DRIVER BEHAVIOR & PERFORMANCE

TECHNICAL REPORT

FOUNDATION FOR TRAFFIC SAFETY

A Randomized Field Trial of Smartphone-Based Feedback Designed to Encourage Safe Driving: Comparing Focused and Self-Chosen Goals to Standard Usage-Based Insurance Messaging

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Title

A Randomized Field Trial of Smartphone-Based Feedback Designed to Encourage Safe Driving: Comparing Focused and Self-Chosen Goals to Standard Usage-Based Insurance Messaging

(April 2025)

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Foreword

Risky driving behaviors, such as speeding and distraction, are prominent contributing factors in motor vehicle crashes. Finding ways to reduce such behaviors is paramount and will have a positive impact on traffic safety. One such avenue, smartphone apps, can monitor and track these behaviors as well as deliver timely and tailored feedback to drivers. Indeed, many monitoring and feedback apps exist, often under the auspices of insurance programs. The AAA Foundation for Traffic Safety commissioned research, presented in this report, to examine whether a safe driving app can reduce rates of speeding, hard acceleration and braking, and cellphone use among a representative sample of drivers.

The current study employs a large-scale randomized controlled trial to examine how different strategies for delivering feedback to drivers affect safety outcomes during an intervention period and whether the benefits persist several weeks after the feedback is removed. The results should be of interest to safety advocates and stakeholders in both the public and private sectors, including those in the insurance industry.

C. Y. David Yang, Ph.D.

President and Executive Director

AAA Foundation for Traffic Safety

About the Sponsor

AAA Foundation for Traffic Safety
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Founded in 1947, the AAA Foundation for Traffic Safety in Washington, D.C., is a nonprofit, publicly supported charitable research and educational organization dedicated to saving lives by preventing traffic crashes and reducing injuries when crashes occur. Funding for this report was provided by voluntary contributions from AAA/CAA and their affiliated motor clubs, individual members, AAA-affiliated insurance companies, and other organizations or sources.

Table of Contents

List of Abbreviations and Acronyms

AIM	Acceptability of Intervention Measure
GEE	Generalized estimating equation
KRD	Kinematic risky driving
NPS	Net Promoter Score
SD	Standard deviation
UBI	Usage-based insurance

Executive Summary

Background

Globally, motor vehicle crashes result in 1.2 million deaths and as many as 50 million non-fatal injuries each year. Most crashes can be prevented by reducing risky driving behaviors such as speeding, hard braking, rapid acceleration, and handheld phone use. Innovations in smartphone telematics enable these behaviors to be measured, paving the way for scalable behavioral interventions to help individuals improve their driver safety. This may already be happening: a growing number of U.S. drivers are enrolled in usage-based insurance (UBI) programs that price policies according to smartphone-measured risky driving behaviors. These programs provide feedback and incentives that should, in theory, lead to safer driving. However, this proposition has not been rigorously tested. Moreover, behavioral science would suggest that the way UBI feedback is typically delivered—multiple behaviors at once, without specific incremental goals or choice over what to focus on—is suboptimal. The primary goal of the present research was to experimentally test whether providing feedback and incentives typical of UBI improves driver safety, and whether greater improvements are possible by assigning or allowing drivers to choose more focused goals.

Method

Drivers were recruited nationally via social media advertisements for a 24-week randomized controlled trial. Their speeding, hard braking, rapid acceleration, and handheld phone use were measured with a smartphone app during a 6-week baseline period. Those who met a threshold for number of drives taken were randomly assigned to one of four groups for a 12-week intervention period. The Observation group served as the control; their driving was monitored during this period, but they received no feedback or incentive. The Standard Feedback group received weekly text message feedback on all four behaviors and could earn up to $100 at the end of the period depending on how safely they drove overall. The Assigned Goal group were asked each week to focus on a specific, low-scoring behavior and given an incremental improvement goal for it; they, too, could earn up to $100 for their overall safe driving. The Chosen Goal group were instead asked to choose a focus behavior and set an improvement goal for it; they, too, could earn up to $100 for their overall safe driving. After the intervention period, participants completed an exit survey and continued to be monitored for an additional 6 weeks.

Analyses

The primary outcome was overall driver safety during the intervention period, measured both by a proprietary 0-to-100 score and a composite of underlying incident

rates. Secondary outcomes were speeding, hard braking, rapid acceleration, and handheld phone use (proprietary scores and incident rates). Analyses controlled for baseline driving behavior and demographic characteristics and compared each treatment group to the control group and each other. The 6-week post-intervention period was analyzed to test for sustained improvements in driver safety. Additional analyses tested whether improvements were greater for certain demographic groups.

Results

A total of 1,449 participants were included in the 12-week intervention period. Results based on both proprietary scores and incident rates showed that participants in all three treatment groups drove significantly more safely overall than the control group. Assigned Goal participants showed non-significantly greater improvement than Standard Feedback participants. All three treatment groups exhibited improvements in speeding (11%–13% reduction relative to control), hard braking (16%–21%), and rapid acceleration (16%–25%), but not handheld phone use. Improvements persisted during the 6-week post-intervention period. Drivers in the treatment groups improved by similar amounts regardless of their age, sex, and race/ethnicity. Urban and suburban drivers improved more than rural drivers in two of the treatment groups, but this may be explained by a small rural sample and chance differences in baseline driver safety.

Implications

This trial experimentally demonstrated, for the first time, that the kinds of feedback and incentives offered by UBI programs can improve driver safety across a range of behaviors. It also showed that these safety improvements may persist beyond a driver's rating period, lessening concerns that UBI discounts reward risky drivers who only drive safely when monitored. In general, similar improvements were seen across key demographic groups, lessening health equity concerns about UBI programs. Counter to what was hypothesized, the three treatment groups experienced a similar degree of improvement, suggesting it may not be beneficial to modify existing UBI programs to focus drivers' attention on one behavior at a time. However, testing with a larger sample may reveal that assigning or allowing drivers to choose their goals offers meaningful benefits—either overall or for specific demographic groups. Regardless, the present results suggest that wider adoption of UBI and similar programs that provide active feedback via text or push notifications and incentives for safer driving would yield road safety gains.

Introduction

Background

Worldwide, motor vehicle crashes result in 1.2 million deaths and upwards of 50 million non-fatal injuries each year (WHO, 2023). Most of these crashes are preventable because their cause can be traced to modifiable driver behaviors such as speeding. Traditional approaches to changing drivers' behaviors may be classified into two broad categories: education and legislation. Education includes formal driver's education, public awareness campaigns, and targeted programs. Legislation includes fines, license penalties, and potential prison time for engaging in risky driving behaviors. The legislative approach has proven especially effective at curbing risky driving—so long as the risky behaviors are detectable and laws are routinely enforced (Oviedo-Trespalacios, 2018; Richard et al., 2018). However, enforcement is resource intensive, and concerns have been raised about racial and ethnic disparities in traffic stops (Pierson et al., 2020).

Innovations in vehicle and smartphone telematics enable a novel and complementary approach to changing drivers' behaviors. Sensors built into some vehicles and nearly all smartphones allow for measurement of an ever-widening range of risky driving behaviors, including speeding, hard braking, rapid acceleration, tight cornering, swerving, late-night driving, distraction, and driving without a seat belt (Ebert et al., 2025; Wahlström et al., 2017). In theory, this information may be fed back to a driver, and rewards may be offered for improving their driving.

In fact, this has been happening for years, at scale, within the context of usage-based auto insurance (UBI) programs. When a driver enrolls in a UBI program, their driving is monitored during a 3- to 6-month rating period, typically by a smartphone telematics application. During this period, the enrollee is given driving feedback and tips via the app. Some programs have an option for active feedback via push notifications, whereas others offer only passive feedback that requires viewing the app. Standard feedback includes scores for overall driver safety and the multiple risky driving behaviors that comprise it (Appendix A). At the end of the rating period, the driver is typically quoted a discounted price on their next policy, the size of which depends on how safely they drove; very risky drivers may see an increased price. UBI programs are popular with customers: enrollment has doubled over the past 6 years, and nearly 1 in 5 U.S. drivers is now enrolled in one (J.D. Power, 2023).

Usage-Based Insurance and Driver Safety

In theory, participating in a UBI program should encourage safer driving. However, this assumes that drivers are willing and able to change their driving behaviors. Certain behaviors that programs rate on may be highly rewarding (e.g.,

handheld phone use), deeply ingrained (e.g., cornering), only partly controllable (e.g., hard braking), or impractical to change (e.g., mileage). Some customers may attempt to change multiple behaviors at once and find that this leads to failure (James et al., 2016). Even if a customer improves their driving safety while being monitored, they may lose the motivation once their policy discount is locked in and revert to risky behaviors (Deci & Ryan, 2008).

The nature of UBI programs makes it difficult to assess whether participation improves driver safety, as only customers who opt in are behaviorally monitored. Consequently, there are no comparison data for customers who do not opt in. Studies of UBI customers have looked for improvements in measured risky driving behaviors between the beginning and end of the monitoring period, while also comparing crash claims between monitored and unmonitored periods and between UBI customers and non-UBI customers. One large study found substantial decreases in overall risky driving over the course of UBI customers' monitoring periods, but also found an increase in crash claims once their monitoring periods ended (they still had fewer claims than customers who never opted into the UBI program) (Jin & Vasserman, 2021). Other research has found improvements for certain behaviors (e.g., hard braking) but not for other, less changeable behaviors (e.g., mileage) (Soleymanian et al., 2019). One study found improvements in speeding, hard braking, and distracted driving, but only among those who regularly engaged with their UBI app (Pinals et al., 2024).

Regardless, without randomly assigning individuals to a UBI program versus a control group, it is not possible to determine if behavioral improvements owe to the feedback and incentives of a UBI program or to confounding factors such as knowing that one's driving is being monitored. Likewise, without monitoring individuals before and after the UBI program, it is not possible to determine if they drive more safely after the program's end than before.

A prior randomized trial simulated the kind of feedback and incentives delivered to UBI customers and found a significant improvement, relative to control, in a composite measure of safe driving (Stevenson et al., 2021). No improvements were found for its component behaviors of speeding, hard braking, or rapid acceleration, but these null results could be due to the study's relatively small sample size. Other randomized trials have recruited UBI customers and delivered additional behavioral interventions involving feedback and incentives; these found significant decreases in handheld phone use relative to control (Delgado et al., 2024), in some cases for weeks after the interventions ended (Ebert, Xiong, Khan, et al., 2024). These results demonstrate that, with the right feedback and incentives, UBI customers can make lasting safety improvements. Notably, unlike UBI programs, these successful interventions focused drivers' attention on changing only one behavior and offered weekly incentives for meeting manageable improvement goals.

Present Research

A large, national field experiment tested whether an intervention modelled after a typical UBI program can improve driver safety, and whether such improvements persist beyond the intervention. It also tested two possible ways to strengthen UBI's impact on driver safety.

First, drivers in one group were assigned one behavior at a time to focus on and provided incremental weekly goals for improvement. UBI apps offer simultaneous feedback on multiple risky behaviors, potentially causing information overload and diverting attention away from behaviors most in need of improvement (Chernev et al., 2015; Chervany & Dickson, 1974; Khaleel et al., 2020; Kortschot et al., 2022; Stevenson et al., 2021). More research is needed to determine whether a simultaneous or sequential approach to changing multiple behaviors is more effective, but two trials have found an advantage for the sequential approach (James et al., 2016). UBI apps also typically do not provide specific behavior change goals. Providing attainable, incremental goals can increase motivation and lead to greater behavior change (Bonezzi et al., 2011; Chokshi et al., 2018).

Second, drivers in another group were asked to choose their own focus behaviors and incremental goals. Choosing one's own goals can increase intrinsic motivation, effort, and performance (Dalton et al., 2016; Patel et al., 2021; Seo et al., 2018). Individuals may be best positioned to know which behaviors they can change and what amount of change is manageable for them. Provision of choice may be important to ensure the effectiveness of public health interventions for certain demographic groups (Reynolds-Tylus, 2019).

The trial examined the following four risky behaviors, which are widely used by UBI programs to quantify drivers' crash risk and price policies (National Association of Insurance Commissioners, 2021).

Handheld Phone Use

Driver distraction is a factor in an estimated two-thirds of all crashes (Blincoe et al., 2023). Handheld phone use is especially dangerous because it takes the driver's eyes off the road and hands off the steering wheel, increasing the odds of crash by 2 to 12 times (Dingus et al., 2016; Dingus et al., 2019). Distracted drivers also take longer to brake, increasing crash severity (Cambridge Mobile Telematics, 2024).

Speeding

Speeding is a factor in 8% of property-damage-only crashes, 12% of injury crashes, and 28% of fatal crashes (National Highway Traffic Safety Administration, 2024). In

general, when vehicles travel at faster speeds, both crash risk and crash severity increase (SWOV, 2012).

Hard Braking

A driver's rate of hard braking predicts crash risk because it is indicative of other dangerous behaviors (e.g., tailgating) and can directly cause a crash (e.g., by giving insufficient time for tailing vehicles to slow their own speed). Unsafe drivers' rate of hard braking is more than four times that of safe drivers (Klauer et al., 2009).

Rapid Acceleration

Rapid longitudinal (forward) acceleration also predicts crash risk, though to a lesser degree than hard braking (af Wåhlberg, 2006; Klauer et al., 2009). Many researchers combine rates of hard braking and rapid acceleration into a single kinematic risky driving (KRD) index. In one study, drivers with elevated KRD rates were 7% more likely to have a crash in the following month (Simons-Morton et al., 2012).

Secondary outcomes were measures of each of these four behaviors individually. Primary outcomes were measures of overall driver safety/risk that averaged together all four behaviors. The trial included a lengthy post-intervention period to test whether any improvements in driver safety were sustained. It also measured drivers' demographic, socioeconomic, and behavioral characteristics to test if any mattered for the success of the interventions and to address concerns about the equity of treatment effects.

