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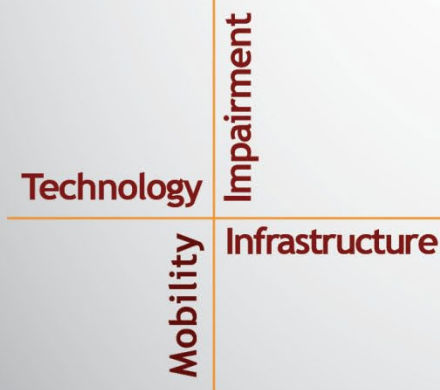
National Surface Transportation Safety Center for Excellence

Parents' Usage of Commercially Available Mobile Phone Applications for Teen Drivers

What Is Working?

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EXECUTIVE SUMMARY

Recent years have shown increasing popularity in a particular type of mobile phone application, or app: parent-teen driver performance monitoring apps. A growing body of research suggests that feedback and post hoc intervention of teen driving can be used as a tool to influence behavioral changes in driving. Commercially available apps for smartphones that incorporate telematics data (i.e., vehicle speed, hard braking, and GPS location) are a trending way for parents to be able to track their teens' driving.

Previous research provides many insights into how teens perceive driver monitoring apps and what role these apps play in improving driving behavior (Gesser-Edelsburg & Guttman, 2013; Peer et al., 2020). Teen driver monitoring apps can provide teens with tangible proof of their driving behavior that either demonstrates positive safe driving behavior or targets areas where constructive criticism on risky behavior is merited. Teens often feel driver monitoring apps are a more objective and unbiased way to monitor their driving with evidence compared to their parents' perceptions. On the other hand, these apps can also be viewed by teens as an extension of parental supervision, as well as an invasion of privacy and a restriction of their independence.

Parents greatly influence their teens' behavior whether they are behind the wheel or not. Parents have a unique role as the main enforcers for what the states may require for licensing rules. Parents have their own views regarding the driving risks that their teens face and may use these driver monitoring apps in different ways. This project aimed to understand what information parents of teen drivers want to see and use on a driving monitoring app and what they find useful for enabling the most effective feedback relationship with their teen. The research team worked with stakeholders to develop survey tools to help better understand parents' and teens' attitudes, preferences, and needs regarding app-based driving feedback.

The survey was administered by State Farm using their survey software (Suzy) to collect data nationally, including research participants from U.S. territories. Suzy can filter by gender, age, employment, education, income, and location. The questions took different forms, including multiple choice, Likert scales, open ended, and ranking questions. A total of 649 responses were received.

It was found that parents generally check monitoring apps the most during the following conditions: locating their teen, situations at certain times of the day, or when they know their teen is driving through bad weather. Parents are using monitoring apps to know where their teen is located, to see if their teen is speeding while driving, and to see the location where the teen is driving. Parents responded that the alerts they prefer from the monitoring apps include crash alerts, speeding alerts, and safe arrival notifications.

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LIST OF ABBREVIATIONS AND SYMBOLS

app	mobile phone application
OBD	On-Board Diagnostic System

CHAPTER 1. INTRODUCTION

Mobile phone applications, or apps, such as those supporting parent-teen driver performance monitoring have become increasingly popular. This is likely attributed to increasing research that shows feedback and post hoc intervention for teens' driving can be used as tools to influence behavioral change. Previous research has shown that when teen drivers are provided real-time feedback on their speeding behaviors, a simple alert can reduce the prevalence of speeding (Creaser et al., 2015). Klauer et al. (2017) found that real-time and post hoc feedback could reduce crash/near-crash rates but only when parents reviewed the post hoc feedback. Thus, there is evidence that real-time monitoring and feedback can improve teen driving performance.

This project aims to understand what information parents of teen drivers are motivated to use on mobile phone applications, what they find useful, not useful, and what tools they would like to have that are not currently available. The research was conducted in a series of three steps: (1) survey tool development (literature scan; detailed below in the background section) and a mobile application store audit for feature analysis of apps available today to then inform, (2) a survey for data collection using the Suzy application administered by State Farm to their research participant database, and (3) data analysis. As the project evolved, we discovered through the research and stakeholder feedback that the information about how parents are using these applications held more value, and the scope shifted the focus on the survey data results solely to parents.

BACKGROUND

The driver's education process and initial period of driving can be a stressful time for parents of teen drivers. Motor vehicle crashes are the leading cause of unintentional death for adolescents—national statistics suggest that seven teens aged 13 to 19 die every day from motor vehicle crash injuries (www.cdc.gov, 2022). Thus, the first 6–12 months of driving can give parents much cause for concern. Commercially available smartphone applications that incorporate telematics data (e.g., GPS location, vehicle speed, hard braking) are becoming more popular as a way for parents to track their teens' driving behavior. For example, the Life360™ smartphone app markets itself as a safety app which allows parents to monitor their teen's location in real time and alerts parents when the teen has arrived at preset destinations. Additionally, other applications (e.g., Google driving mode) either force the teen's smartphone to remain unusable or monitor phone use when the vehicle is in motion (e.g., Zendrive™).

Musicant & Lotan (2015) demonstrated that novice teen drivers would engage with a cell phone app that provided feedback on safe driving when participating with groups of teen drivers who were competing for rewards. Other research groups have also developed feedback and monitoring apps that provide rewards and engage teen drivers in novel ways. Sezgin & Lin (2019) found that technology-based interventions can be effective, especially when paired with social influence and parental involvement.

There is evidence to suggest that mobile phone apps generally can improve teen driving safety, especially with parental involvement. However, it is unknown what tools parents actually use and/or what app features will entice parents to use these apps if they are not already using them.

LITERATURE REVIEW

Teen Attitudes, Perceptions, and Beliefs Towards Driver Monitoring Apps

Evidence suggests that teens are extrinsically motivated to use driver monitoring apps. For example, driving improvements for teens were more prominent when monetary incentives were offered in conjunction with app utilization (Miriam et al., 2018). Peer et al. (2020) found that teens tend to feel that apps have a positive effect on safety-related driving behaviors, and this effect is higher when it is combined with an incentive. Additionally, they found that teens feel driver monitoring apps are a more reliable and objective way to monitor their driving compared to when their parents are the monitor (Peer et al., 2020). Apps can provide teens with objective proof that they are competent drivers. Technology is also viewed as an objective indicator that would be acceptable to both the parent and teen driver when they performed well or needed to improve a particular driving skill. There is evidence to suggest that teens have a more positive response to driver monitoring apps when the apps are labeled as mentors instead of monitors (Gesser-Edelsburg & Guttman, 2013).

Some studies indicate that a teen's intention to adopt a driving safety app is largely contingent on a combination of their greater intentions to engage in safe driving behaviors and to use safety tools (i.e., performance apps), more positive attitudes, greater perceived norms towards safe driving practices, and more personal agency in engaging in safe driving practices (Caitlin et al., 2020). Intentions to engage in safe driving practices can be correlated to intentions to adopt a driving safety app. Peer et al. (2020) found that drivers who previously drove safely were more likely to use a monitoring app for feedback and had higher app usage, which led to improvements in safety-related driving skills.

On the other hand, research also shows that teens can have negative feelings towards using driver monitoring apps. Gesser-Edelsburg and Guttman (2013) found that many teens feel negatively towards driver monitoring technologies, stating that the virtual component was an extension of parental supervision and could cause tension in their relationships with their parents. Additionally, several teens felt that these apps were an invasion of their privacy and a restriction on their independence. Teens may have mixed feelings regarding their parents being role models for safe driving.

Effects/Considerations of Parent-Teen Relationship on Effective Use of Monitoring Apps

A large body of literature links parenting style to teen driving style. Studies have shown that parenting style can directly influence a young person's driving style. Farah et al. (2014) found that families with more authoritative parenting and a high commitment to safety adopted a more careful approach to driving and those with less authoritative parenting styles drove more riskily. Additionally, Hamann et al., (2019) found that authoritative parenting led to higher seatbelt usage and fewer speeding events for teen drivers. Having an authoritative parenting style has been shown to reduce the risk of crash events for teen drivers compared to those with uninvolved parenting styles (Jewett et al., 2016).

Parents are a strong influence on their children's behavior, and this is no different for driving. A study by Farah et al. (2014) found that event rates measured for parents were also found to

positively correlate with event rates for young drivers. Research has demonstrated that teen driving behaviors often mimic that of their parents (Hamann et al., 2019). Young drivers are influenced by their parents' driving behaviors through imitation. Parents can shape their teens' driving behaviors through their own practices and can play a crucial role in shaping the behaviors, attitudes, and skills of their teen drivers.

Farah et al. (2014) found that even though most interventions are geared mainly toward novice drivers, they also had a positive effect on the behavior of parents, showing that intervention has a larger impact than just the targeted group. When these programs can target factors such as parenting beliefs, practices, and skills, they can foster positive development. When interventions involve media and direct parent engagement, they have been found to not only affect the parents' behaviors but that they also improved teens' driving skills and reduced their risky driving behaviors (Curry et al., 2015).

Parents are invested in how their teens are licensed because they are the main enforcers of what the states may require for licensing rules. Not only do parents have their own views regarding driving risks but also have a notion of what their roles and their plan should be for managing the risks when their teens start driving. Additionally, parents have their own personal views about restrictions once their teens are behind the wheel and notions about when these restrictions should be lifted. There is limited research on how family dynamics, priorities, and tasks shift once a teenager in the family starts driving and assumes responsibilities for at least their own mobility but potentially the mobility of younger siblings (Williams et al., 2006).

EXISTING MOBILE APPLICATIONS

The research team conducted a review of both the Android (Play Store) and iPhone (App Store) for all relevant applications available to both teens and parents that monitor and report different aspects of the driving experience. The applications were tested to determine the types of data available within these applications and what features could be customized.

As application analysis progressed, the applications began to take form into themed groups of monitoring apps, such as Mobile-Based Telematics, Insurance Company Smartphone Apps, Independent On-Board Diagnostic (OBD) Plug-In Devices, and Indirectly Related Applications. See Table 1 below for a summary of the applications identified and tested. As some applications required additional equipment to be able to use the full range of features, not all applications could be fully explored or tested. In this case, the screenshots available in the application store, user reviews, app descriptions, or other public information online were retrieved to find more detail. No original equipment manufacturer (OEM) in-vehicle based systems were assessed as the scope was on mobile phone applications.

Table 1. Mobile application store audit scope.

Application Category	Definition	Applications Assessed*
Mobile-Based Telematics	Uses mobile device features such as the accelerometer, gyroscope (rotational movements), and device GPS to monitor driving.	Life 360, SafeDrive for Teen Drivers, DON'T Parent & Child Apps, Floowdrive,
Insurance Company Smartphone Apps	Typically uses an in-vehicle device provided by insurance company to accompany the mobile application.	Drive with Safety, Right Track, Snapshot, Steer Clear
Independent OBD Plug-In Devices	Uses a third-party (not insurance) in-vehicle device to be self-installed and accompanied by the mobile application.	Moto Watchdog, Autobrain
Indirectly Related Applications	Applications not advertised as monitoring or driver performance measuring, but measure key safety driving factors such as fatigue, eye movement, or distracted driving and could be incorporated into other monitoring applications.	Keep Alert, TripRec Driving Recorder

*Apps in this table represent an evaluation of unpaid apps or the unpaid versions of apps listed.

**Please note several of these applications may no longer be available at the time of this report's publication.

The applications were assessed for the following variables: Performance Tracking, Monitoring Features, Gains (e.g., insurance incentive, money-based incentives, social influence), and Risks (e.g., privacy issues, battery drainage, internet dependency issues).

Performance tracking gave a good glimpse into what current application developers view as the top safety factors of driving. The most commonly found performance notifications included speed, safety belt usage, hard braking maneuvers, and rapid acceleration. It was not clear from each application what threshold of excess speed was used to determine factors like speeding or rapid acceleration.

