.

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