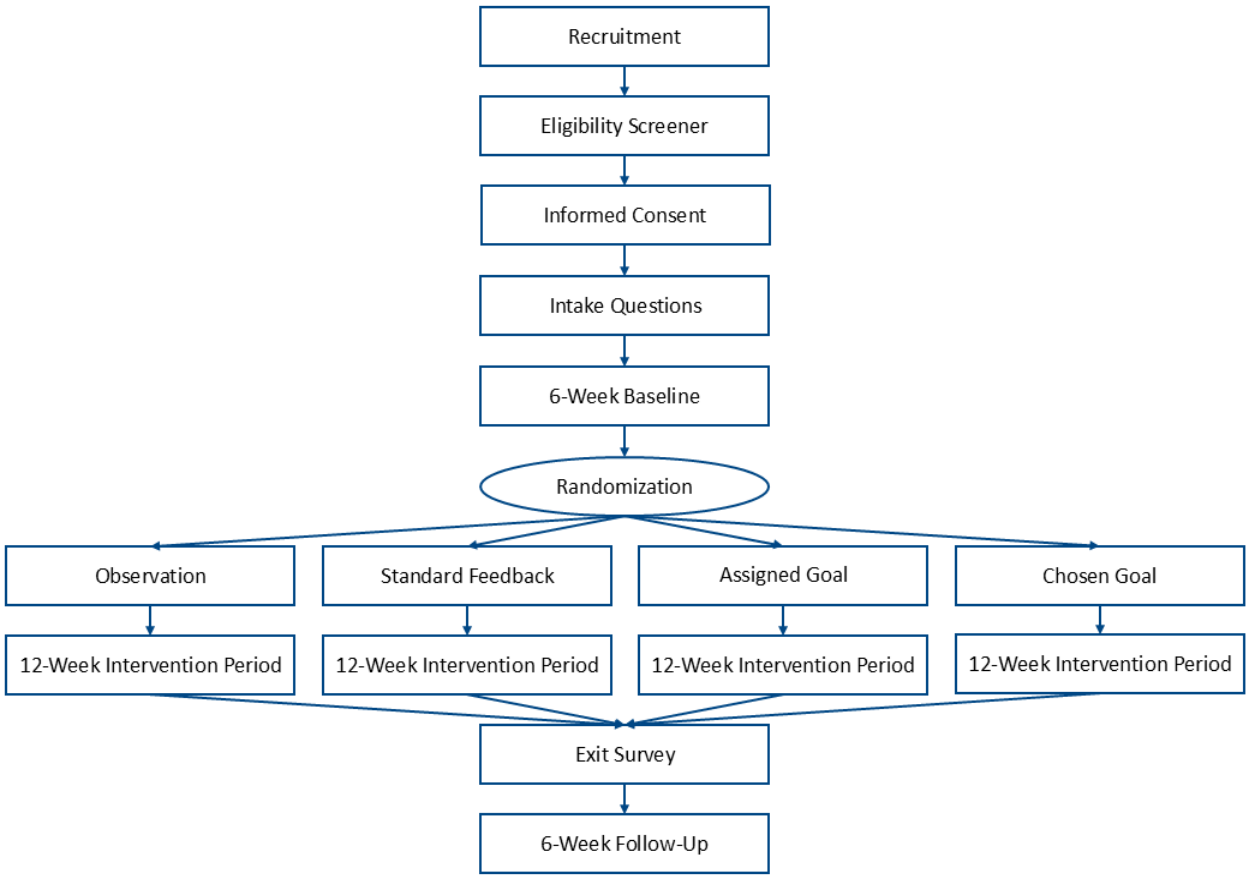
Method

Overview

Drivers were recruited online. Individuals who met study eligibility criteria and consented were asked to install an app on their phone to measure driving behavior. Those with sufficient drives during a baseline period were randomly assigned to one of four study arms for the intervention period. Observation participants were merely monitored and served as the control group. Standard Feedback participants were given weekly feedback on their "driver focus," "gentle braking," "smooth acceleration," and "safe speeds" and earned money at the end of the intervention period based on their overall driver safety. Assigned Goal participants were given feedback on their lowest-scoring behavior and earned money based on overall safety. Chosen Goal participants were given feedback on a behavior of their choosing and earned money based on overall safety. Driving behavior continued to be monitored during a post-intervention (aka "follow-up") period. This study flow is depicted in Figure 1. Analyses compared the three

treatment arms to the control arm on overall safety and on each of the four measured behaviors.

Figure 1. Study flow.



Ethics Statement

The University of Pennsylvania Institutional Review Board approved the study protocol. The protocol was preregistered on ClinicalTrials.gov (NCT06101251). Publicly sharing hypotheses, methods, and analysis plan before a study is conducted enhances research transparency. Participants gave their informed consent to be in the study. All participants could earn up to $150 for completing all study requirements. Participants assigned to a treatment arm could earn up to $100 more depending on how safely they drove. Participation took place virtually via digital platforms.

Digital Platforms

The study used multiple digital platforms to carry out recruitment, screening, consent, surveying, messaging, data collection, and payment. These platforms are briefly described here.

Meta Ads

Meta is the parent company of Facebook and Instagram, the two most used social networks in the U.S. (Enberg, 2023). The Meta Ads platform was used to advertise on both social networks, targeting ads based on demographics and other characteristics.

Qualtrics

Qualtrics is a HIPAA-compliant, web-based survey tool. It was used to securely screen for eligible individuals among those who clicked study ads; administer informed consent; collect demographic information; and send participants to the Way to Health platform to complete study enrollment.

Way to Health

Way to Health is a HIPAA-compliant, web-based platform at the University of Pennsylvania that provides technology infrastructure and automation for large-scale behavior change interventions. The platform has integrations with the Way to Drive app, enabling it to collect driving data; Twilio, enabling it to send text messages; and Greenphire ClinCard®, enabling it to pay participants. Way to Health was used to collect demographic information, enroll participants into Way to Drive, process incoming driving data, randomize participants to study arms, deliver study messages, generate individual driving dashboards, administer the exit survey, and compensate participants.

Way to Drive

Way to Drive is a smartphone telematics application designed by researchers at the University of Pennsylvania and licensed from Cambridge Mobile Telematics, a leading U.S. driving telematics company. The app is available to consenting research participants for both iOS and Android phones. The app deploys the same algorithms many UBI programs use to classify trips as driver vs. non-driver (Ebert, Xiong, Patel, et al., 2024), measure risky driving behaviors like handheld phone use and speeding, and generate safety scores for insurance rating purposes. Once installed and given permission to access phone information such as location and motion, the app is designed to collect data in the background without user intervention. Within the app, users may view their trips and change driver/non-driver classifications. Unlike UBI telematics apps, Way to Drive does not deliver in-app driving feedback, making it suitable for

randomized controlled trials that provide varying levels of feedback through other means (e.g., text messages generated by Way to Health).

Greenphire ClinCard®

ClinCard® is a leading payment method for clinical trials. Its virtual debit card option was used for the present study. Automations in Way to Health created pending payments, which were reviewed and approved by a member of the study team. Way to Health then sent these approved payments to ClinCard®, which disbursed the funds to participants' virtual debit cards.

Participant Recruitment

Participants were recruited with advertisements on Facebook and Instagram. Ads were placed in the U.S. and directed at smartphone owners who regularly commuted. They depicted a car on a road with the words "Driving Study / On your phone / Be safer / Get $150." The possibility of additional payments, which could be earned if a participant was assigned to a treatment arm, was not mentioned to reduce the likelihood of differential attrition between treatment and control.

Recruitment took place in waves between January 25 and March 21, 2024, which allowed the research team to monitor enrollment and adjust ad targeting to ensure even enrollment across sex and age subgroups. Those who clicked the ad were taken directly to a brief screening survey in Qualtrics. In addition, 704 individuals who previously expressed interest in the study during an October 2023 Meta recruitment pilot were invited to the screening survey. Screening questions assessed whether individuals met the following eligibility criteria:

- No one in household previously enrolled[1]
- ≥18 years of age, English reading proficiency
- Anticipated driving ≥2 days/week in the next 6 months
- Owned an iPhone or Android smartphone,
- Passed an attention check

Eligible individuals proceeded to the informed consent form. Those who consented were asked to supply the following demographic information: ethnicity, race, sex assigned at birth, gender identity, educational attainment, household income, number of tickets for a moving violation in the prior 5 years, and number of car crashes (regardless of fault) in the prior 5 years (Appendix B). Participants were then redirected to the Way to Health platform to create an account and securely provide their name,

[1] This item was added to the screener after the first wave of recruitment, when it was discovered that some individuals had created multiple accounts.

email address, cell number, mailing address, and date of birth. The redirect URL included a random, unique 12-digit ID that enabled linkage of Qualtrics responses to the participant's Way to Health account.

Upon account creation, Way to Health enrolled participants into Way to Drive via an application programming interface (API) with the Cambridge Mobile Telematics platform. This enrollment triggered a text message from Cambridge Mobile Telematics to the participant inviting them to install the app. Concurrently, Way to Health enrolled the participant into the ClinCard® virtual payment system. Way to Health sent the participant a welcome email that included information about installing the Way to Drive app, accessing ClinCard®, and what to expect from the study. Reminders were sent to participants who had not installed the app. Participants who installed the app and had at least four driver trips within the first week were paid $15.[2]

After each recruitment wave, the research team screened for duplicate accounts by inspecting IP addresses and associated email and mailing addresses. In addition, accounts created without prior eligibility screen or consent were identified by missing 12-digit ID. Time zone information from Qualtrics and longitude and latitude information from the Way to Drive app were used to screen for individuals outside the U.S. Duplicate, ineligible, and non-U.S. accounts were unenrolled, and an email was sent to the address on file explaining the reason for unenrollment.

Baseline Period

For each participant, the 6-week baseline period began immediately upon enrollment and lasted for 6 weeks beyond enrollment day. During the 6-week baseline period, participants' trips were monitored via the Way to Drive app, but they did not receive feedback on their driving behavior. Each week Way to Drive detected a driver trip they received $5 via ClinCard®.[3] If the app did not detect a driver trip, the participant received a text message check-in to help troubleshoot potential problems.

At the end of the baseline period, if a participant had at least 24 driver trips, they were randomized into one of the four study arms by Way to Health, which sent them an arm-specific email describing what to expect during the 12-week intervention period. Those in the treatment arms were told they would get text message feedback on their driving each Sunday, with a link to a progress report providing more detailed feedback,

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[2] When the study first launched, participants were paid $15 merely for installing and registering the app. To prevent people from doing this multiple times using temporary phone numbers, the standard for payment was raised.

[3] When the study first launched, participants could also earn the weekly $5 merely if their app was properly enabled for at least four of the seven days. To discourage non-drivers from participating during the baseline period, the standard for payment was raised.

and a text message safe driving tip each Monday. They were also informed that, depending on how safely they drove, they could earn up to $100 at the end of the 12 weeks. If a participant had fewer than 24 driver trips, they were sent a text and email explaining that they had been unenrolled from the study, thanking them, and requesting that they uninstall the app, which no longer collected trip data.

Intervention Period

The intervention period began the first Sunday after the end of a participant's baseline period and lasted 12 weeks. Observation participants did not receive messages during this period, aside from messages about payment for app compliance, or about potential app non-compliance. Participants in the three treatment arms received text message feedback each Sunday of the 12-week intervention period and the Sunday immediately after this period. Messaging varied by treatment arm, as described in detail in the following sections. At a high level:

- Standard Feedback participants always received feedback and safety tips on all four behaviors (driver focus, gentle braking, smooth acceleration, and safe speeds).
- Assigned Goal participants received feedback and tips on one behavior at a time—the behavior they scored lowest on—and an assigned goal for it.
- Chosen Goal participants received feedback and tips on one behavior and goal of their choosing.

Each behavior was scored on a 0-to-100 scale, where 100 is safest. Scores are not normalized; for example, 90 may be above average for one behavior but merely average for another. The algorithm used to calculate each "TrueMotion UBI trip score" is proprietary to Cambridge Mobile Telematics; however, based on prior research, participants were given the following guidance on what a score of 90 or above approximately corresponded to within each category:

- Driver focus: <3 minutes of handheld phone use per hour of driving
- Gentle braking: <3 hard brakes per 100 miles of driving
- Smooth acceleration: <1 rapid acceleration per 100 miles of driving
- Safe speeds: <15 seconds of speeding (≥10 mph above limit) per hour of driving

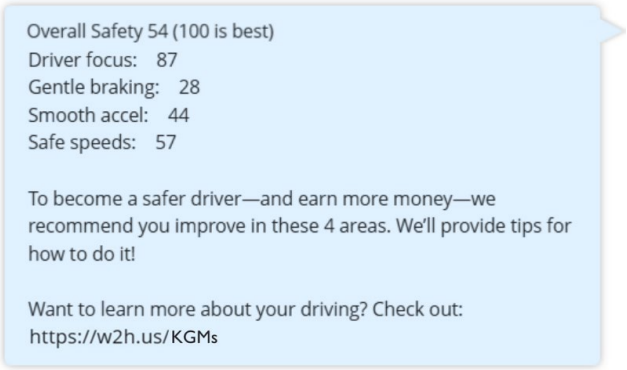
Treatment participants could earn up to $100 based on their final "overall safety" score, which was calculated by averaging their four final behavior scores. Each final behavior score was the simple average of their 12 weekly and one baseline score for that behavior. Baseline and weekly scores were calculated by taking the trip duration-weighted average of all driving trip scores during that period.

Weekly Feedback

At the beginning of the intervention period, all treatment arm participants were texted their baseline overall safety score and their scores for each of the four behaviors. Those in the Standard Feedback arm were told "To become a safer driver—and earn more money—we recommend you improve in these 4 areas. We'll provide tips for how to do it!" Each subsequent week, Standard Feedback participants were texted their running scores (simple average of their baseline scores and weekly intervention scores) for overall safety and the four behaviors. Figure 2 shows sample Standard Feedback messaging for the first three weeks.