Closely related to performance tracking, the monitoring features used telematics data either from the smartphone itself or from a device that plugs into the vehicle's OBD port. Using the smartphone itself, several monitoring apps reported phone usage while driving if the screen was turned on, applications were opened, or the phone was physically being moved around while the vehicle was in motion. Certain apps identified dangerous times of night or after-curfew times as times to be monitored while driving. Other features used location-based services to determine safe-arrival notifications or geofencing to notify parents of unauthorized driving to locations other than those defined in the app. Crash detection could also be detected based on telematics data.

The most common gains and incentives found were related to lowering insurance premiums or a percentage of the driver's auto policy if the monitoring system reported safe driving performance. While advertised as free, many of these applications required subscriptions to use the full range of services and features. Others were point-based systems that could then be

“cashed in” for monetary rewards or gift cards. In one case, the app was a learning program-based application that incentivized students to complete the program to receive a program completion certificate. For teens, social influence variables often took the form of leaderboards that could be compared to other participants within the application. A monthly or weekly score would often be used to “rank” teens against a leaderboard. Other apps used badges or symbols to showcase the status of stellar driving performance.

Risks identified across all applications included privacy risks such as sharing information with third parties, insecure location tracking, or independent applications sharing driving data without permission to insurance companies, or release to lawful court orders. Other risks to the teens included battery drainage by using these apps, which would not allow them to communicate with parents or use their GPS if they did not have a way to charge their phone while away from home. Risks to the app performance itself include dependency on internet or GPS to function if a teen entered a rural area with no service.

CHAPTER 2. METHODS

PROJECT OBJECTIVES AND SCOPE

This research project began with the goal of answering the following questions:

1. What information is the most important to parents in determining if intervention in their teen's driving behaviors is necessary?
2. What are the top reasons why parents use/do not use driver monitoring apps?

To answer these questions, the research team developed a survey tool alongside GM and State Farm to better understand the attitudes, preferences, and needs of parents of novice teen drivers. The survey focused on what commercially available tools parents of novice teen drivers are using, what features they find the most useful, least useful, and what currently unavailable information they would like access to.

STAKEHOLDER FEEDBACK

The first round of survey tool development was reviewed with stakeholder representatives from GM and State Farm, who requested, at the time of project award, to be involved in these initial stages. Two tracks were presented, one with an approach more focused on usability features to inform future app design, and the other approach more focused on the psychological and behavioral motivators to increase app usage. These tracks emerged out of findings from the literature review and app store audit exercise that determined a parental focus may be of more value.

A usability focus track could have explored several other variables, such as the greatest barriers to use and feature preferences, role and level of self-agency's effect on frequency of use (making commitment statements), most effective balance of peer competition vs. individual gain, design consistencies and gamified design analysis, and how features that promote engagement can be incorporated/paralleled to usable information for parents' app usage. An ultimate research goal became gaining insights for driver performance app developers that may allow them to create an app that is more user-centered, creating a more positive experience and therefore increasing usage. While all these factors were deemed important, it was decided that it was more important to understand which apps parents were using, how parents use these apps, and in what situations they are used to deduce what might make them more usable in the future, and more importantly, incorporate features that better facilitate the post hoc feedback.

The psychological motivation focus track presented other variables for exploration, such as training tools for parents on what is important for effective performance feedback loops. This would require exploring their understanding of their relationship with their teen and the role of trust, role of privacy, and consideration of how their peers might influence teens' receptiveness to feedback and usage of these apps. However, it was determined that, as a first step, usage patterns of these apps were more important. Survey questions related to psychological motivators should first be explored in the form of what parents believe their teens' opinions are regarding parental app use.

From this review and a closer look at the Suzy database pool, it was determined that the administration of a teen survey would not yield robust results or high responses, either in tangent with their respective parents who also took the survey or if given the survey independent of a parent-teen connection. Rather than one survey tool for teens and one survey tool for parents answering two different sets of research questions, the research team was advised by stakeholder representatives to narrow scope to focus on parents only with one survey tool. One survey tool was therefore developed (Appendix A) for parents that incorporated both the usability track and the psychological and behavioral motivator track in order to meet both stakeholders' needs from this data. This survey tool's new goal was to provide data on how parents are using these apps and how to enable more effective performance feedback loops through the information provided by the app.

REFINED SCOPE

The survey tool was disseminated nationally to gain a generalizable sample of parents of teen drivers across the U.S. Specifics of the survey not only identified the specific apps that are being used by parents of teen drivers, but focused on the type of information that parents are most motivated to use and in what situations. For example, there are common types of information that many of the feedback apps provide, which include hard braking events, speeding events, trip distance, seat belt use, road type, or destination notification. Most apps provide some, but not all, of these features and it was of interest to determine what parents most want to know about. Is there more interest in hard braking events versus speeding events? Do parents want to be alerted when their teens arrive at a destination? Do they only check these apps at certain times of day (e.g., late nights), or for certain locations (e.g., long-distance sporting events)? Additionally, we collected and evaluated information on parental attitudes and opinions on how these apps might enable safe driving feedback discussions, along with their willingness to use these apps for this purpose and how this affects their level of trust with their teen. The full survey can be found in Appendix A.

DATA COLLECTION

The parent survey tool was administered by State Farm in their survey software Suzy to collect data nationally, including research participants from U.S. territories. This interface allowed for age inclusions to be adjustable from 13–73 years, and allowed for filtering by gender, age, employment, education, income, and location. For most surveys, general results have an average response of 600, with a maximum response of 1,000 respondents. Most surveys received a gender split response of 60% female and 40% male. Survey questions took a variety of forms, including multiple choice (up to 11 choices), Likert scales, open ended, and ranking questions.

The survey criteria required participants to be parents of teenagers 15 to 19 years old who were licensed and that drove unsupervised without a parent/guardian present in the car. The licensure phase only (not learners) was chosen to ensure the monitoring of independent driving was the focus for understanding post hoc feedback intervention effectiveness. It was not a criterion for participation to use smartphone driver monitoring apps. However, to report past or active experience with these apps, they must have reported experience with such apps.

State Farm administered the survey tool in Suzy and collected data. This initial set of surveys yielded 535 responses. After an initial examination for data cleaning by the research team, it was discovered that many of the responses were contradictory about teen licensing status and age. It was evident that most respondents did not understand the question, which resulted in a smaller pool due to exclusion criteria. It was also clear that nearly half the respondents did not use monitoring apps, and thus a criterion to use the apps was implemented. The research team met with State Farm to make modifications to the survey for clarity. The revised survey was reissued, resulting in a total of 345 responses.

DATA CLEANING AND ANALYSIS

Both surveys initially yielded a combined total of 880 responses. The research team first cleaned the data set for duplicates and then completed coding before analysis began. During the data set cleaning, we removed responses from parents with no teens in the household, parents with teens who did not drive alone, and parents who had teens under 15 years old. Once those responses were removed from the data set, a total of 649 responses were deemed usable for analysis.

We began our analysis by finding the distribution levels of independent variables, including how often the teen drove unsupervised, the teen's age, how long they had been able to drive solo without an adult in the vehicle, driver's licensing status of their oldest teen, how many crashes their teen had been in, and which smartphone apps (if any) they used most often to monitor their teen's driving.

For the parents who reported they had never used a driver monitoring smartphone app with their teen before, we summed the number of responses for each option and produced a histogram of the percentages to each response. Once we established why parents were not using smartphone apps, we proceeded to ask parents who did use smartphone apps why they used them and how often they checked the app, which yielded 315 responses. We then summed the number of responses for each option and produced a histogram of the percentages for each response. Additionally, we asked how their teens felt about their parents using apps. We summed the number of responses for each of these options as well and produced histograms of the percentages for each response.

A chi-squared test of independence was performed on select survey questions. The independent variables were frequency of unsupervised driving time and amount of time driving alone (see Table 2). The dependent variables varied but were all in a "Yes/No" response format. Therefore, a 3×2 and 5×2 test of independence were performed. Within each test, 2×2 comparisons were made when the overall model was deemed statistically significant.

Table 2. Independent variables and respective definitions.

Variable	Definition
Frequency of Unsupervised Driving	<ul style="list-style-type: none">• Infrequent – teen drives unsupervised less than once a month, once a month, every other week, or once a week• Several times a week – teen drives unsupervised for multiple trips a week• Multiple times daily – teen drives unsupervised multiple times daily
Amount of Time Driving Alone	<ul style="list-style-type: none">• 1–3 months• 4–6 months• 7–9 months• 10–12 months• > 12 months

CHAPTER 3. RESULTS

Figure 1 summarizes how often teens drove unsupervised, whether multiple times daily, once a week, several times a week, every other week, once a month, or less than once a month by age:

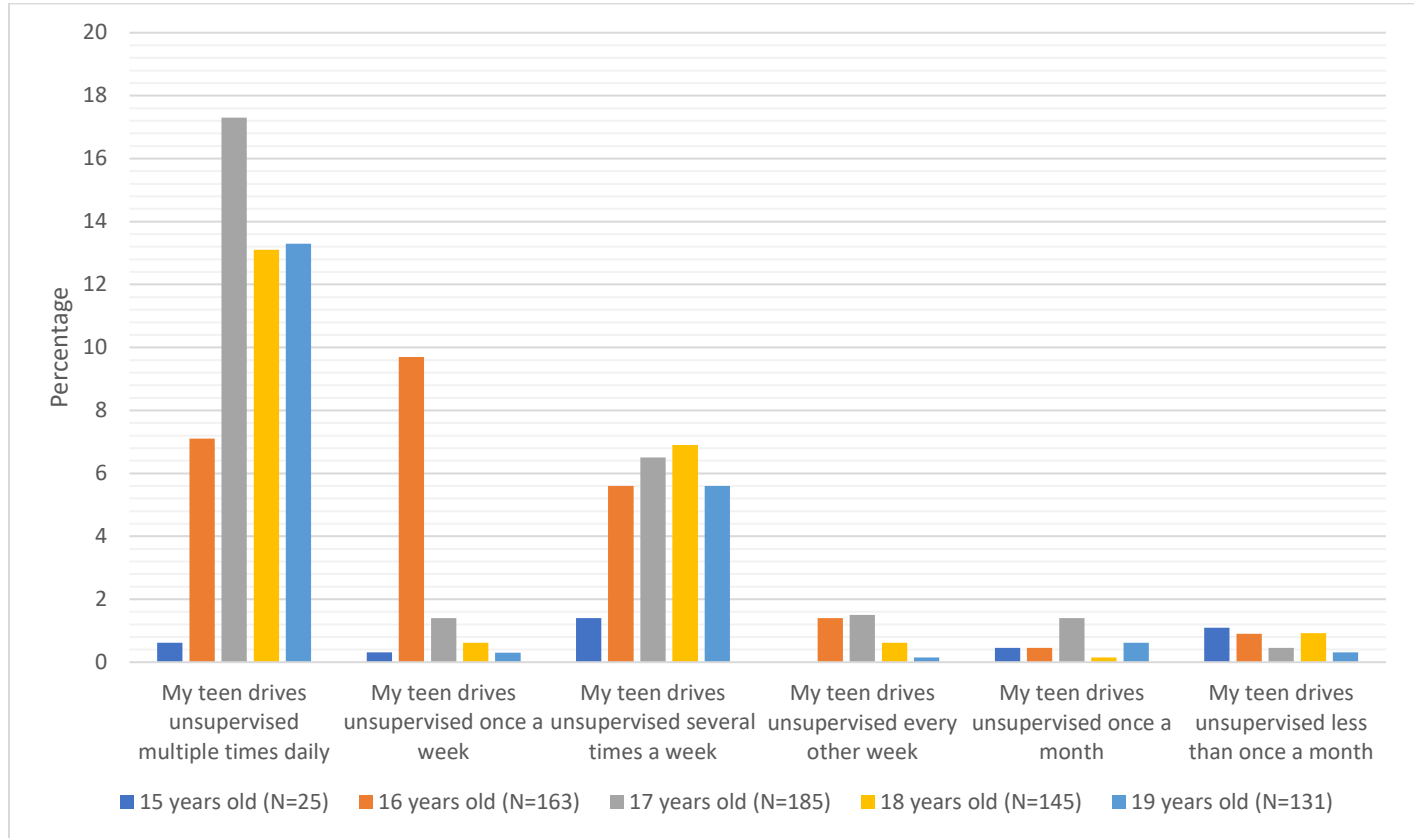


Figure 1. Chart. How often teen drove unsupervised (N=649).

Most teens drive more frequently, especially in the upper age groups.

Figure 2 shows how long teens had been able to drive solo without an adult in the car by age group. This histogram shows that for all age groups, the majority of teens had been solo driving longer than 12 months.

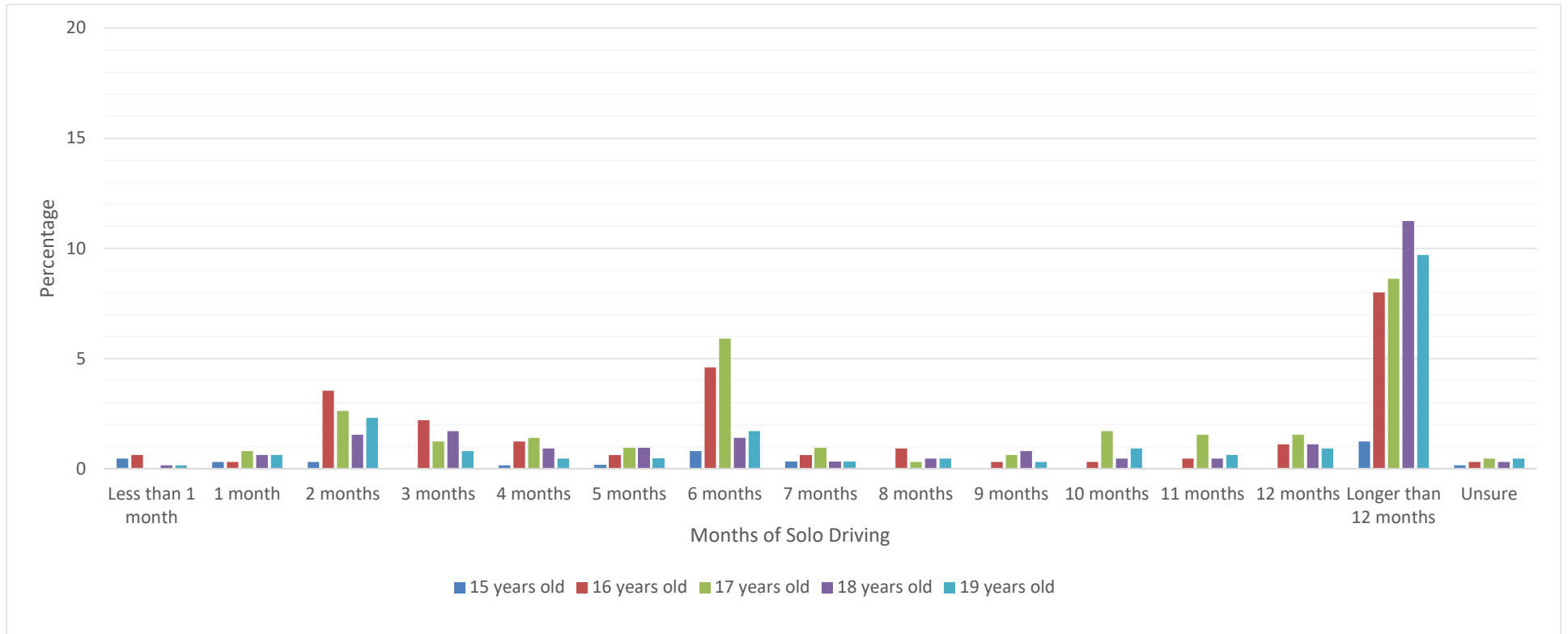


Figure 2. Graph. The percentage of teens by age and duration of unsupervised driving in the study sample (N=649).

Figure 3 shows the percentage of crashes that the teen drivers have been involved in when the teen was driving unsupervised. Twenty-four percent of the respondents reported that their teen had been involved in at least one crash while driving unsupervised.

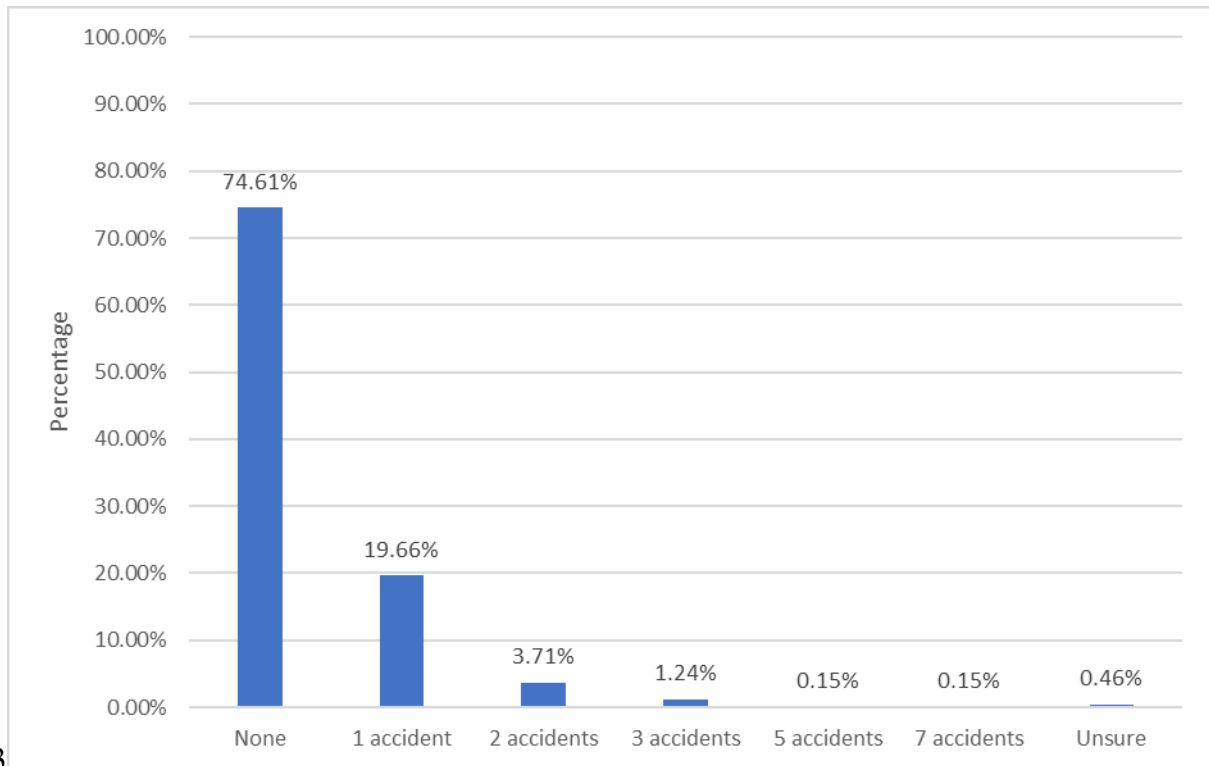


Figure 3

Figure 3. Graph. Percentage of crashes teen has been involved in while driving unsupervised (N=646).

Figure 4 shows the different types of apps parents use to monitor their teen’s driving if they use any app at all. Nearly half (48.8%) of parents reported never using an app to monitor their teens driving, followed by 28% of parents using Life360 to monitor their teen.

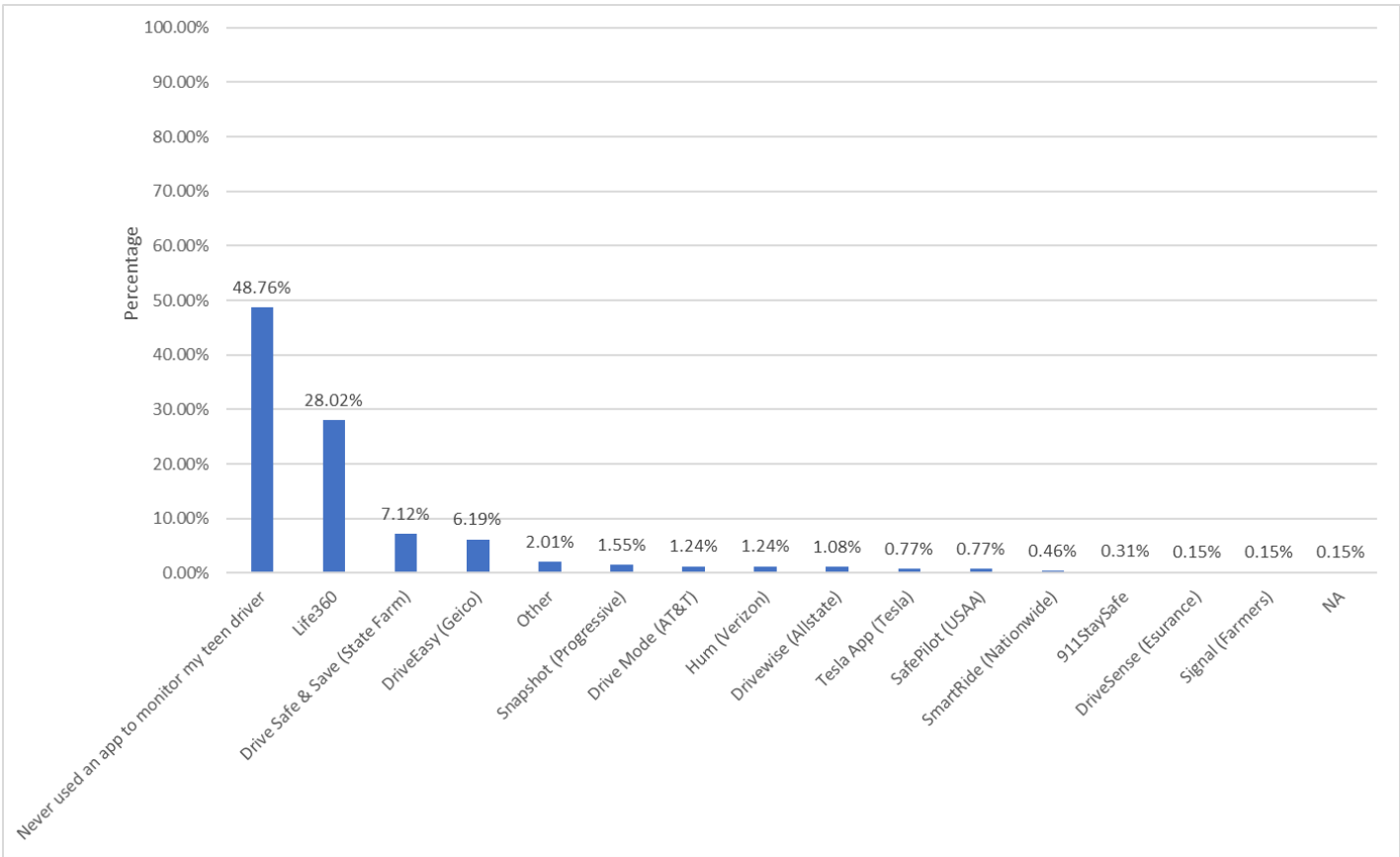


Figure 4. Graph. Apps parents use to monitor their teen’s driving (N=646).

Parents Who Do Not Use Monitoring Apps

A total of 48.5% of the 649 respondents reported that they do not use a monitoring app for their teen driver. Additionally, there were 19 participants who did not fully complete the survey; therefore, their responses were not included in the analysis. Thus, 315 respondents reported they did use a monitoring app and 315 respondents reported they did not use monitoring apps (50%/50% split). Of the parents not using apps, a total of 44% responded that they trusted their teen and did not feel the need to monitor them, followed by 43% answering that there was no specific reason they were not interested in using apps (see Figure 5). Parents were able to select multiple options for this question.