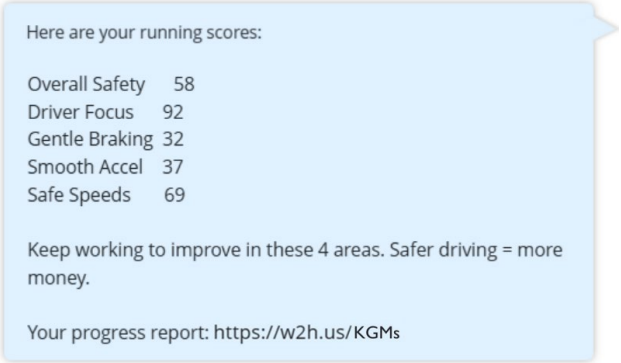
Figure 2. Standard Feedback Messaging. Sample text messaging at the beginning of the first three weeks of the intervention period.

Week 1



Week 2

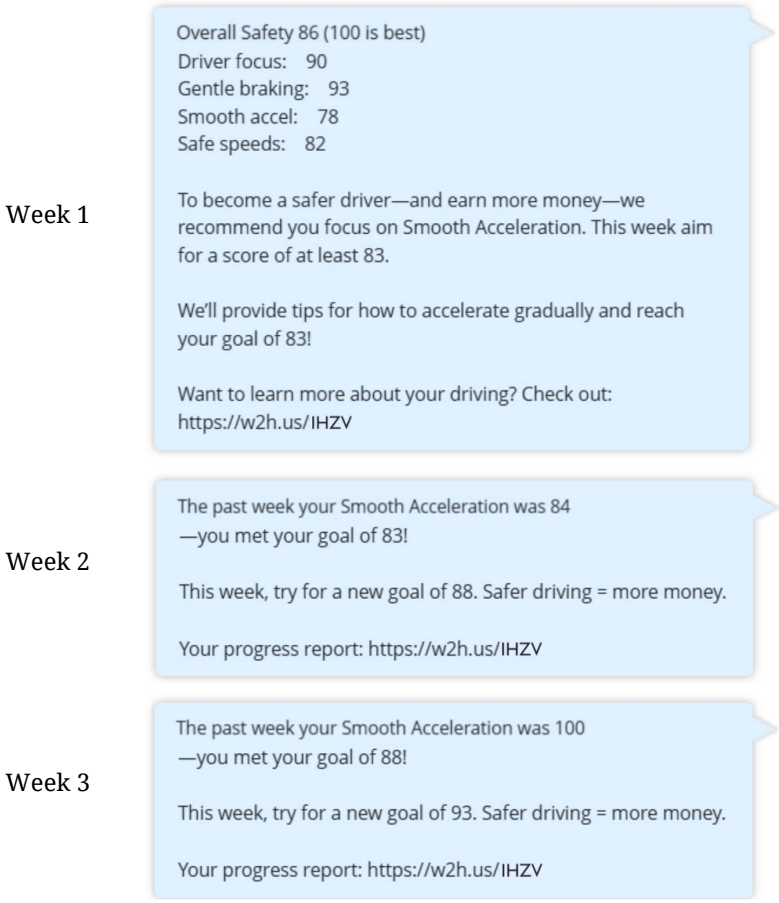
Week 3



Those in the Assigned Goal arm were recommended a behavior to focus on and a goal for their weekly score in this area (e.g., "To become a safer driver—and earn more money—we recommend you focus on GENTLE BRAKING. This week aim for a score of at least 66."). The assigned area was their lowest-scoring behavior at baseline, and the goal for the upcoming week was a score five points[4] greater than their baseline score. Each subsequent Sunday, if they met their goal and their focus behavior still had the lowest running score, they were given a new goal for the behavior that was five points greater than the previous one. If they met their goal and a different behavior now had the lowest running score, they were reassigned this other behavior to focus on, with a goal that was five points greater than their new focus behavior's running score. If they did not meet their goal, they were given the same goal for the coming week—unless it was the third consecutive week that they did not meet this goal, in which case they were reassigned to focus on a different behavior with the next-lowest running score. In sum, Assigned Goal participants worked on one behavior at a time, with incrementally more difficult weekly goals; participants were reassigned to work on a new behavior if they either improved so much that this new behavior became their lowest-scoring, or their improvement stalled. Figure 3 shows sample Assigned Goal messaging for the first three weeks.

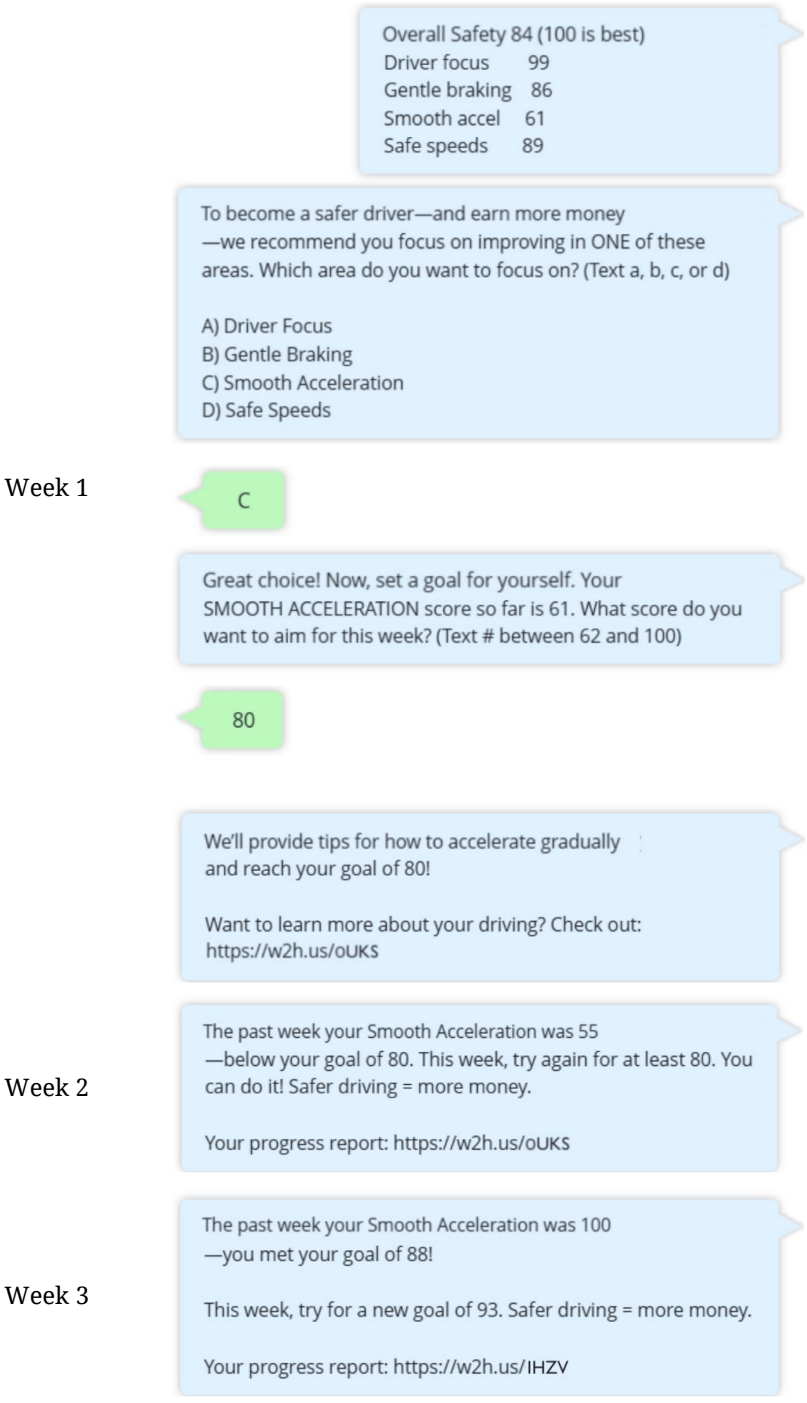
[4] For driver focus, a behavior with higher scores and less variability in scores, 3-point increments were used.

Figure 3. Assigned Goal Messaging. Sample text messaging at the beginning of the first three weeks of the intervention period.



Those in the Chosen Goal arm were first asked to choose a behavior to focus on (e.g., "To become a safer driver—and earn more money—we recommend you focus on improving in ONE of these areas. Which area do you want to focus on?"). Then they were asked to set a goal for their weekly score in this area (e.g., "Great choice! Now, set a goal for yourself. Your SMOOTH ACCELERATION score so far is 79. What score do you want to aim for this week?"). They were allowed to choose any number greater than their baseline score. The logic for subsequent weeks was similar to the Assigned Goal logic: Those who met their goal were asked to choose a new goal for the same behavior that was greater than their previous goal. If they met their goal and a different behavior now had the lowest running score, they could choose to continue working on the previous behavior or to switch to a new behavior. If they did not meet their goal, they were given the same goal for the coming week. If it was the third consecutive week and they had not yet met this goal, they could choose to continue working on the previous behavior or to switch to a new one. Figure 4 shows sample Chosen Goal messaging for the first three weeks.

Figure 4. Chosen Goal Messaging. Sample text messaging at the beginning of the first three weeks of the intervention period.



Safety Tips

Each Monday, treatment participants were texted a safe driving tip designed to motivate and help them change a risky driving behavior. Some examples are provided below and a full list is found in Appendix C:

- *If you need to slam on the brake to prevent a crash, please do! But by getting better at defensive driving, you can anticipate the need to brake sooner and avoid a lot of these situations. What counts as a hard brake? You'll know it when you feel it! Your head moves forward as your body is held back by the seat belt.*
- *Instead of driving 10 mph over the speed limit to get to your destination on time, you could try leaving a little earlier. For a 20-mile trip, all you need to do for a leisurely drive is hop in the car 3 minutes earlier!*
- *Guess what? Smooth acceleration can save you money! Drivers who accelerate fast waste anywhere from 5% to 14% of their gas or battery life. Fast acceleration also wears down a car's engine and tires, and some insurance programs charge more to those who make a habit of accelerating fast. Whenever you can, speed up smoothly.*

Standard Feedback participants received a rotating selection of tips concerning all four driving behaviors. Assigned Goal and Chosen Goal participants only received tips related to their current focus behavior.

Weekly Dashboard

To simulate the graphical and gamified nature of many UBI apps, and to ensure all treatment participants had access to the same detailed driving information, a weekly dashboard was provided via a link in the Sunday feedback text message (see complete dashboard in Appendix D). The dashboard for all three treatment arms included the following components:

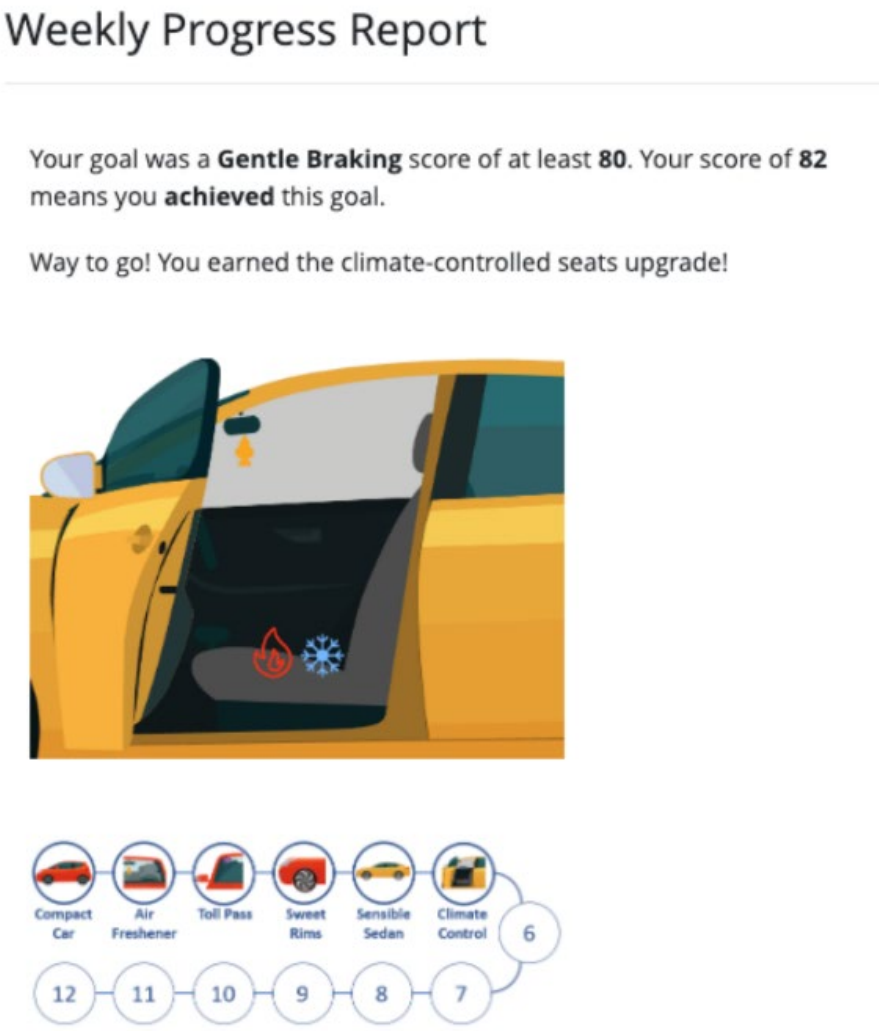
- Dial showing running score for overall safety (Figure 5)
- Baseline overall safety score
- Table showing baseline, personal best, most recent, and running scores for the four behaviors (Figure 5)
- Brief, plain-language definitions of the four behaviors and overall safety
- A 2-min video about the Way to Drive app with detailed information about how to earn a score of ≥90 for each behavior
- Research team's email address

Figure 5. Running score dial and breakouts for four behaviors in dashboard.