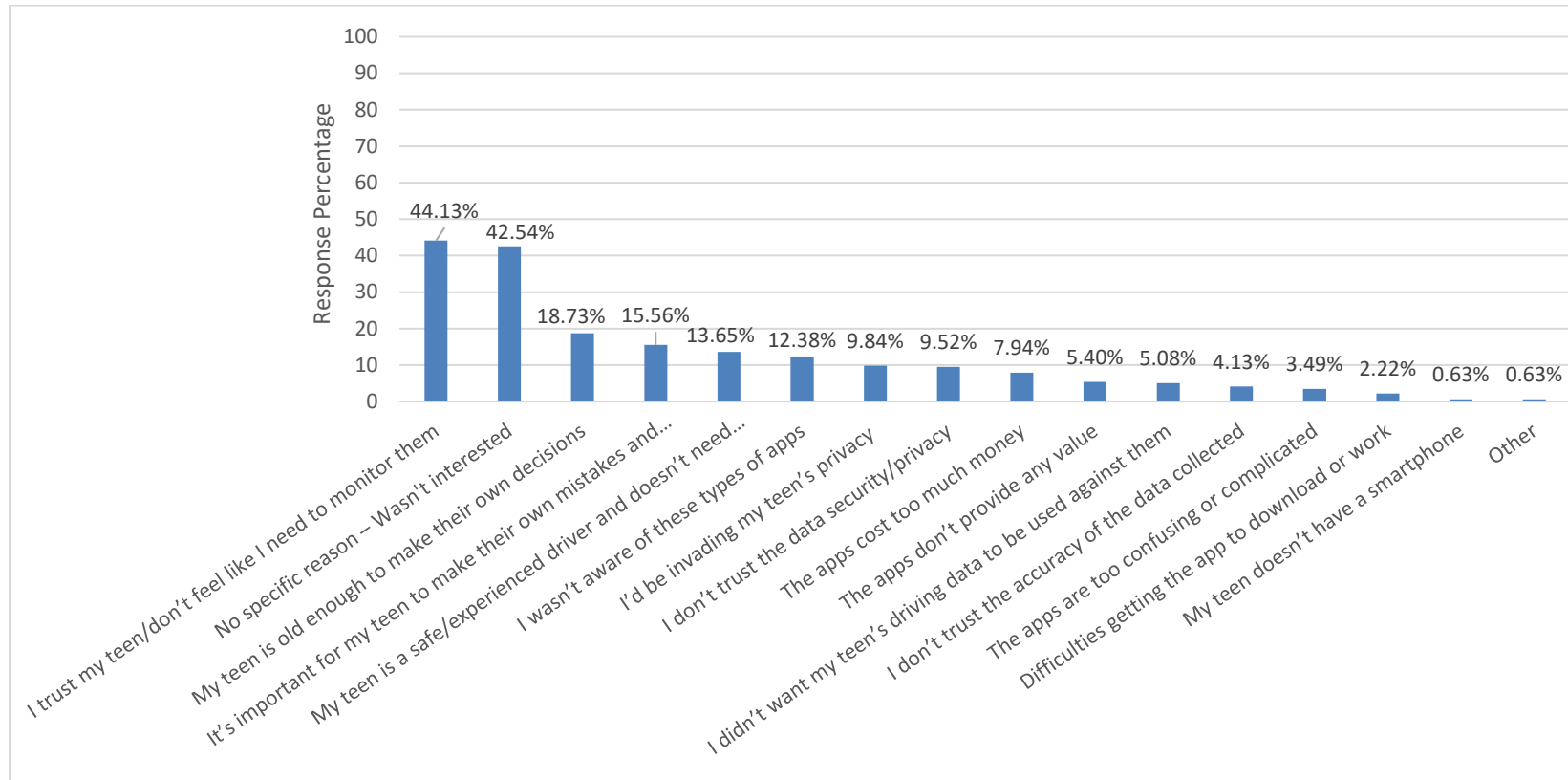


Figure 5. Graph. Parents' reasons for not using apps (N=315).

The frequency of unsupervised driving (e.g., infrequent driving, multiple times daily) did not impact parents' trust in teens, $\chi^2(2, 315) = 0.29, p = .86$. However, the length of time since licensure impacted parents' trust, with a decrease in trust between months 1–3 and 4–6 with a statistically significant recovery for greater than 12 months, $\chi^2(4, 311) = 23.39, p < .0001$ (see Figure 6).

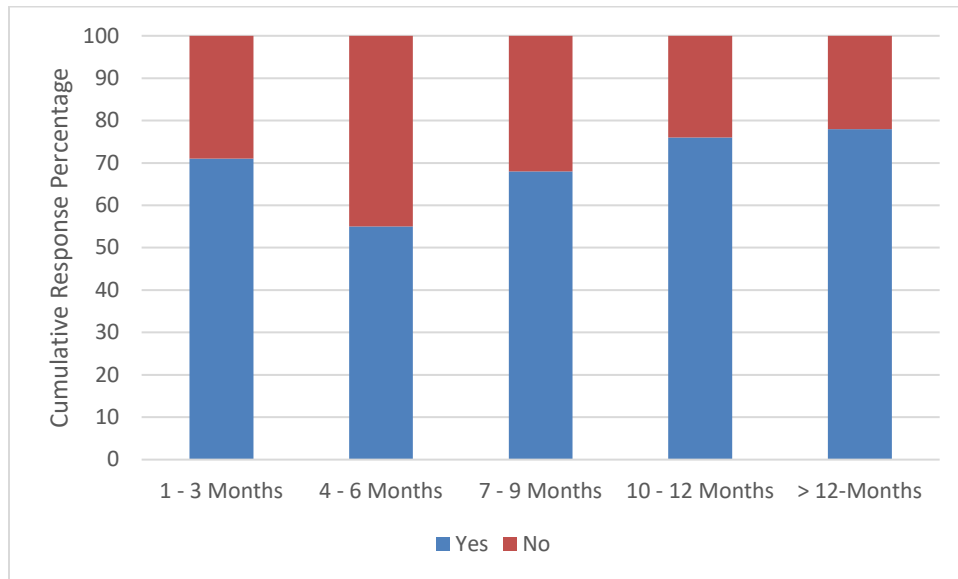


Figure 6. Graph. Percentage of parents who trust their teen while driving unsupervised as a function of months since licensure.

For no specific reason/wasn't interested, the frequency of unsupervised driving trips, $\chi^2(2, 315) = 38.84, p < .0001$, and amount of time since licensure that the teen has been driving unsupervised affected the percentage of parent response, $\chi^2(2, 315) = 20.35, p < .001$. Parents with teens who drove unsupervised infrequently were more likely to be uninterested in using a tracking app than those with teens who drove multiple times daily or several times a week (see Figure 7).

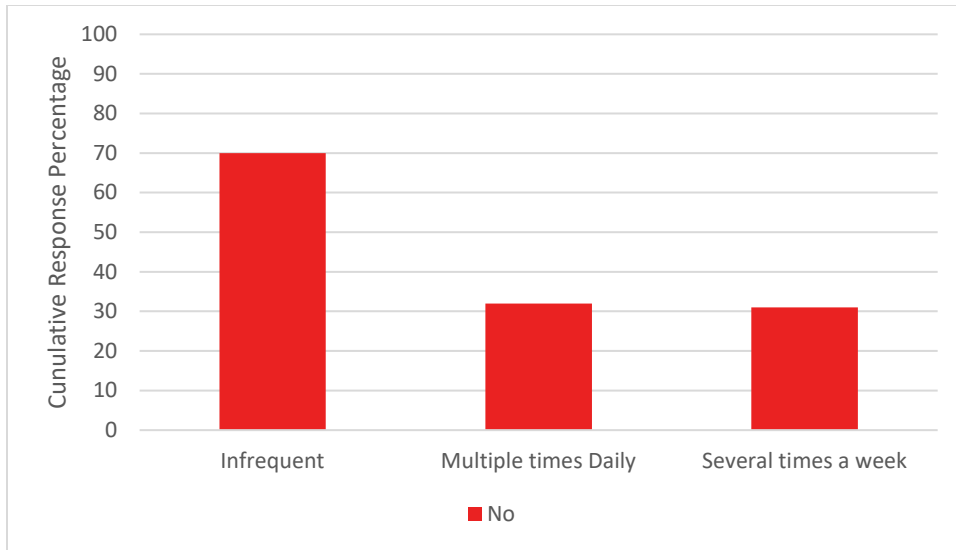


Figure 7. Graph. Parents’ interest in using monitoring apps based on number of times per week their teen drives unsupervised.

As the amount of time since licensure increased, parents became more interested in using the apps. Specifically, in the first 1–3 months of unsupervised driving, only 37% of parents were interested in using tracking apps. This significantly increased to 56% at 4–6 months. Numerically, there was an increase in percentage at 7–9 months, then 10–12 months and longer than 12 months, but these were not significantly different from the 56% at 4 to 6 months.

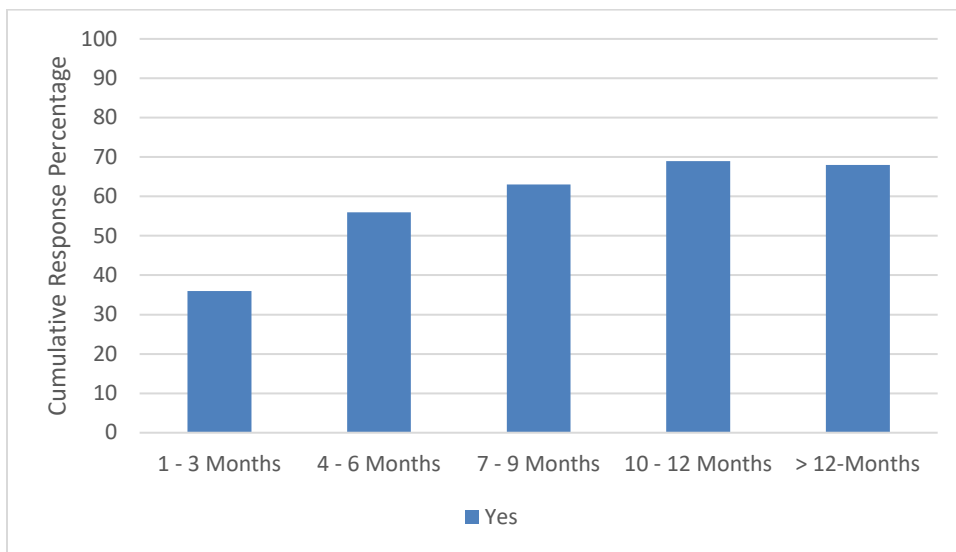


Figure 8. Graph. Impact of amount of time since licensure on parents’ interest in monitoring apps.

Parents Who Use Monitoring Apps

A total of 48.5 percent of the 649 respondents reported that they do use a monitoring app for their teen driver. Figure 9 shows the responses as to how often parents check monitoring apps when they do use them. A total of 30.1% of parents answered that they check their monitoring apps several times a week, followed closely by checking the app daily (28.2%).