		Start	Best	Last	Avg
	Driver Focus	91	93	93	92
	Gentle Braking	60	82	82	74
	Smooth Acceleration	71	73	68	71
	Safe Speeds	85	88	84	86

To keep focus on their target behavior and weekly goals, those in the Assigned Goal and Chosen Goal arms saw an additional section at the top of the dashboard (Figure 6), which described how they performed relative to the prior week's goal and the progress they had made to date in meeting their weekly goals. Achievements and setbacks were graphically represented by a car that could gain or lose upgrades depending on the participant's performance. Each week they met their goal, the car "leveled up" (e.g., "Way to go! You earned the massage seats upgrade!"). If they missed their goal by a certain score increment, the car leveled down (e.g., "Oh no! You lost the high-end sound system upgrade."). The dashboard depicted the current state of their car after any upgrade or downgrade, as well as their car's progress with respect to all 13 possible states it could be in.

Figure 6. Achievements and upgrades tracker in dashboard for drivers in Assigned Goal and Chosen Goal arms.



Exit Survey

At the end of their 12-week intervention period, participants received text messages and emails inviting them to take an exit survey about their experience with the study (Appendix E). The survey included the following:

- A Net Promoter Score (NPS) question
- The Acceptability of Intervention Measure (AIM)
- Questions about whether the study helped them become a safer driver and whether they would like to continue being in it
- Questions about the helpfulness of various interventions delivered to the treatment arms

- Questions about how they approached improving their driver safety, tailored to each treatment arm
- An open-ended question asking for suggestions to improve study interventions
- The Ten-Item Personality Inventory measuring the Big Five personality traits (Gosling et al., 2003)
- The 5-item Delay Discounting Task measuring present bias (i.e., strength of preference for immediate versus delayed rewards) (Koffarnus & Bickel, 2014)
- A question about how many car crashes they had been in during the study
- A question about whether they were interested in being contacted about future research opportunities.

Participants were paid $15 for completing the survey.

Post-Intervention

Immediately after the end of their intervention period, participants continued to be monitored for a 6-week follow-up period. They were asked to keep Way to Drive installed and collecting their trip data. During the post-intervention period, they received no study messages aside from those related to $5 payment for app compliance, or to troubleshoot potential app non-compliance.

Participant Withdrawal

When a participant withdrew from the study, study communications and data collection were stopped. Data collected prior to withdrawal were maintained for analysis. Participants who texted “bye” or “stop” in response to the text asking them to install Way to Drive before the start of the intervention period were unenrolled. If a participant texted “bye” or “stop” after the intervention period began, they stopped receiving study texts but continued to be enrolled in the study and eligible for compensation. They received a confirmation message informing them that if they wanted to withdraw from the study, they should email the study team.

Primary and Secondary Outcomes

The primary outcome was overall driver safety/risk, an equal-weighted average of the secondary outcomes measuring four driving behaviors. There were two versions of each secondary outcome (Table 1): (a) a 0-to-100 driving score calculated by Cambridge Mobile Telematics and used by auto insurers to determine crash risk (100 is safest) and (b) a behavior metric indicating the proportion of drive time, or the rate per 100 driving miles, that they engaged in the risky behavior (0 is safest). To derive the overall risk outcome, the four secondary behavior metrics were converted to z-scores and then averaged. To aid interpretability and facilitate comparisons across study periods, z-scores were computed with grand means based on all 24 weeks of monitoring.

Table 1. Primary and secondary outcomes

	Driving Scores	Behavior Metrics
Primary	Overall safety (0–100, 100 is safest; mean of scores below)	Overall risk (higher is riskier; mean of z-scores of metrics below)
Secondary	Driver focus (0–100)	Handheld phone use, seconds per hour of driving
	Safe speeds (0–100)	Speeding (≥10 mph above limit), seconds per hour of driving
	Gentle braking (0–100)	Hard braking (≤−0.30 g-force[5]), events per 100 miles of driving
	Smooth acceleration (0–100)	Rapid acceleration (≥0.27 g-force[6]), events per 100 miles of driving

Acceptability and Engagement Outcomes

The exit survey probed the acceptability and helpfulness of the study and its interventions. Behavioral indicators of unacceptability were participants' texting 'bye' or 'stop' to end study text messaging and participant withdrawal. Engagement indicators included treatment participants' level of interaction with the weekly dashboard and Chosen Goal participants' responsiveness to goal setting text message prompts.

Net Promoter Score (NPS)

NPS was derived for each arm, and overall, by first calculating the percentage of respondents who were "promoters" (those rating the intervention period a 9 or 10 on "How likely are you to recommend this safe driving program to a friend or colleague?") and the percentage who were "detractors" (those rating 0–6). Detractor percentage was subtracted from promoter percentage to yield NPS.

Acceptability of Intervention Measure (AIM)

For each participant, an AIM score was calculated by averaging their ratings (1–5 scale) for the four items.

[5] This is the default threshold for hard braking events in the Way to Drive app. Some published research has used a higher threshold (e.g., ≤−0.40 g-force), resulting in a lower incidence rate. (Stevenson et al., 2021)

[6] This is the default threshold for rapid acceleration events in the Way to Drive app. Some published research has used a higher threshold (e.g., ≥0.35 g-force), resulting in a lower incidence rate. (Simons-Morton et al., 2012)

Helpfulness of Program

Responses to this single item (1–5 scale) were analyzed as an ordinal outcome using the Kruskal-Wallis test.

Desire to Continue in Program

Responses to this single item (1–5 scale) were analyzed as an ordinal outcome using the Kruskal-Wallis test.

Helpfulness of Intervention Components

The rated helpfulness (1–5 scale) of each of four intervention components (text message feedback on driving, weekly dashboard, text message tips for safer driving, potential to earn money) was analyzed as an ordinal outcome. For inferential tests of between-group comparisons, participants who indicated they were not aware of the intervention component were excluded.

Behaviors They Tried to Improve

The percentage of participants who indicated they tried to improve on each of the four behaviors in Week 1 was compared between treatment arms. Mean number of behaviors they reported trying to improve was also compared.

SMS Messages Disabled

The percentage of participants who disabled study text messages by texting ‘bye’ or ‘stop’ during the intervention period was compared between arms.

Unenrollment Rates

The percentage of participants who unenrolled during the intervention period was compared between arms.

Dashboard Engagement

For each treatment participant, the proportion of weekly dashboards viewed was calculated. Mean proportion across treatment arms was compared. Exploratory analyses examined whether improvements from baseline in driver safety were greater among those who engaged with the dashboard more.

Goal Engagement

For Chosen Goal participants, proportion of weeks where a target behavior was set and proportion where a score goal was set were calculated and then averaged as an indicator of engagement with goal selection. On weeks where a participant's behavior and goal were carried over from the prior week, the participant was deemed engaged. Exploratory analyses examined whether improvements from baseline in driver safety were greater among those who were more engaged.

Power Analysis

A sample from previous research using the Way to Drive app had a mean (SD) overall safety score of 76 (17). Assuming a 20% attrition rate and five pre-specified comparisons, it was determined that 1,264 total participants would be needed to have 80% power to detect a five-point difference in overall safety between intervention arms with alpha = 0.01. To be adequately powered, the research team sought to enroll a total of at least 1,300 participants who met baseline criteria for randomization to a study arm.

Analysis Plan

Aim 1: Randomized Controlled Trial

The primary outcome analysis was intention-to-treat, in which all participants were analyzed as randomized to measure effectiveness. The primary outcome was overall safety/risk during the 12-week intervention period. The generalized estimating equation approach was used with treatment arm, study period, and arm × period interaction as primary predictors, adjusting for the following covariates. Baseline overall safety/overall risk, moving violations, and car crashes were continuous variables; all others were categorical and dummy-coded in the regression (see Table 2 for categories).

- Baseline overall safety/overall risk
- Age
- Sex
- Race/ethnicity
- Urban/suburban/rural residence, derived from ZIP code using the Urbanization Perceptions Small Area Index (Bucholtz et al., 2020)
- Household income
- Education level
- Number of moving violations in prior 5 years
- Number of car crashes in prior 5 years

If a participant chose not to disclose information about one of these covariates, they were still included in the analysis with this covariate dummy-coded as undisclosed.

Generalized estimating equation models allow for missing outcome data over time and include all collected data in the analysis.

Each of the three treatment arms were compared to control, testing for the significance of its arm × period interaction. In addition, each successive treatment arm was compared to the one before (i.e., arm 3 vs 2, arm 4 vs 3) based on their arm × period interaction terms, for a total of five comparisons. Due to the multiple pre-planned contrasts, the Holm method was used to adjust for multiple comparisons. For clarity of presentation, adjusted *P*-values are reported and may be compared directly to an alpha of 0.05 (Blakesley et al., 2009). Covariate-adjusted means and confidence intervals were calculated using a bootstrapping method with 1,000 simulations (Cheng et al., 2013). Confidence intervals were not adjusted for multiple comparisons. As such, some differences that appear statistically significant based on confidence intervals, and which have significant unadjusted *P*-values, have non-significant adjusted *P*-values.

Additional analyses were conducted using the same modeling approach for the secondary outcomes—that is, the scores and metrics related to distraction, speeding, braking, and acceleration. For these analyses, baseline overall safety/overall risk was replaced by the appropriate, behavior-specific baseline score or metric.

Aim 2: Sustained Effects

The same analytic approach as Aim 1 was used to compare the outcomes by randomization arm during the 6-week post-intervention period.

Aim 3: Equity and Effect Moderator

Primary outcome results were examined for subgroups related to age, sex, race/ethnicity, income, education, urban/suburban/rural residence, delay discount rate, and each of the Big Five personality traits. Heterogeneity in treatment effects was examined for each of these potential moderator variables. Participants who did not disclose the information pertinent to a given variable were excluded from the analysis testing for its moderation. For each of the 12 potential moderators, dummy-coded moderator × arm × period interaction terms were added to a model that already included all relevant two-way interaction terms, and the change in Wald value was used to test for moderation. For each significant *P*-value, the nature of the moderation was determined by inspection of the underlying three-way terms.

The relatively large number of moderator tests, and the fact that these tests do not control for possible moderator variable overlap, biases results toward false positives; at the same time, small subgroup sample sizes biases results toward false negatives (Blette et al., 2023). Rather than Holm-adjusting *P*-values to account for the number of tests and potentially obscure real relationships that exist, unadjusted *P*-values are reported—with

the caveat that some of these results may be false positives and should be interpreted cautiously.

Results

Participant Characteristics

A total of 1,449 participants were randomly assigned to study arms for the intervention period. Of these, 719 (49.6%) reported being assigned female at birth and 721 (49.8%) reported being assigned male. Mean (SD) age was 40.1 (15.5). The sample was racially and ethnically diverse: 229 (15.8%) identified as non-Hispanic and Black, 815 (56.2%) as non-Hispanic and White, 164 (11.3%) as Hispanic and any racial group, and 226 (15.6%) as another racial group. At baseline, mean (SD) overall safety was 76.7 (10.9), with driver focus of 92.5 (8.6), safe speeds of 71.2 (19.7), gentle braking of 75.6 (16.6), and smooth acceleration of 67.3 (20.8). Overall risk was 0.04 (0.49), with 3.8 (5.3) minutes of handheld phone use per hour, 2.4 (2.7) minutes of speeding per hour, 8.6 (8.8) hard brakes per 100 miles, and 10.3 (13.3) rapid accelerations per 100 miles. Table 2 shows these and other variables by study arm. There were no significant differences between study arms on any of these sociodemographic (Ps > 0.10) or baseline variables (Ps > 0.51). Note that study arms were slightly imbalanced for two reasons: (a) the block randomization procedure in the Way to Health platform was suboptimally configured for heavy volumes and (b) due to a coding error, 86 participants who did not qualify for randomization were randomized but unenrolled before their intervention period started, and by chance more of these were in the Assigned Goal and Chosen Goal arms.

Table 2. Participant characteristics and baseline driving

Mean (SD)	Overall	Observation	Standard Feedback	Assigned Goal	Chosen Goal
n	1449	372	369	356	352
Age					
18–24	316 (21.8)	75 (20.2)	85 (23.0)	72 (20.2)	84 (23.9)
25–34	277 (19.1)	81 (21.8)	66 (17.9)	74 (20.8)	56 (15.9)
35–44	305 (21.0)	78 (21.0)	79 (21.4)	76 (21.3)	72 (20.5)
45–54	261 (18.0)	59 (15.9)	77 (20.9)	58 (16.3)	67 (19.0)
55–70	252 (17.4)	65 (17.5)	54 (14.6)	69 (19.4)	64 (18.2)
Above 70	38 (2.6)	14 (3.8)	8 (2.2)	7 (2.0)	9 (2.6)
Sex					
Female	719 (49.6)	177 (47.6)	173 (46.9)	185 (52.0)	184 (52.3)
Male	721 (49.8)	194 (52.2)	194 (52.6)	169 (47.5)	164 (46.6)
Undisclosed	9 (0.6)	1 (0.3)	2 (0.5)	2 (0.6)	4 (1.1)
Race/ethnicity					
Non-Hispanic Black	229 (15.8)	60 (16.1)	58 (15.7)	54 (15.2)	57 (16.2)
Non-Hispanic White	815 (56.2)	198 (53.2)	210 (56.9)	196 (55.1)	211 (59.9)
Hispanic	164 (11.3)	42 (11.3)	42 (11.4)	50 (14.0)	30 (8.5)
Other	226 (15.6)	68 (18.3)	56 (15.2)	52 (14.6)	50 (14.2)
Undisclosed	15 (1.0)	4 (1.1)	3 (0.8)	4 (1.1)	4 (1.1)
Residence					
Urban	392 (27.1)	100 (26.9)	108 (29.3)	91 (25.6)	93 (26.4)
Suburban	871 (60.1)	227 (61.0)	217 (58.8)	222 (62.4)	205 (58.2)
Rural	186 (12.8)	45 (12.1)	44 (11.9)	43 (12.1)	54 (15.3)
Education level					
High school or less	133 (9.2)	33 (8.9)	32 (8.7)	34 (9.6)	34 (9.7)
Some college, no degree	308 (21.3)	77 (20.7)	83 (22.5)	74 (20.8)	74 (21.0)
College and above	999 (68.9)	260 (69.9)	253 (68.6)	247 (69.4)	239 (67.9)
Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Undisclosed	9 (0.6)	2 (0.5)	1 (0.3)	1 (0.3)	5 (1.4)
Household income					
Below $60,000	480 (33.1)	127 (34.1)	114 (30.9)	104 (29.2)	135 (38.4)
$60,000–$99,000	379 (26.2)	92 (24.7)	105 (28.5)	95 (26.7)	87 (24.7)
$100,000–$149,000	307 (21.2)	75 (20.2)	73 (19.8)	97 (27.2)	62 (17.6)
Over $150,000	215 (14.8)	59 (15.9)	61 (16.5)	46 (12.9)	49 (13.9)
Undisclosed	68 (4.7)	19 (5.1)	16 (4.3)	14 (3.9)	19 (5.4)
Tickets past 5 yrs	0.3 (0.7)	0.2 (0.6)	0.3 (0.7)	0.3 (0.8)	0.2 (0.6)
Crashes past 5 yrs	0.4 (0.7)	0.4 (0.7)	0.4 (0.7)	0.4 (0.8)	0.4 (0.7)

Mean (SD)	Overall	Observation	Standard Feedback	Assigned Goal	Chosen Goal
Overall safety	76.7 (10.9)	76.2 (10.6)	76.9 (11.5)	76.5 (11.1)	77.1 (10.4)
Driver focus	92.5 (8.6)	92.7 (8.5)	92.2 (8.2)	92.5 (8.4)	92.5 (9.5)
Safe speeds	71.2 (19.7)	70.4 (19.3)	72.0 (19.7)	70.8 (19.5)	71.6 (20.2)
Smooth acceleration	67.3 (20.8)	66.2 (20.8)	67.7 (21.7)	67.9 (20.2)	67.6 (20.6)
Gentle braking	75.6 (16.6)	75.3 (16.9)	75.8 (16.7)	74.8 (17.2)	76.6 (15.5)
Overall risk	0.04 (0.49)	0.03 (0.45)	0.04 (0.51)	0.05 (0.50)	0.04 (0.51)
Handheld phone use, min/hr	3.8 (5.3)	3.6 (5.2)	4.0 (5.0)	3.8 (5.2)	3.8 (5.8)
Speeding, min/hr	2.4 (2.7)	2.3 (2.3)	2.3 (2.6)	2.5 (3.0)	2.4 (2.7)
Hard brakes per 100 mi	8.6 (8.8)	8.8 (9.4)	8.5 (8.5)	9.0 (8.8)	8.3 (8.6)
Rapid accelerations per 100 mi	10.3 (13.3)	10.6 (13.1)	10.2 (13.3)	9.6 (11.3)	10.7 (15.4)

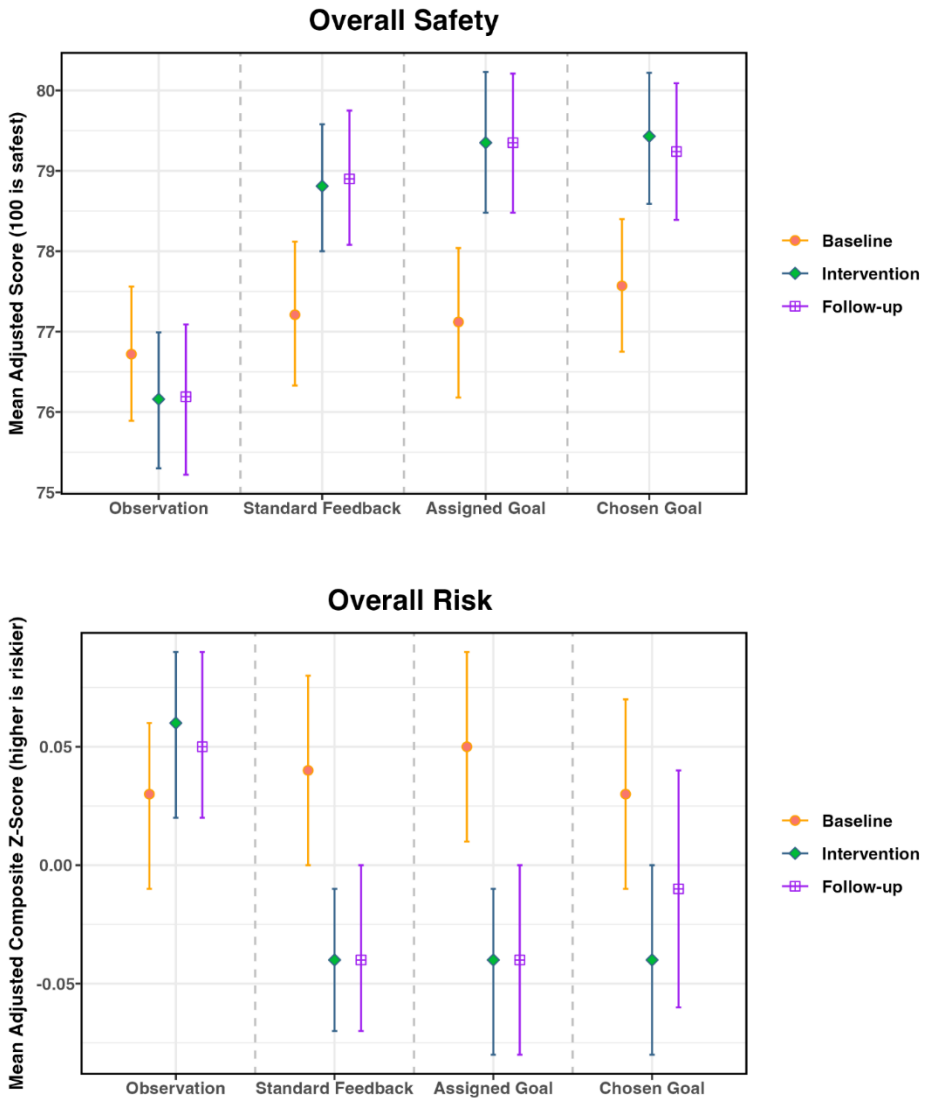
Aim 1—Primary and Secondary Analyses

Primary Outcomes

Results for both primary outcomes are shown in Figure 7. During the intervention period, Standard Feedback (adjusted M = 78.8), Assigned Goal (adjusted M = 79.4), and Chosen Goal (adjusted M = 79.4) participants all had higher overall safety scores than Observation (adjusted M = 76.2), adjusted Ps < 0.001. Differences between treatment groups were not significant, adjusted Ps > 0.10, though Assigned Goal was marginally higher than Standard Feedback before adjusting for number of tests, P = 0.053.

Results for overall risk scores mirrored those for overall safety. During the intervention period, Standard Feedback (adjusted M = -0.04), Assigned Goal (adjusted M = -0.04), and Chosen Goal (adjusted M = -0.04) participants all had lower overall risk scores than Observation (adjusted M = 0.06), adjusted Ps < 0.001. Treatment group differences were not significant, adjusted Ps > 0.28.

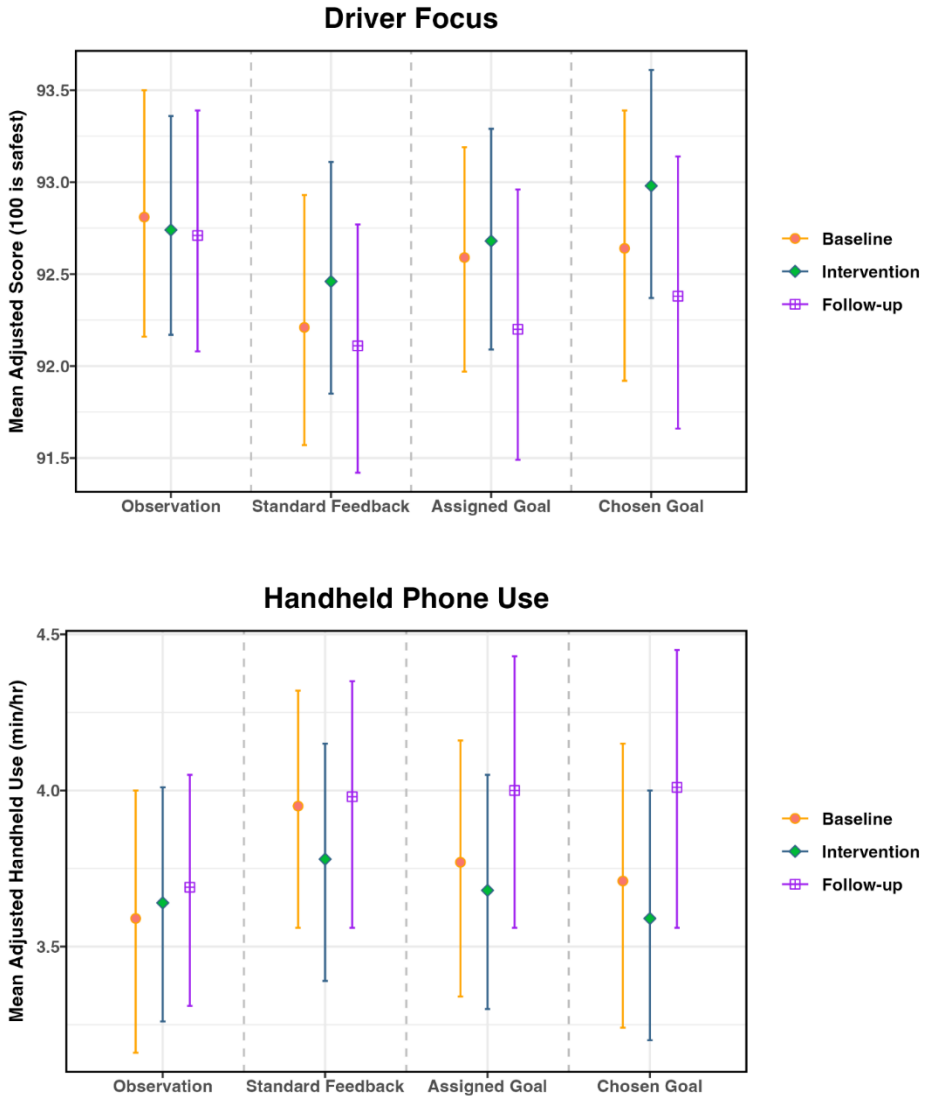
Figure 7. Overall driver safety score and composite risk score by study arm. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).



Driver Focus

During the intervention period, Standard Feedback (adjusted *M* = 92.5), Assigned Goal (adjusted *M* = 92.7), and Chosen Goal (adjusted *M* = 93.0) participants all had similar driver focus scores as Observation (adjusted *M* = 92.7) and each other, adjusted *P*s = 1 (Figure 8). Correspondingly, Standard Feedback (adjusted *M* = 3.8), Assigned Goal (adjusted *M* = 3.7), and Chosen Goal (adjusted *M* = 3.6) participants all had similar minutes of handheld phone use per hour as Observation (adjusted *M* = 3.6) and each other, adjusted *P*s = 1.

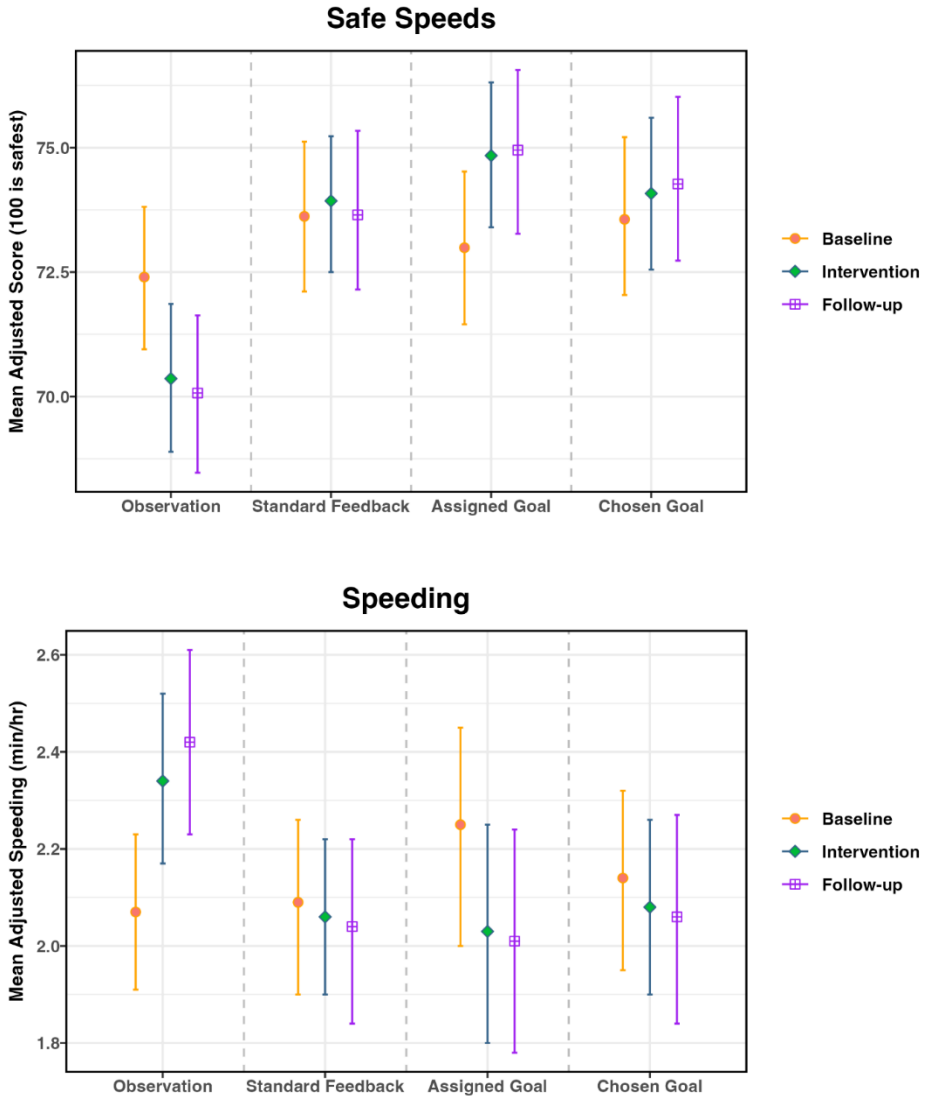
Figure 8. Driver focus score and handheld phone use rate by study arm. Top panel: Mean adjusted driver focus score (100 is safest). Bottom panel: Mean adjusted handheld phone use (min/hr).