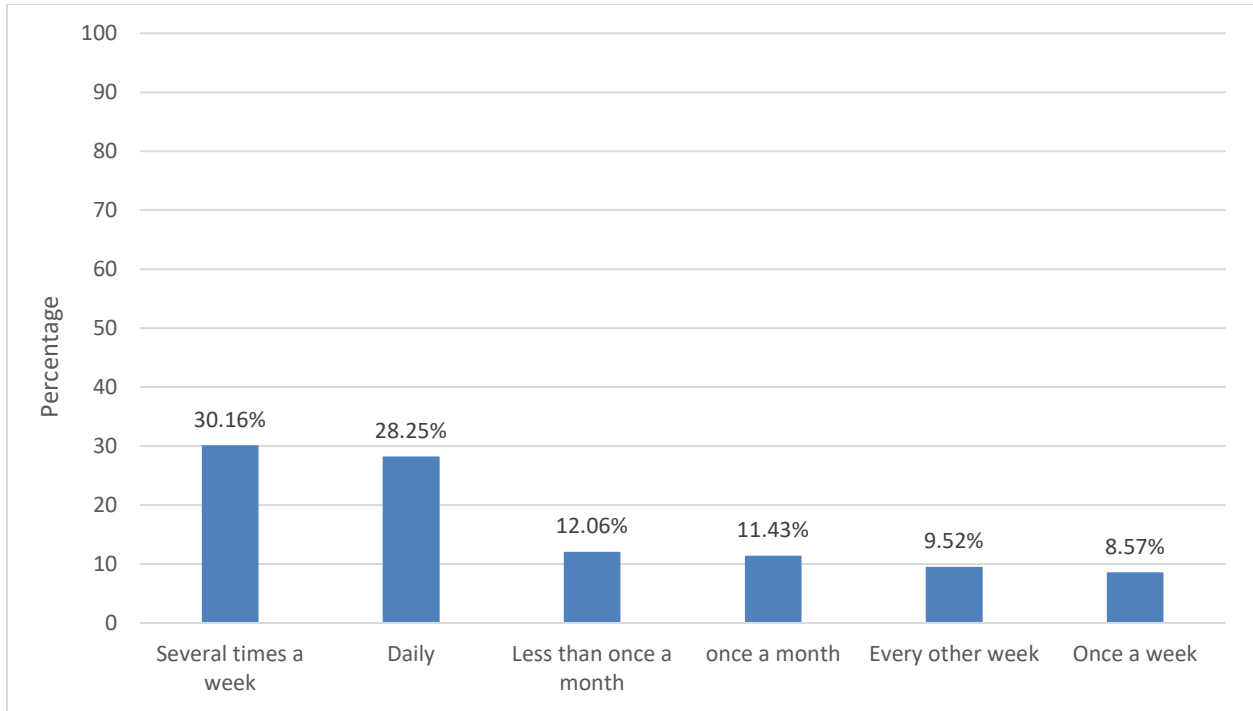


Figure 9. Graph. How often parents check the monitoring app (N=315).

Figure 10 shows why parents are using monitoring apps; 69.9% of parents who reported using apps answered that they use monitoring apps to know where their teen is located, followed by 50.1% answering that they use apps to find out if their teen is speeding while driving, and 41.5% using apps so they can know when their teen is driving. Parents were able to select multiple options for this question.

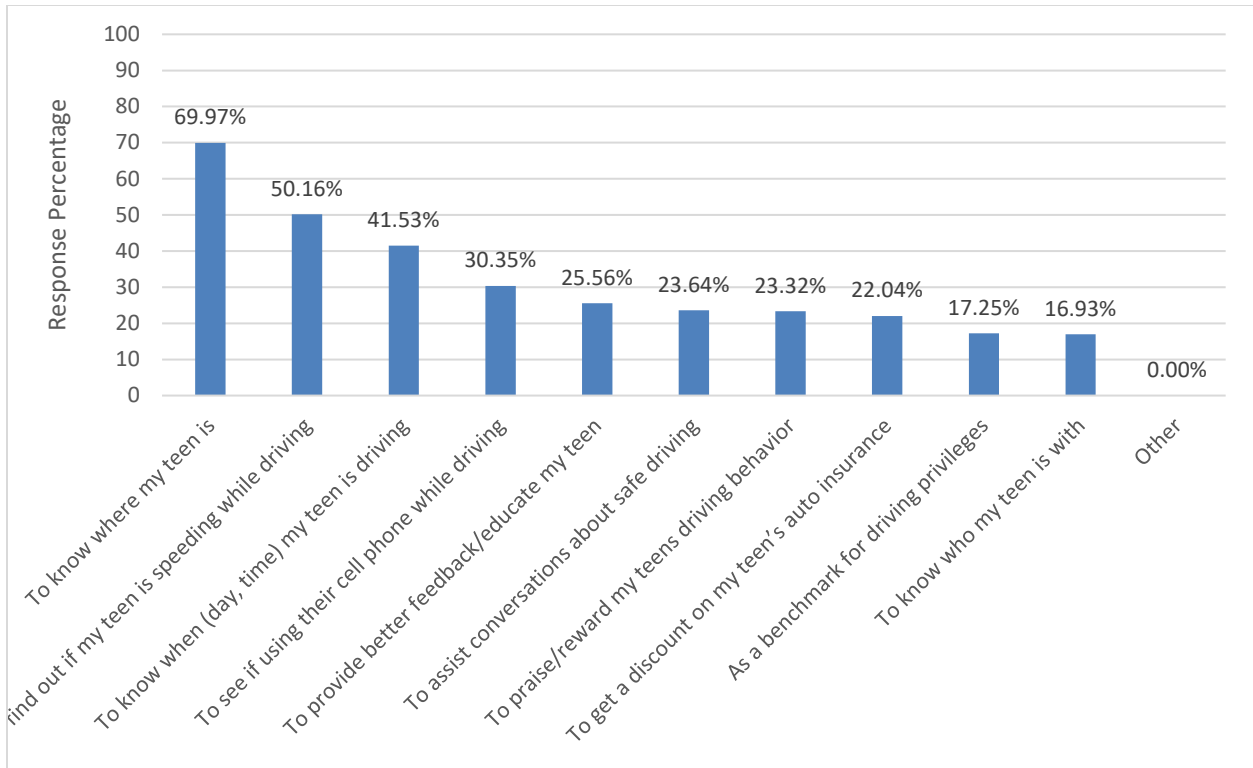


Figure 10. Graph. Why parents use data monitoring apps (N=313).

Figure 11 shows the responses for the conditions under which parents check the driver monitoring app they use for their teen:

- 27.8 percent responded that they use the app when they are trying to locate their teen.
- 15.3 percent said they check it at certain times of day.
- 14.7 percent answered that they check it when they know their teen is driving in bad weather.

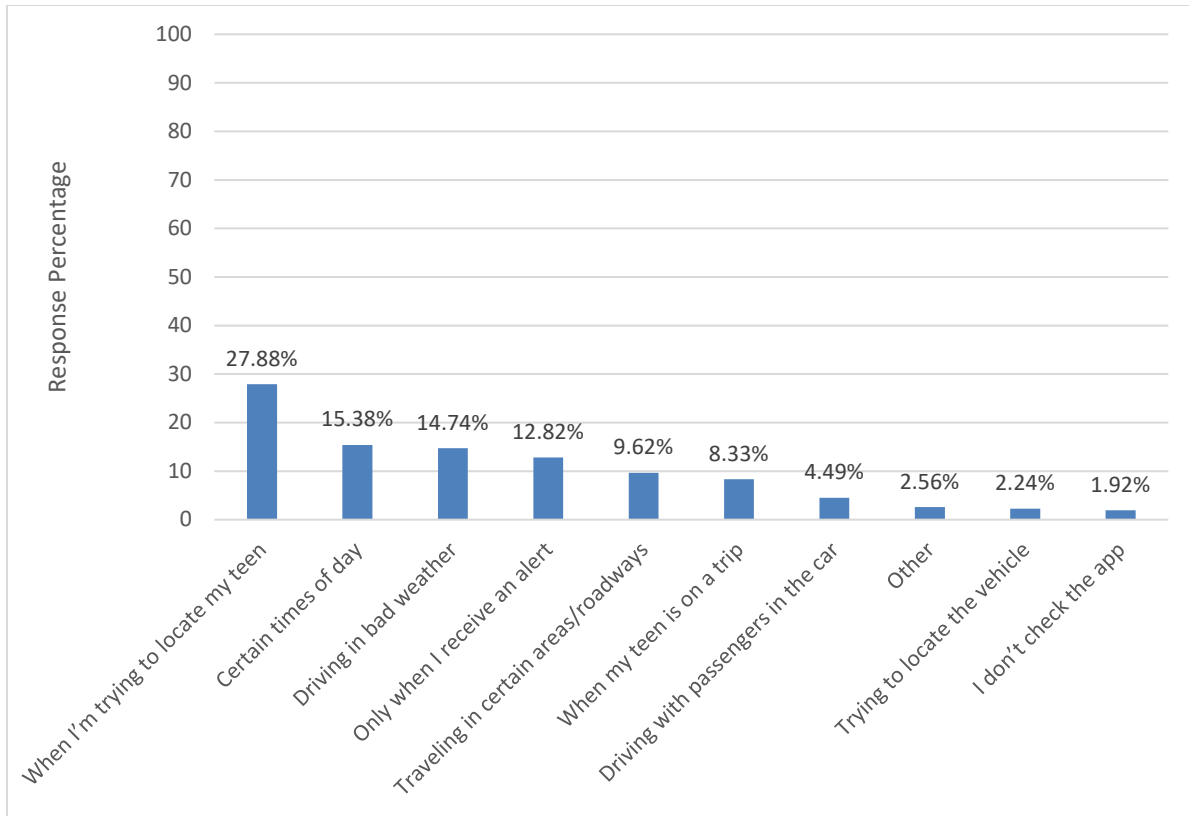


Figure 11. Graph. Conditions under which parents check app (N=312).

Figure 12 illustrates how parents answered that their teens feel regarding their driving app usage; 73.4% of parents answered that their teen was aware that they used the app and they were fine with it.

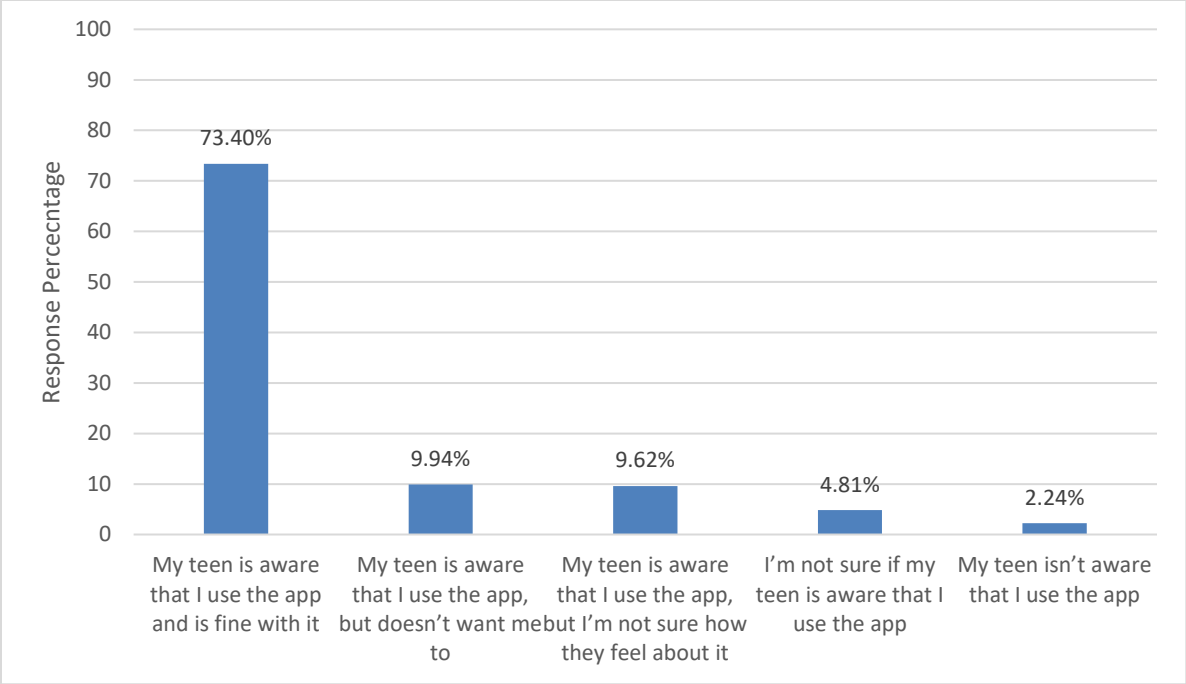


Figure 12. Graph. Parents' assessment of their teens feelings on parents using apps (N=312).

Figure 13 demonstrates the responses as to why parents think teens do not want them to use monitoring apps; 83.8% of parents responded that their teen believes they are a safe driver and do not need to be monitored. This is followed by 51.6% answering that their teen believed the parent was violating their privacy when they used monitoring apps.