Safe Speeds

During the intervention period, Standard Feedback (adjusted *M* = 73.9), Assigned Goal (adjusted *M* = 74.8), and Chosen Goal (adjusted *M* = 74.1) participants all had higher safe speeds scores than Observation (adjusted *M* = 70.4), adjusted *P*s < 0.01 (Figure 9). Treatment group differences were not significant, adjusted *P*s > 0.25. Correspondingly, Standard Feedback (adjusted *M* = 2.1), Assigned Goal (adjusted *M* = 2.0), and Chosen Goal (adjusted *M* = 2.1) participants all had fewer minutes of speeding per hour than Observation (adjusted *M* = 2.3), adjusted *P*s < 0.01. Treatment group differences were not significant, adjusted *P*s > 0.25.

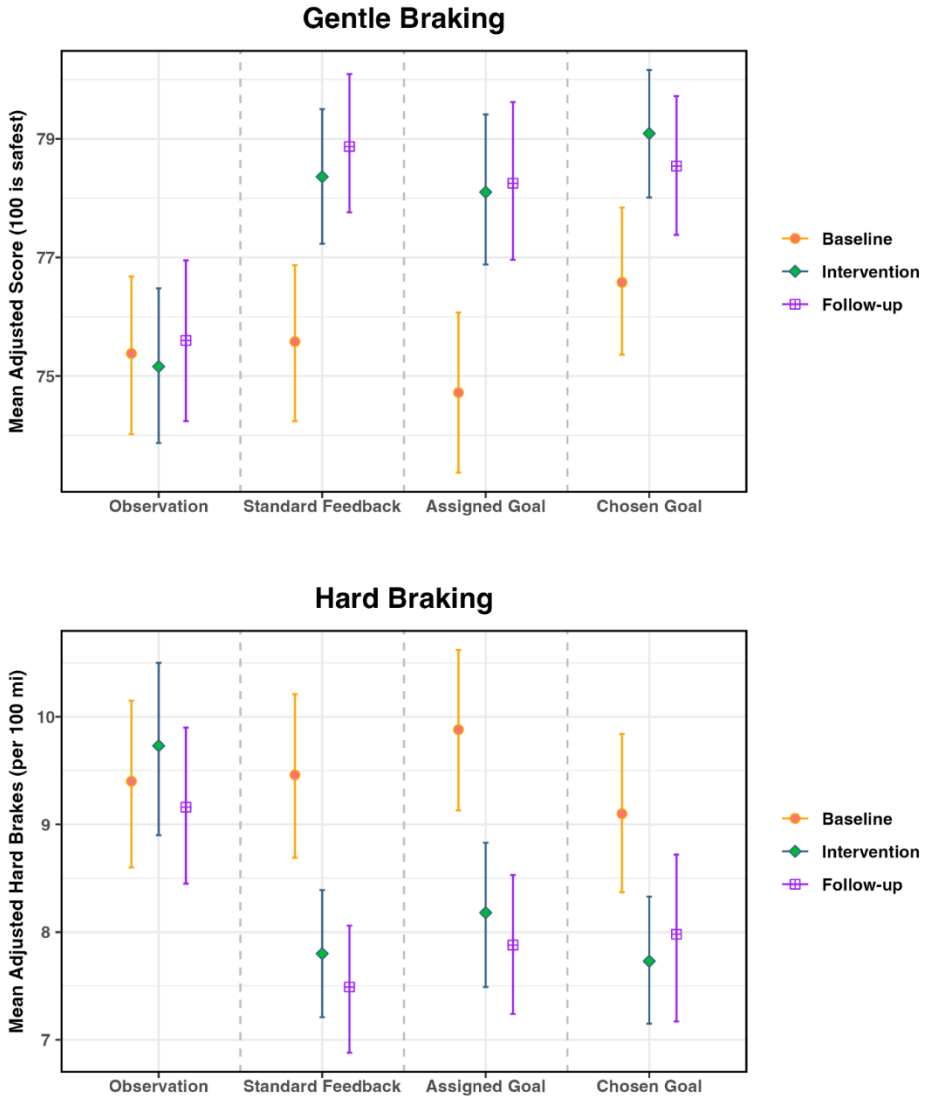
Figure 9. Safe speeds score and speeding rate by study arm. Top panel: Mean adjusted safe speeds score (100 is safest). Bottom panel: Mean adjusted speeding (min/hr).



Gentle Braking

During the intervention period, Standard Feedback (adjusted *M* = 78.4), Assigned Goal (adjusted *M* = 78.1), and Chosen Goal (adjusted *M* = 79.1) participants all had higher gentle braking scores than Observation (adjusted *M* = 75.2), adjusted *P*s < 0.01 (Figure 10). Treatment group differences were not significant, adjusted *P*s = 0.16. Correspondingly, Standard Feedback (adjusted *M* = 7.8), Assigned Goal (adjusted *M* = 8.2), and Chosen Goal (adjusted *M* = 7.7) participants all had fewer hard brakes per 100 miles than Observation (adjusted *M* = 9.7), adjusted *P*s < 0.01. Treatment group differences were not significant, adjusted *P*s = 0.39.

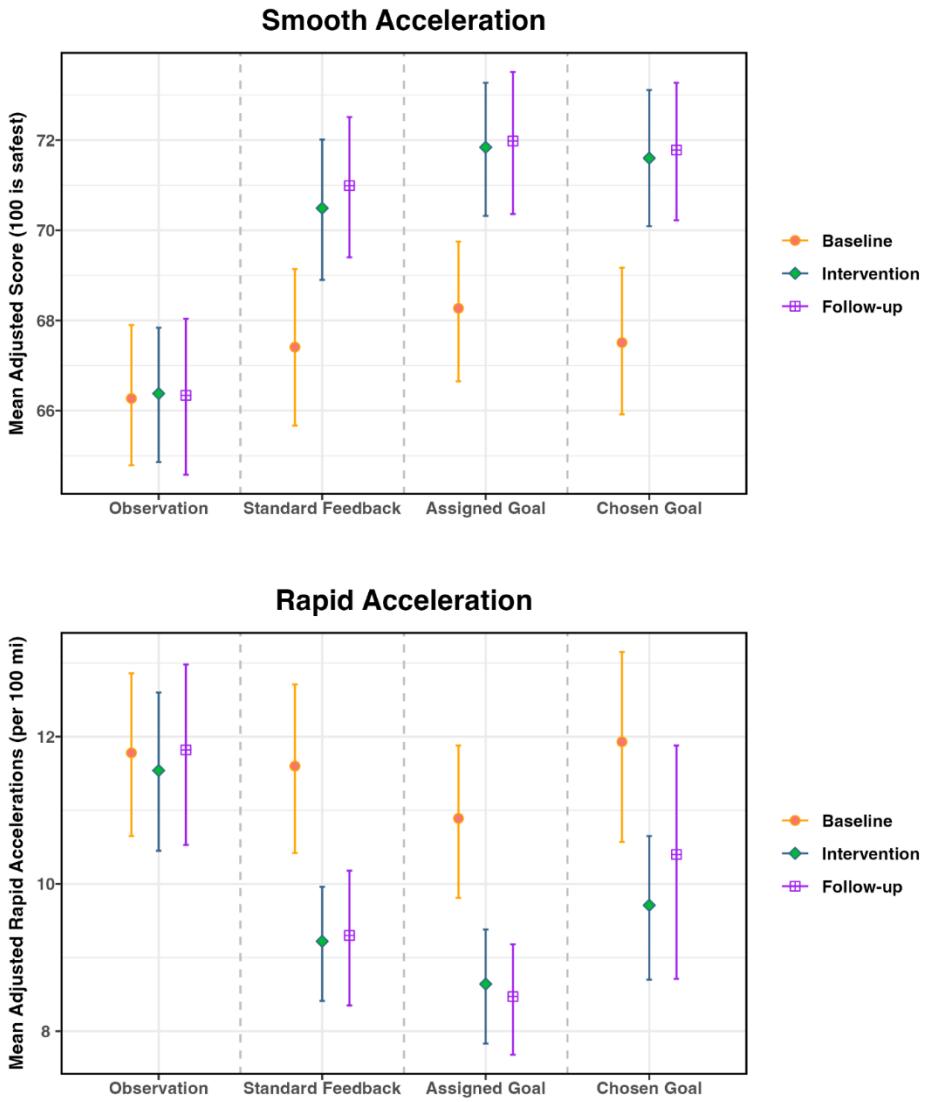
Figure 10. Gentle braking score and hard brake rate by study arm. Top panel: Mean adjusted gentle braking score (100 is safest). Bottom panel: Mean adjusted hard brakes per 100 miles.



Smooth Acceleration

During the intervention period, Standard Feedback (adjusted *M* = 70.5), Assigned Goal (adjusted *M* = 71.8), and Chosen Goal (adjusted *M* = 71.6) participants all had higher smooth acceleration scores than Observation (adjusted *M* = 66.4), adjusted *P*s < 0.001 (Figure 11). Treatment group differences were not significant, adjusted *P*s > 0.53. Correspondingly, Standard Feedback (adjusted *M* = 9.2), Assigned Goal (adjusted *M* = 8.6), and Chosen Goal (adjusted *M* = 9.7) participants all had fewer rapid accelerations per 100 miles than Observation (adjusted *M* = 11.5), adjusted *P*s < 0.01. Treatment group differences were not significant, adjusted *P*s = 1.

Figure 11. Smooth acceleration score and rapid acceleration rate by study arm. Top panel: Mean adjusted smooth acceleration score (100 is safest). Bottom panel: Mean adjusted rapid accelerations per 100 miles.



Aim 2—Sustained Effects

Primary Outcomes at Follow-Up

Standard Feedback (adjusted M = 78.9), Assigned Goal (adjusted M = 79.4), and Chosen Goal (adjusted M = 79.2) continued to have higher overall safety scores than Observation (adjusted M = 76.2), adjusted Ps < 0.01. Treatment group differences were not significant, adjusted Ps = 0.19 (see Figure 7).

For overall risk scores, Standard Feedback (adjusted *M* = -0.04) and Assigned Goal (adjusted *M* = -0.04) continued to be lower than Observation (adjusted *M* = 0.05), adjusted *P*s < 0.001. However, Chosen Goal (adjusted *M* = -0.01) no longer differed significantly from Observation, adjusted *P* = 0.15. Treatment group differences were not significant, *P*s > 0.07 (see Figure 7).

Driver Focus at Follow-Up

Standard Feedback (adjusted *M* = 92.1), Assigned Goal (adjusted *M* = 92.2), and Chosen Goal (adjusted *M* = 92.4) continued to have similar driver focus as Observation (adjusted *M* = 92.7) and each other, adjusted *P*s = 1. Likewise, Standard Feedback (adjusted *M* = 4.0), Assigned Goal (adjusted *M* = 4.0), and Chosen Goal (adjusted *M* = 4.0) all had similar minutes of handheld phone use per hour as Observation (adjusted *M* = 3.7) and each other, adjusted *P*s = 1 (see Figure 8).

Safe Speeds at Follow-Up

Assigned Goal (adjusted *M* = 75.0) and Chosen Goal (adjusted *M* = 74.3) continued to have higher safe speeds scores than Observation (adjusted *M* = 70.1), adjusted *P*s < 0.05. However, Standard Feedback (adjusted *M* = 73.6) no longer differed significantly from Observation, adjusted *P* = 0.11. Treatment group differences were not significant, adjusted *P*s > 0.22 (see Figure 9).

Standard Feedback (adjusted *M* = 2.0), Assigned Goal (adjusted *M* = 2.0), and Chosen Goal (adjusted *M* = 2.1) all continued to have fewer minutes of speeding per hour than Observation (adjusted *M* = 2.4), adjusted *P*s < 0.01. Treatment group differences were not significant, adjusted *P*s = 0.37 (see Figure 9).

Gentle Braking at Follow-Up

Standard Feedback (adjusted *M* = 78.9) and Assigned Goal (adjusted *M* = 78.3) continued to have higher gentle braking scores than Observation (adjusted *M* = 75.6), adjusted *P*s < 0.05. However, Chosen Goal (adjusted *M* = 78.5) no longer differed significantly from Observation, adjusted *P* = 0.23. Treatment group differences were not significant, adjusted *P*s > 0.12 (see Figure 10).

Assigned Goal (adjusted *M* = 7.9) continued to have fewer hard brakes per 100 miles than Observation (adjusted *M* = 9.2), adjusted *P* < 0.01. However, Standard Feedback (adjusted *M* = 7.5), adjusted *P* = 0.060, and Chosen Goal (adjusted *M* = 8.0), adjusted *P* = 0.51, no longer differed significantly from Observation. Treatment group differences were not significant, adjusted *P*s > 0.34 (see Figure 10).

Smooth Acceleration at Follow-Up

Standard Feedback (adjusted *M* = 71.0), Assigned Goal (adjusted *M* = 72.0), and Chosen Goal (adjusted *M* = 71.8) continued to have higher smooth acceleration scores than Observation (adjusted *M* = 66.3), adjusted *P*s < 0.05. Treatment group differences were not significant, adjusted *P*s > 0.78 (see Figure 11).