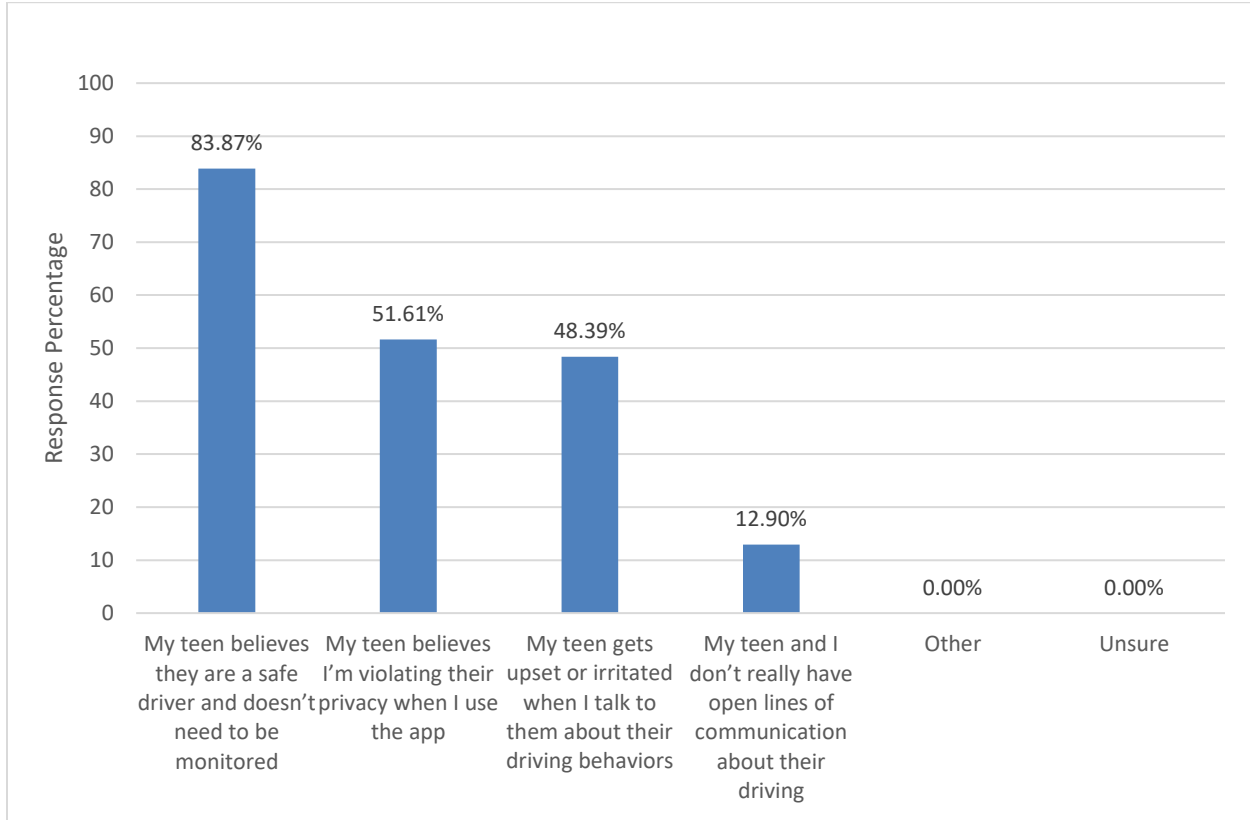


Figure 13. Graph. Reasons teens do not want parents to use apps (N=31).

Figure 14 illustrates the app alerts that parents preferred to receive from the monitoring apps; 60.5% of parents answered that they wanted crash alerts, 47.4% wanted to receive speeding alerts, and 40% wanted safe arrival notifications.

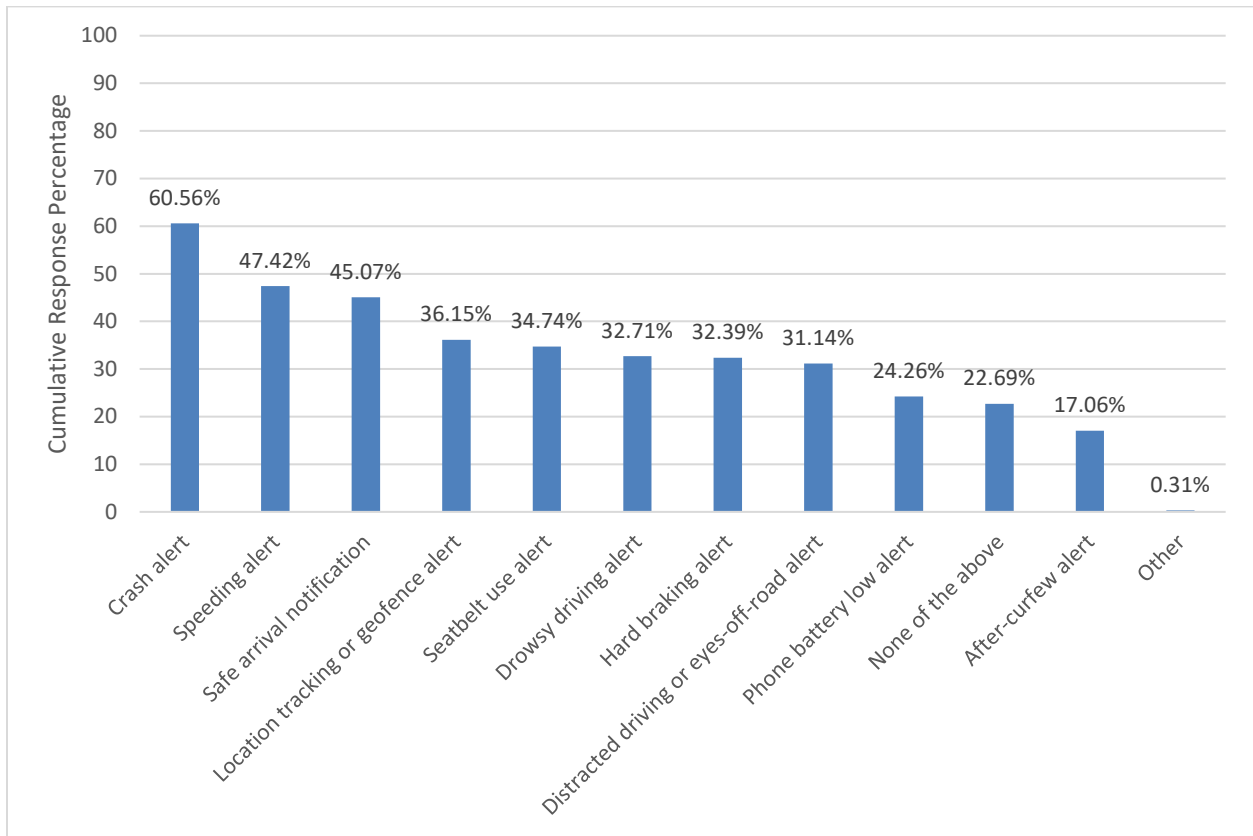


Figure 14. Graph. Monitoring app alerts parents would like to receive (N=639).

However, preferences for specific app alerts differed as a function of teen driving. Unsupervised driving frequency and amount of time driving alone were investigated for differences across app alerts. More often than not, driving frequency impacted alert preference, while amount of time driving alone did not. For example, the crash alert was more likely to be preferred by parents of teens who drove unsupervised multiple times daily compared to those who had teens who drove infrequently, $\chi^2(1, 473) = 6.21, p < .05$ (see Figure 15 and Figure 17). However, the amount of time driving alone did not influence preference. This pattern held for the location tracking (see Figure 16), safe arrival (see Figure 17), seatbelt use, distracted driving, and drowsy driving alerts.

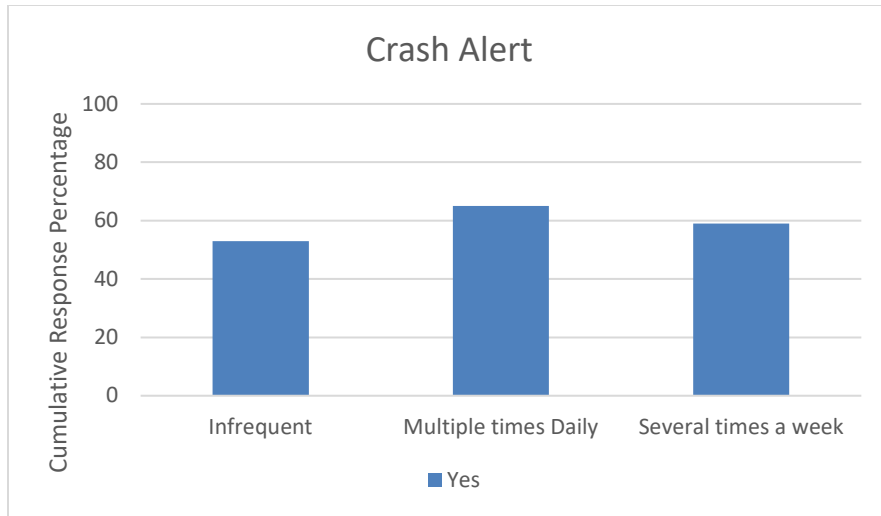


Figure 15. Graph. Preference for crash alert across teen driving frequency.

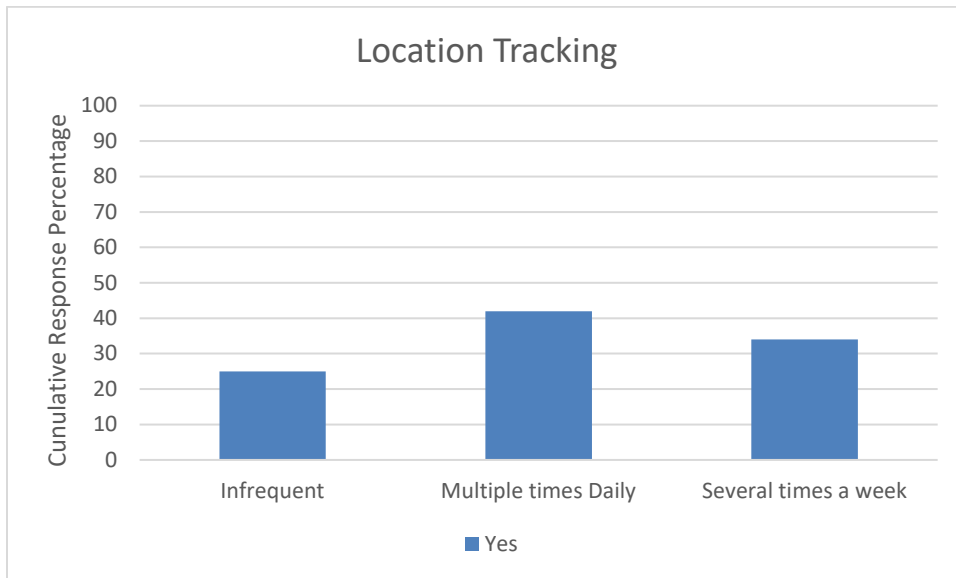


Figure 16. Graph. Preference for location tracking across teen driving frequency.

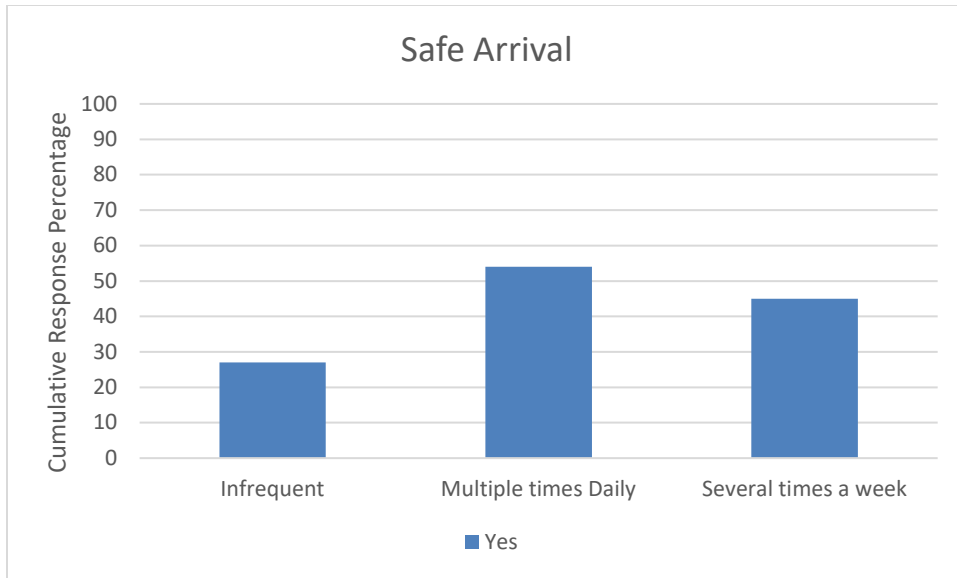


Figure 17. Graph. Preference for safe arrival across teen driving frequency.

Parents were asked to rate (on a scale of 1 to 5) the extent to which they agree (5) or disagree (1) with a provided statement. The statements “my teen makes corrections based on my feedback” (3.61 average) and “my teen’s driving behavior is influenced by my own driving behavior” (3.4 average) were the most agreed with statements. The most disagreed with statements were “my teen finds workarounds or ways to disable the app” (1.99 average) and “my teen uses social influences (peer pressure) as an excuse for bad driving performance” (1.93 average).

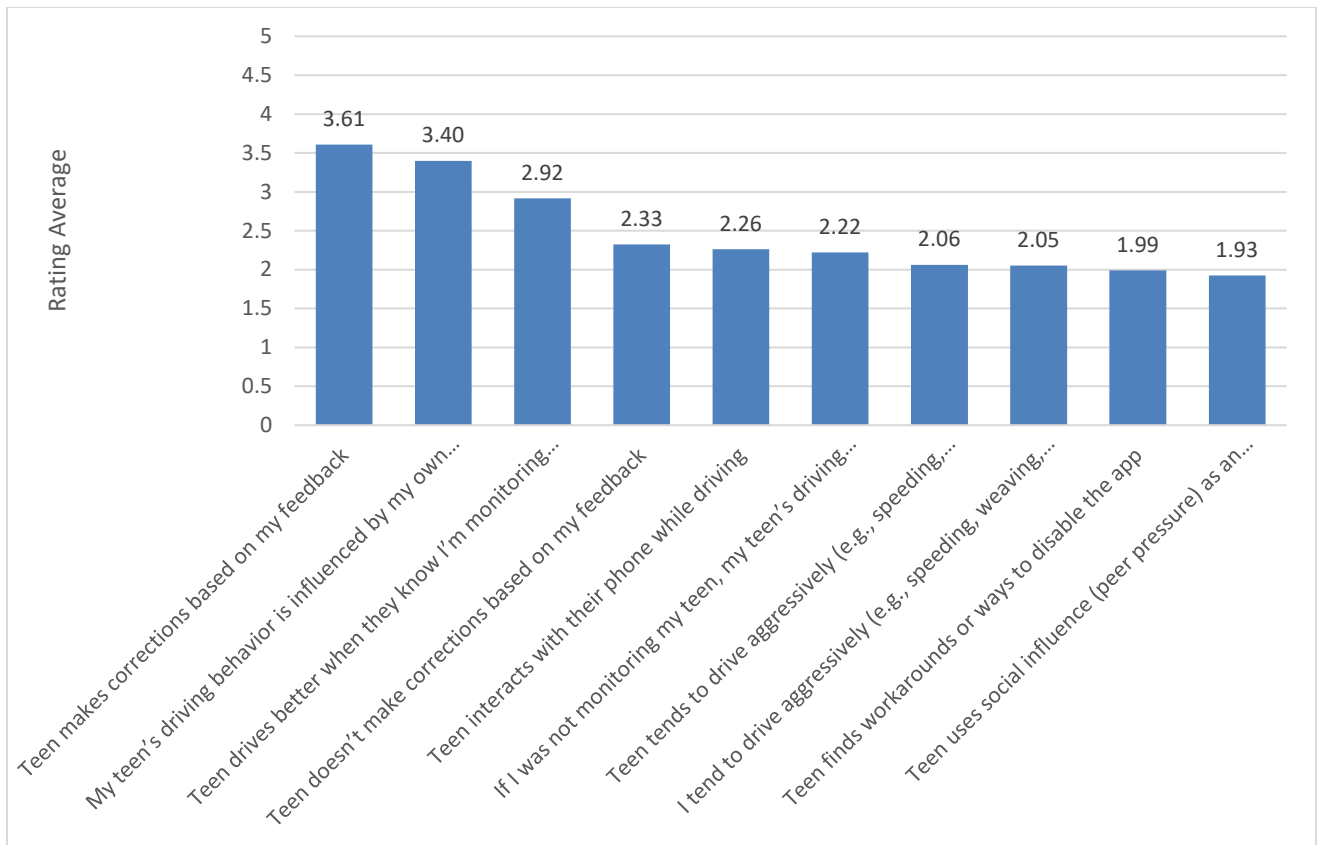


Figure 18. Graph. Parents agreement or disagreement with statements (N=627).

Table 3. Comparing crash alert preference across teen driving.

	Frequency of Unsupervised Driving			Amount of time Driving Alone				
	Infrequent (A)	Multiple Times Daily (B)	Several Times a week (C)	1-3 Months	4-6 Months	7-9 Months	10-12 Months	> 12 Months
Yes	53%	65%	59%	58%	47%	49%	53%	59%
No	47%	35%	41%	42%	53%	51%	47%	41%
Overall	$\chi^2(2, 639) = 6.40, p < .05$			$\chi^2(4, 624) = 6.42, p = 0.17$				
A x B	$\chi^2(1, 473) = 6.21, p < .05$							
A x C	$\chi^2(1, 312) = 1.25, p = 0.26$							
B x C	$\chi^2(1, 493) = 1.59, p = 0.21$							

CHAPTER 4. CONCLUSIONS

Our research found that most driver monitoring apps could be grouped into four categories:

1. mobile-based telematics,
2. insurance company smartphone apps,
3. independent OBD plug-in devices, and
4. indirectly related applications.

The most commonly available performance tracking notifications were speed, safety belt usage, hard braking maneuvers, and rapid accelerations. Monitoring features included phone usage, late night drives/after curfew, safe arrival notifications, and crash notification.

After refining our scope, this project collected and evaluated information regarding parents' attitudes and opinions on driver monitoring apps, their willingness to use them, and how apps affected their trust in their teens. The sample pool consisted of 25 fifteen-year-olds, 163 sixteen-year-olds, 185 seventeen-year-olds, 145 eighteen-year-olds, and 131 nineteen-year-olds (average age 17.29 years). Research found that 25% of the sample had been involved in at least one accident. It was found that parents generally check monitoring apps the most during the following conditions: locating their teen, at certain times of the day, or when they know their teen is driving in bad weather. Parents are using monitoring apps to know where their teens are located, to see if their teens are speeding while driving, and to see the location of where the teen is driving. App usage in such a manner allows parents to provide feedback to their teens to help reduce crash/near-crash rates.

Additionally, we analyzed data regarding parents not using monitoring apps. The most frequently cited reasons for not using a monitoring app was that a parent trusts their teen or the parent was not interested in using an app. About half of respondents reported they trust their teen and did not need to use monitoring apps. However, parents with teens who infrequently drove unsupervised were less likely to be interested in using a monitoring app than those parents with teens who drive unsupervised often. Further, as a teen's solo driving experience increased in time, their parent's interest in using a monitoring app increased. This suggests that parents with teens who drive unsupervised infrequently or those early in their driving experience (i.e., 1–3 months) think they do not need to use monitoring apps. However, that period of time is when novice drivers are the least experienced and are arguably in need of monitoring the most. Overall, these results suggest that parents with teens who drive infrequently or have just started driving unsupervised could be targeted for outreach.

Parents generally answered that their teens are aware that they use driver monitoring apps and are fine with it. When asked why they believe their teen does not want them to use these apps, parents responded that their teen believes they are safe drivers and do not need to be monitored and that the apps are violating their privacy. This confirms what the research team found regarding teens' attitudes and/or opinions of monitoring apps within the literature. Evidence shows that parental involvement in their teen's driving does lead to improvement. With feedback, parents can influence changes to their teen's driving behaviors. Apps are a more

objective way to provide this feedback to their teen. Parents responded that the alerts they prefer from the monitoring apps include crash alerts, speeding alerts, and safe arrival notifications. The frequency of unsupervised driving was found to influence preference for various app alerts. Parents with teens who drove unsupervised infrequently were less likely to prefer app alerts than parents with teens who drove with higher frequency.

Most of the survey respondents used the app Life360 to monitor their teens, followed by Drive Safe & Save, as well as DriveEasy. This survey was available for parents to submit responses from November 2, 2023, through November 23, 2023. It is likely that app usage has increased since the survey was distributed, which is therefore a limitation. Parents responded that having speeding alerts and crash alerts would help improve their teen's driving behavior and safety on the road. These apps allow parents to track their teen's driving behavior and make suggestions of safer driving behavior for their teens.

Parents agreed with the statement that their teens make corrections based on parental feedback and that their teens' driving behavior is influenced by their own driving behavior. On the other hand, parents disagreed with the statements that their teens use social influence (peer pressure) as an excuse for bad driving performance and that their teens find work-arounds or ways to disable the app. Crash alerts, speeding alerts, and distracted driving or eyes-off-road alerts were ranked by parents as being the most impactful in improving their teens' driving behavior. It is important to note though that 60% of parents thought crash alerts were important, indicating 40% of parents did not think they were important. Clearly, more education is needed for parents to understand the benefits of monitoring apps.

In conclusion, this project successfully met its goal to determine what information parents of teen drivers are motivated to use on mobile phone apps, what they find most useful, and what tools they would like to have access to. Further research will be needed to expand information about parent responses to include teen responses. Teen perceptions may not be what their parents believe them to be. Distributing a like survey to teens through a different tool could provide more valuable insight into thoughts and perceptions about driver monitoring apps. Based upon the results of these national surveys, we will gain greater insights into the motivation behind the use of specific phone apps by parents and teens. This information will be invaluable to further guide app developers in providing not only information that parents and teens will be motivated to use but also in improving teen driving safety.

APPENDIX A. SURVEY TOOL

Survey Details

Overview:

- Dashboard: State Farm
- Title: Teen Driving
- Description: We look forward to learning more about your thoughts and experiences.
- Responses: 95
- Date Created: November 02, 2023
- End Date: November 23, 2023

Target Audience:

- Age: 35-65
- Gender: Any
- Previous Action Targeting:
 - Not Participated In:
 - Think of your teen who can drive unsupervised without a parent or guardian present in the car. If you have more than one, think of your OLDEST teen. Which of the following best describes how often (on average) your teen drives unsupervised?
 - Participated In:
 - Which of the following describes your current situation?
 - Selected the following option(s):
 - I have at least one teen child in my household who drives unsupervised without a parent/guardian present in the car
 - OR:
 - Participated In:
 - Which of the following describes your current situation?
 - Selected the following option(s):
 - I have at least one teen child in my household who drives unsupervised without a parent/guardian present in the car
 - OR:
 - Participated In:
 - Which of the following describes your current situation?
 - Selected the following option(s):
 - I have at least one teen who drives unsupervised without a parent/guardian present in the car
 - OR:
 - Participated In:
 - What is the driver licensing status of your oldest teen?
 - Selected the following option(s):
 - Has a provisional driver's license (can drive solo but with nighttime/passenger restrictions) OR Has a full driver's license (no required supervision or restrictions)

- OR:
- Participated In:
 - What is the driver licensing status of your oldest teen?
 - Selected the following option(s):
 - Has a provisional driver's license (can drive solo but with nighttime/passenger restrictions) OR Has a full driver's license (no required supervision or restrictions)
- OR:
- Participated In:
 - Think of your teen who can drive unsupervised without a parent or guardian present in the car. If you have more than one, think of your OLDEST teen. Which of the following best describes how often (on average) your teen drives unsupervised?
 - Did not select the following option(s):
 - I don't have a teen in my household NOR I have a teen, but he/she doesn't drive solo without a parent or guardian in the car NOR Unsure

Action Link:

- <https://app.suzy.com/brand/49f47d21-e4f2-404f-bdc2-4ee456990858/survey/262cf312-7573-48f9-b7e9-3b0633cbe032/edit/review>

Survey Text

Q1. [MC]- Think of your teen who can drive unsupervised without a parent or guardian present in the car. If you have more than one, think of your OLDEST teen. Which of the following best describes how often (on average) your teen drives unsupervised?