Assigned Goal (adjusted *M* = 8.5) had fewer rapid accelerations per 100 miles than Observation (adjusted *M* = 11.8), adjusted *P* = 0.011. However, Standard Feedback (adjusted *M* = 9.3), adjusted *P* = 0.13, and Chosen Goal (adjusted *M* = 10.4), adjusted *P* = 0.72, no longer differed significantly from Observation. Treatment group differences were not significant, adjusted *P*s > 0.61 (see Figure 11).

Aim 3—Equity and Effect Moderators

Primary outcome results are shown for subgroups based on age (Figure 12), sex (Figure 13), race/ethnicity (Figure 14), income (Figure 15), education (Figure 16), residence (Figure 17), delay discounting (Figure 18), and Big Five traits (Figures 19 to 23).

Overall Safety Moderation

Residence moderated treatment effects during the intervention period, *P* = 0.011. Specifically, the Standard Feedback and Assigned Goal interventions were more effective among participants in suburban and urban areas than those in rural areas (Figure 17). This continued to be the case at follow-up. None of the other variables significantly moderated treatment effects during the intervention period or after.

Overall Risk Moderation

Residence again moderated treatment effects during the intervention period, *P* = 0.010, due to Standard Feedback and Assigned Goal being more effective among participants in suburban and urban areas (Figure 17). This generally continued to be the case at follow-up, *P* = 0.051. Extraversion, *P* = 0.030, and openness, *P* = 0.027, moderated intervention (but not post-intervention) period treatment effects, with treatments generally less effective among more extraverted and open individuals (see Figure 19, 21). None of the other variables significantly moderated the treatment effects during the intervention period or after, *P*s > 0.05.

Figure 12. Overall driver safety score and composite risk score by study arm and age. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

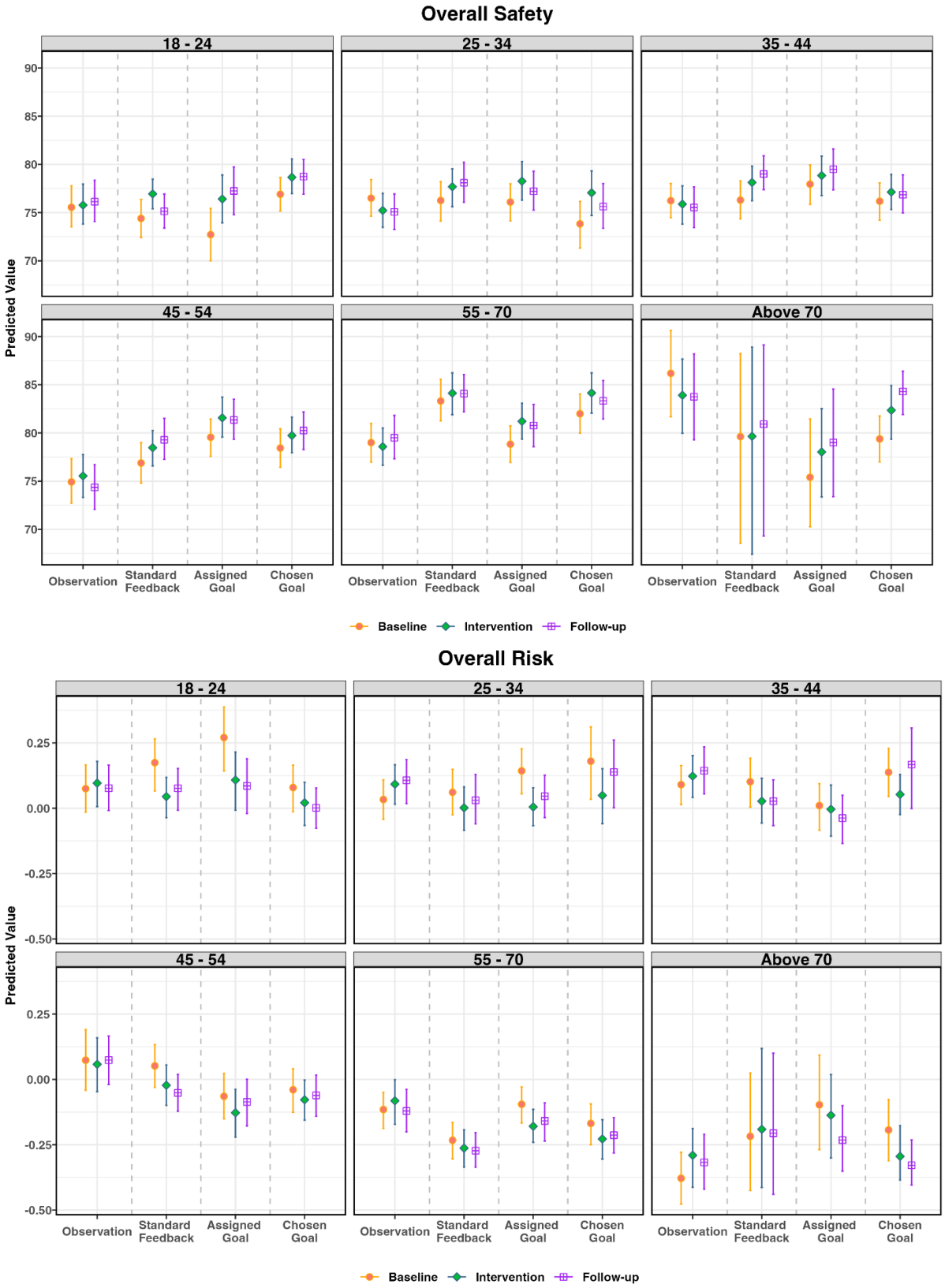


Figure 13. Overall driver safety score and composite risk score by study arm and sex. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

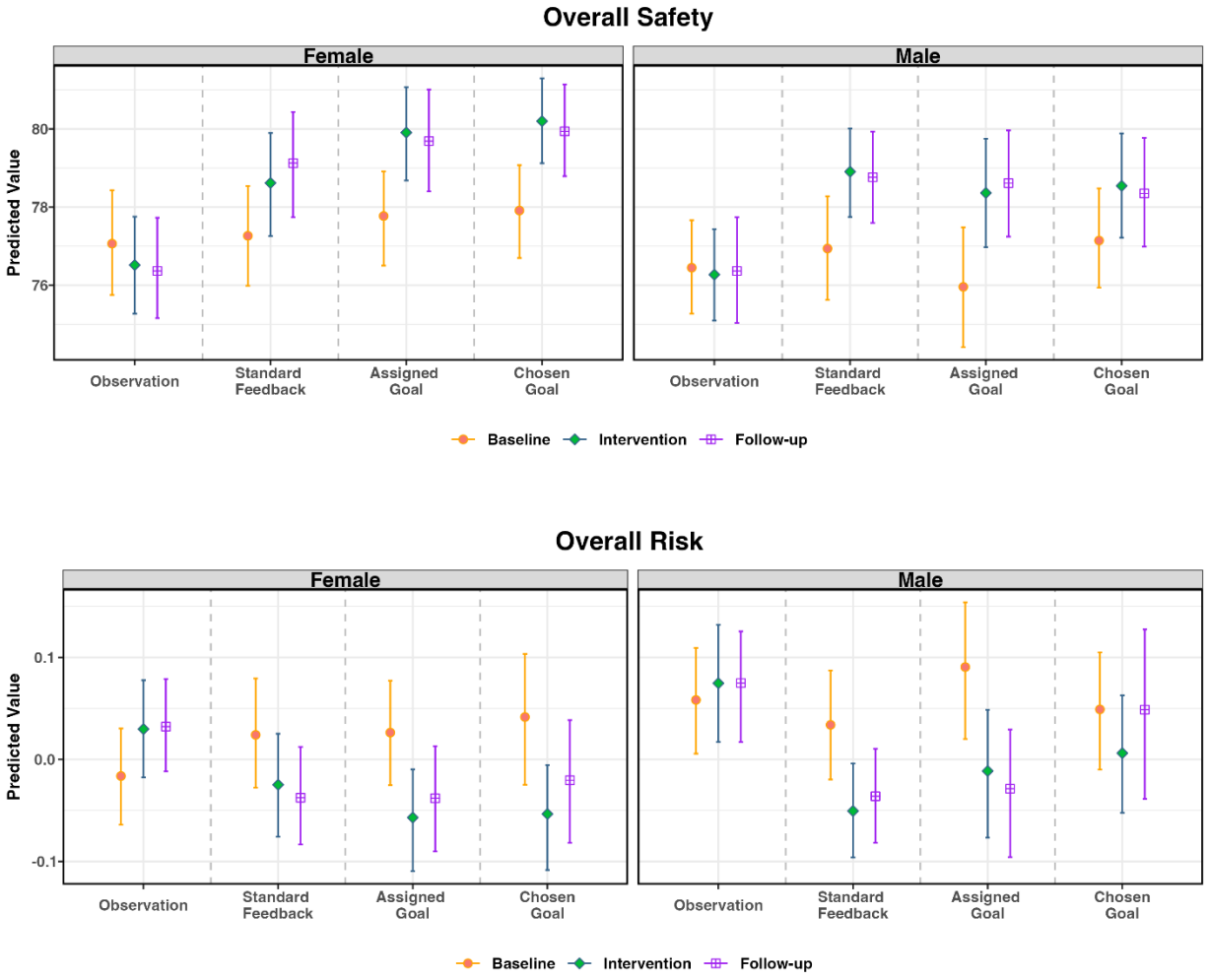


Figure 14. Overall driver safety score and composite risk score by study arm and race/ethnicity. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

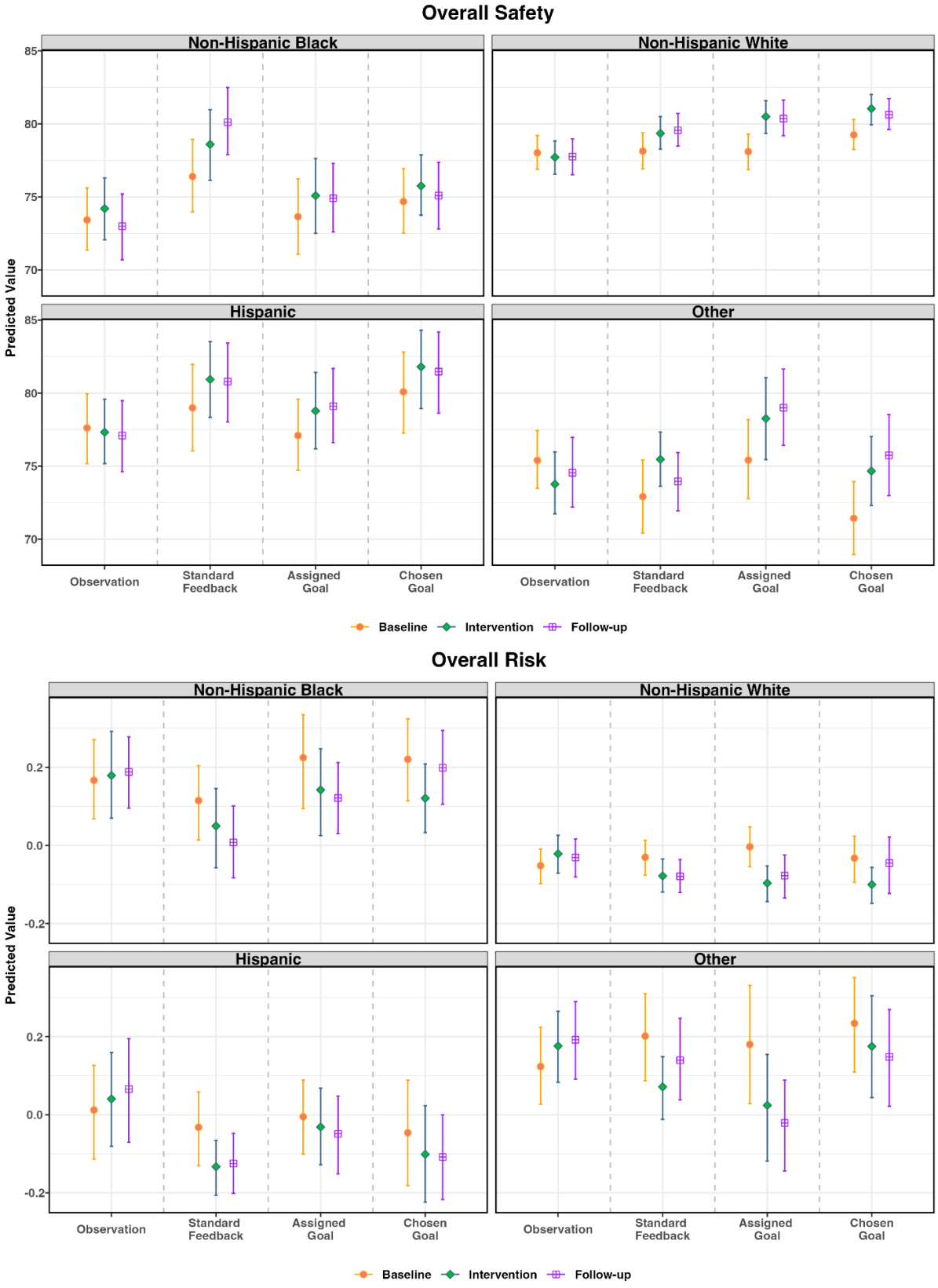


Figure 15. Overall driver safety score and composite risk score by study arm and household income. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