1. I don't have a teen in my household
2. I have a teen, but he/she doesn't drive solo without a parent or guardian in the car
3. My teen drives unsupervised less than once a month
4. My teen drives unsupervised once a month
5. My teen drives unsupervised every other week
6. My teen drives unsupervised once a week
7. My teen drives unsupervised several times a week
8. My teen drives unsupervised multiple times daily
9. Unsure

Q2. [MC]- Again, thinking of your OLDEST teen who can drive solo, what is their current age?

1. Under 15 years old
2. 15 years old
3. 16 years old
4. 17 years old
5. 18 years old
6. 19 years old
7. 20 years or older

Q3. [MC]- How long has your teen been able to drive solo without an adult in the car?

1. Less than 1 month
2. 1 month
3. 2 months
4. 3 months
5. 4 months
6. 5 months
7. 6 months
8. 7 months
9. 8 months
10. 9 months
11. 10 months
12. 11 months
13. 12 months
14. Longer than 12 months
15. Unsure

Q4. [MC]- What is the driver licensing status of your oldest teen?

1. Has a learner's permit (must be supervised by a licensed adult in the vehicle)
2. Has a provisional driver's license (can drive solo but with nighttime/passenger restrictions)
3. Has a full driver's license (no required supervision or restrictions)

Q5. [MC]- How many accidents has your teen been involved in while driving solo (regardless of fault)?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10 or more
11. None
12. Unsure

Q6. [MC]- Which of the following smartphone apps, if any, have you used MOST OFTEN to monitor your teen when they're driving?

1. 911StaySafe
2. DriveEasy (Geico)

3. Drive Mode (AT&T)
4. Drive Safe & Save (State Farm)
5. DriveSense (Esurance)
6. Drivewise (Allstate)
7. Hum (Verizon)
8. IntelliDrive (Travelers)
9. Life360
10. Mama Bear
11. RightTrack (Liberty Mutual/Safeco)
12. SafePilot (USAA)
13. Signal (Farmers)
14. SmartRide (Nationwide)
15. Snapshot (Progressive)
16. TeenInstatrack
17. Tesla App (Tesla)
18. TrueLane (Hartford)
19. Other (please specify)
20. I have never used a smartphone app to monitor my teen driver

Q7. [MC]- Why haven't you used a driver monitoring smartphone app with your teen?

1. I wasn't aware of these types of apps
2. I had difficulties getting the app(s) to download or work properly
3. The apps are too confusing or complicated to use
4. I don't trust the data security/privacy of the app(s)
5. I don't trust the accuracy of the data collected by the app(s)
6. I trust my teen and don't feel like I need to monitor them
7. My teen is a safe/experienced driver and doesn't need additional help
8. The apps don't provide any value to my teen or me
9. My teen doesn't have a smartphone
10. My teen is old enough to make their own decisions
11. I didn't want my teen's driving data to be used against them (e.g., by police, in a crash)
12. It's important for my teen to make their own mistakes and learn from them
13. I'd be invading my teen's privacy if I used those apps
14. The apps cost too much money
15. No specific reason – I just wasn't interested
16. Other (please specify)

Q8. [MC]- On average, how often do you use the {Q6} app to monitor your teen's driving?

1. Less than once a month
2. Once a month
3. Every other week

4. Once a week
5. Several times a week
6. Daily

Q9. [MC]- What do you use the {Q6} app for? Select all that apply.

1. To know where my teen is
2. To know who my teen is with
3. To provide better feedback/educate my teen
4. To find out if my teen is speeding while driving
5. To praise/reward my teen for good driving behavior
6. To assist conversations with my teen about safe driving
7. As a benchmark for my teen's driving privileges
8. To know when (day, time) my teen is driving
9. To get a discount on my teen's auto insurance
10. To find out if my teen is using their cell phone while driving
11. Other (please specify)

Q10. [MC]- Under which condition do you check the {Q6} app the most?

1. Certain times of day (examples: teen's late-night trips, morning school commutes, etc.)
2. Only when I receive an alert from the app
3. When my teen is driving for long/extended trips
4. When my teen is driving with passengers in the car
5. When my teen is traveling in certain areas or on certain roadways
6. When my teen is driving in bad weather
7. When I'm trying to locate my teen
8. When I'm trying to locate the vehicle that my teen drives (e.g., stolen vehicle, parking lot locator)
9. Other (please specify)
10. I don't check the app

Q11. [MC]- Which of the following best describes how your teen feels about you using the {Q6} app?

1. My teen isn't aware that I use the app
2. I'm not sure if my teen is aware that I use the app
3. My teen is aware that I use the app and is fine with it
4. My teen is aware that I use the app, but doesn't want me to
5. My teen is aware that I use the app, but I'm not sure how they feel about it

Q12. [MC]- Why doesn't your teen want you to use the {Q6} app? Select all that apply.

1. My teen believes I'm violating their privacy when I use the app
2. My teen believes they are a safe driver and doesn't need to be monitored
3. My teen and I don't really have open lines of communication about their driving
4. My teen gets upset or irritated when I talk to them about their driving behaviors

5. Other (please specify)
6. Unsure

Q13. [MC]- What is the likelihood that you would recommend the {Q6} app to parents of other teen drivers?

1. Very unlikely
2. Unlikely
3. Neutral/Unsure
4. Likely
5. Very likely

Q14. [MC]- Which of the following driver monitoring app alerts, if any, would you want to receive when your teen is driving? Select all that apply.

1. Speeding alert
2. Hard braking alert
3. Crash alert
4. Location tracking or geofence alert
5. Safe arrival notification
6. Seatbelt use alert
7. Distracted driving or eyes-off-road alert
8. After-curfew alert
9. Drowsy driving alert
10. Phone battery low alert
11. Other (please specify)
12. None of the above

Q15. [SCALE]- In your opinion, what level of impact (if any) would each of the app alerts have in improving your teen's driving behavior and on-road safety?

- a. Speeding alert
- b. Hard braking alert
- c. Crash alert
- d. Location tracking or geofence alert
- e. Safe arrival notification
- f. Seatbelt use alert
- g. Distracted driving or eyes-off-road alert
- h. After-curfew alert
- i. Drowsy driving alert
- j. Phone battery low alert

Q16. [MC]- Which of the following statements, if any, are reasons why you would use Location Tracking for your teen? Select all that apply.

1. Make sure my teen arrived at their destination safely
2. Locate my teen when they do not respond to a text/phone call
3. See where my teen has been or where they currently are
4. Have peace of mind if I'm worried that my teen may get kidnapped or go missing
5. Find my teen if they are involved in a crash
6. Enforce house driving rules, such as location and curfew restrictions
7. Other (please specify)
8. I would not use Location Tracking

Q17. [MC]- Which of the following statements, if any, are reasons why you would you use Speed Tracking for your teen? Select all that apply.

1. Know when they drive over the speed limit in certain areas, such as school and construction zones
2. Know when they drive over the speed limit by less than 10 mph in residential neighborhoods
3. Know when they drive over the speed limit by less than 10 mph in city/downtown areas
4. Know when they drive over the speed limit by less than 10 mph on highways/interstates
5. Know when they drive over the speed limit by 10-20 mph in residential neighborhoods
6. Know when they drive over the speed limit by 10-20 mph in city/downtown areas
7. Know when they drive over the speed limit by 10-20 mph on highways/interstates
8. Know when they drive over the speed limit by more than 20 mph in residential neighborhoods
9. Know when they drive over the speed limit by more than 20 mph in city/downtown areas
10. Know when they drive over the speed limit by more than 20 mph on highways/interstates
11. Know every time my teen goes over the speed limit
12. Other (please specify)
13. I would not use Speed Tracking

Q18. [MC]- Which of the following statements, if any, are reasons why you would you use Distracted Driving Tracking for your teen? Select all that apply.

1. Know every time my teen interacts with their cellphone while driving (examples: texting, social media scrolling)
2. Know when they interact with their cellphone while driving in areas with speed limits under 30 mph
3. Know when they interact with their cellphone while driving in areas with speed limits of 30-45 mph
4. Know when they interact with their cellphone while driving in areas with speed limits of 50-65 mph
5. Know when they interact with their cellphone while driving in areas with speed limits over 65 mph
6. Know when they interact with their cellphone while driving in residential neighborhoods

7. Know when they interact with their cellphone while driving in city/downtown areas
8. Know when they interact with their cellphone while driving on highways/interstates
9. Know when they interact with their cellphone when they're NOT stopped at a stop sign or stop light
10. Other (please specify)
11. I would not use Distracted Driving Tracking

Q19. [MC]- Which of the following statements, if any, are reasons why you would use Seat Belt Tracking for your teen? Select all that apply.

1. Know every time my teen doesn't wear a seatbelt while driving
2. Know every time my teen doesn't wear a seatbelt while riding as a passenger
3. Know when they aren't wearing a seatbelt while driving in areas with speed limits under 30 mph
4. Know when they aren't wearing a seatbelt while driving in areas with speed limits of 30-45 mph
5. Know when they aren't wearing a seatbelt while driving in areas with speed limits of 50-65 mph
6. Know when they aren't wearing a seatbelt while driving in areas with speed limits over 65 mph
7. Know when they aren't wearing a seatbelt while driving in residential neighborhoods
8. Know when they aren't wearing a seatbelt while driving in city/downtown areas
9. Know when they aren't wearing a seatbelt while driving on highways/interstates
10. Know when my teen's passengers aren't wearing seatbelts
11. Other (please specify)
12. I would not use Seat Belt Tracking

Q20. [SCALE]- To what extent do you agree or disagree with the following statements.

- a. My teen uses social influence (peer pressure) as an excuse for bad driving performance
- b. My teen tends to drive aggressively (e.g., speeding, weaving, tailgating)
- c. My teen finds workarounds or ways to disable the app
- d. My teen makes corrections to their driving based on my feedback
- e. My teen doesn't make corrections to their driving based on my feedback
- f. I tend to drive aggressively (e.g., speeding, weaving, tailgating)
- g. My teen interacts with their phone while driving
- h. My teen drives better when they know I'm monitoring them
- i. If I was not monitoring my teen, my teen's driving performance would worsen
- j. My teen's driving behavior is influenced by my own driving behavior

Q21. [MC]- In which state does your oldest teen live?

1. Alabama
2. Alaska
3. Arizona
4. Arkansas
5. California

6. Colorado
7. Connecticut
8. Delaware
9. District of Columbia
10. Florida
11. Georgia
12. Hawaii
13. Idaho
14. Illinois
15. Indiana
16. Iowa
17. Kansas
18. Kentucky
19. Louisiana
20. Maine
21. Maryland
22. Massachusetts
23. Michigan
24. Minnesota
25. Mississippi
26. Missouri
27. Montana
28. Nebraska
29. Nevada
30. New Hampshire
31. New Jersey
32. New Mexico
33. New York
34. North Carolina
35. North Dakota
36. Ohio
37. Oklahoma
38. Oregon
39. Pennsylvania
40. Rhode Island
41. South Carolina
42. South Dakota
43. Tennessee
44. Texas
45. Utah
46. Vermont
47. Virginia
48. Washington
49. West Virginia

- 50. Wisconsin
- 51. Wyoming
- 52. None of the above

Q22. [MC]- Which of the following best describes the area in which you live?

- 1. Rural or under 25,000
- 2. A small town between 25,000 and 75,000
- 3. A small metropolitan area between 75,001 and 250,000
- 4. A medium sized metropolitan area between 250,001 and 500,000 people
- 5. A large metropolitan area between 500,001 and 1 million people
- 6. A very large metropolitan area over 1 million people
- 7. Unsure

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