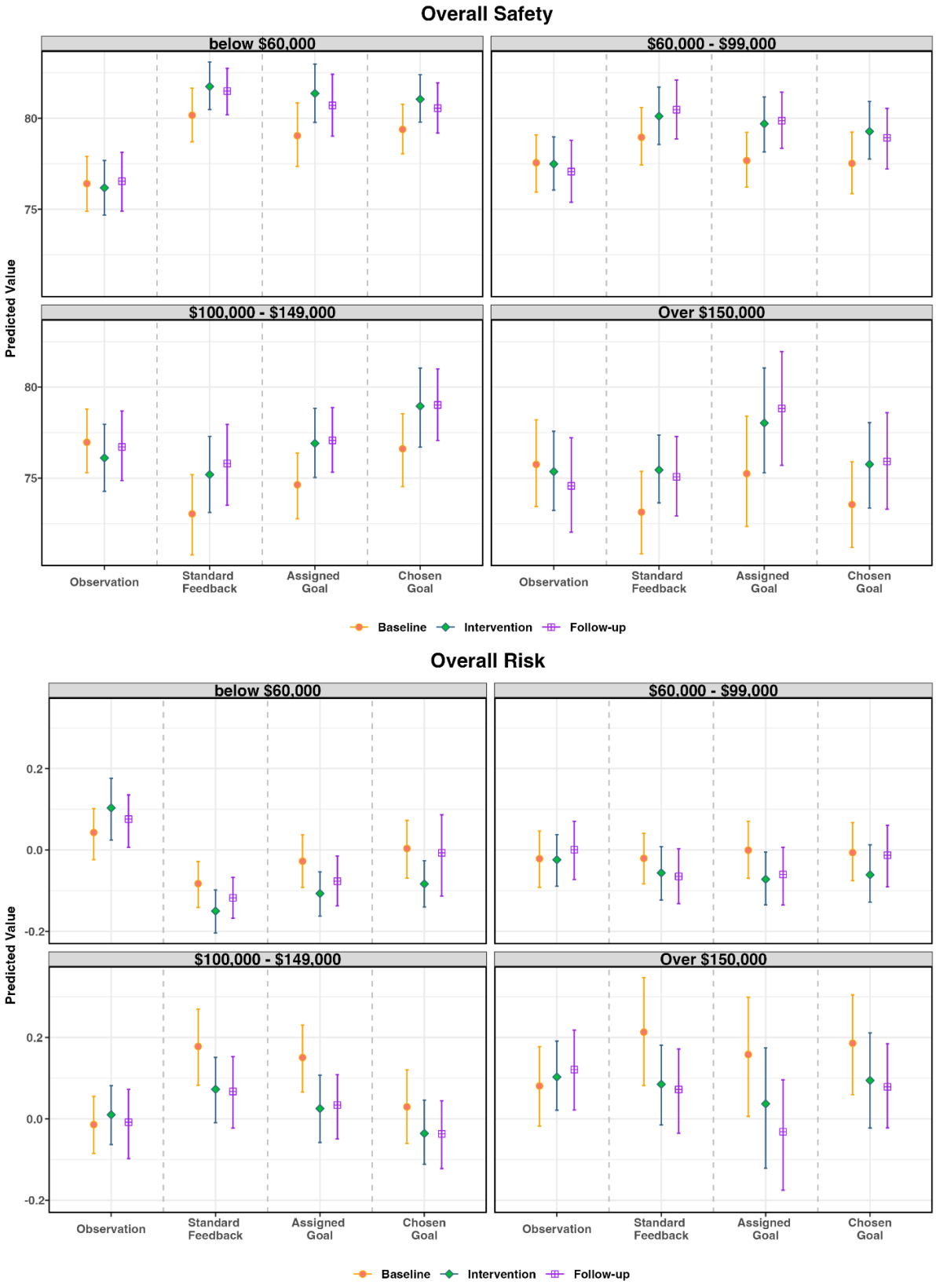


Figure 16. Overall driver safety score and composite risk score by study arm and education level. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

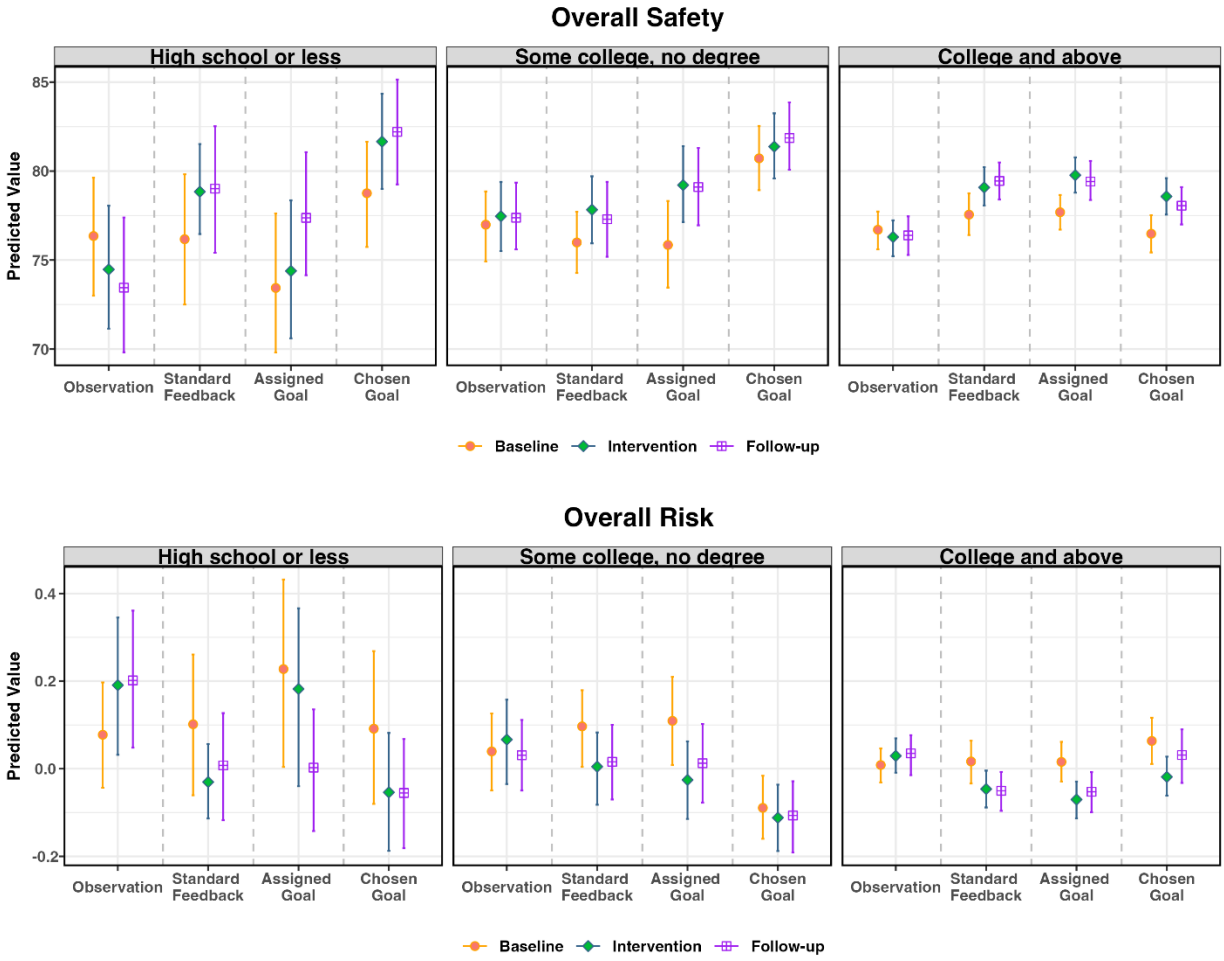


Figure 17. Overall driver safety score and composite risk score by study arm and residence. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

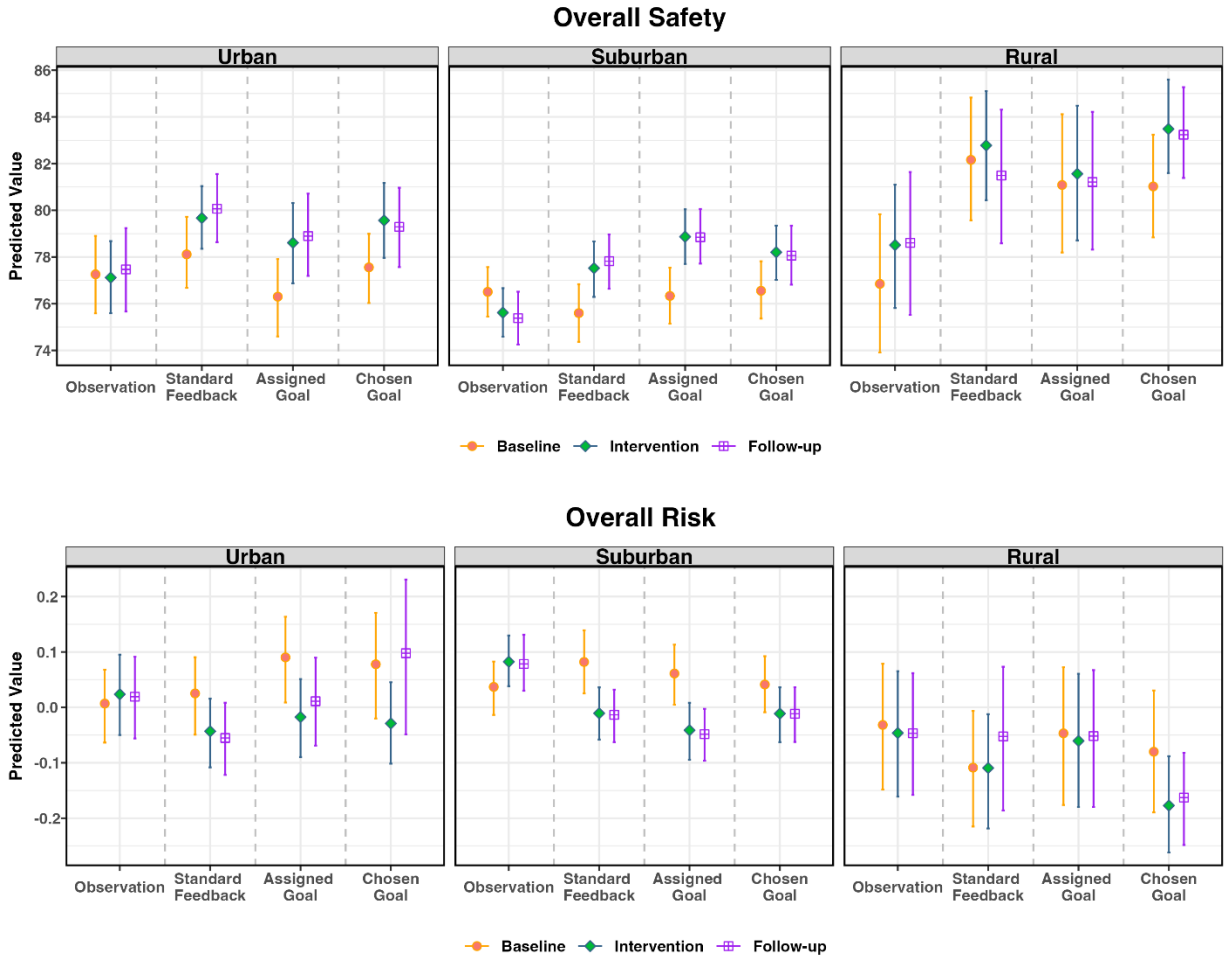
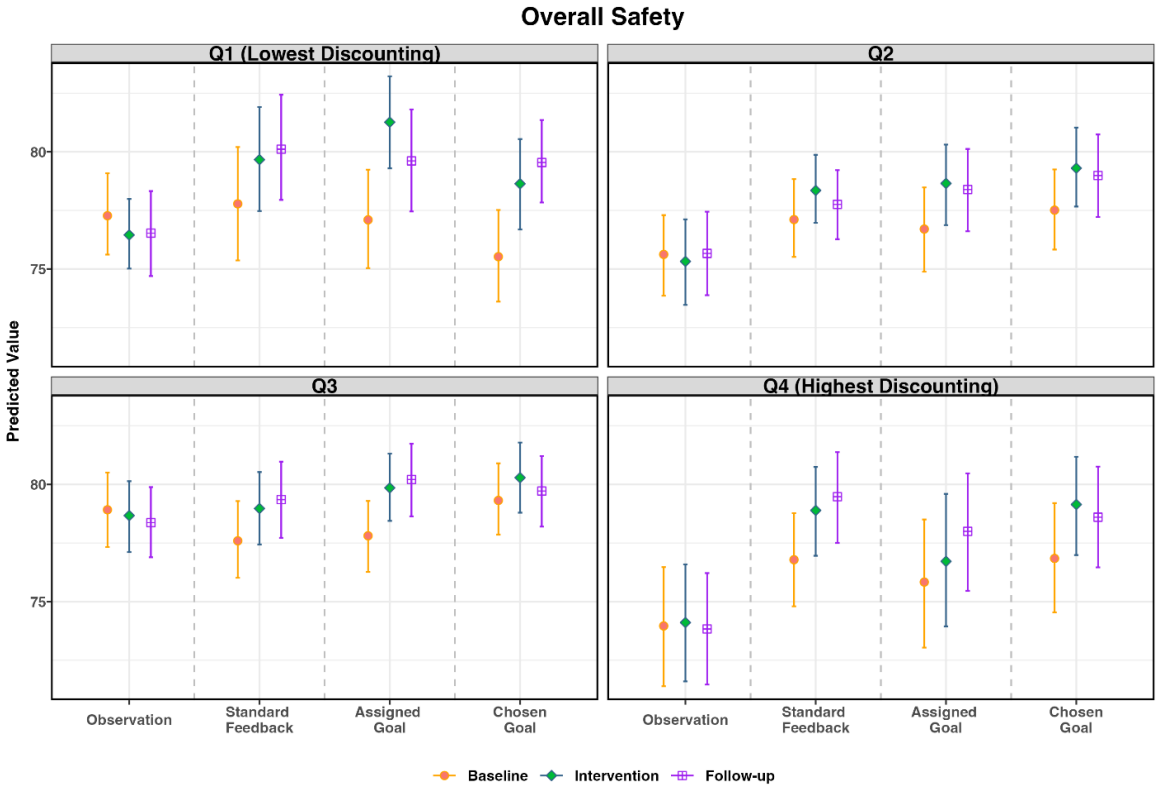


Figure 18. Overall driver safety score and composite risk score by study arm and delay discounting. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier). A higher discount rate indicates a stronger preference for immediate versus delayed rewards.



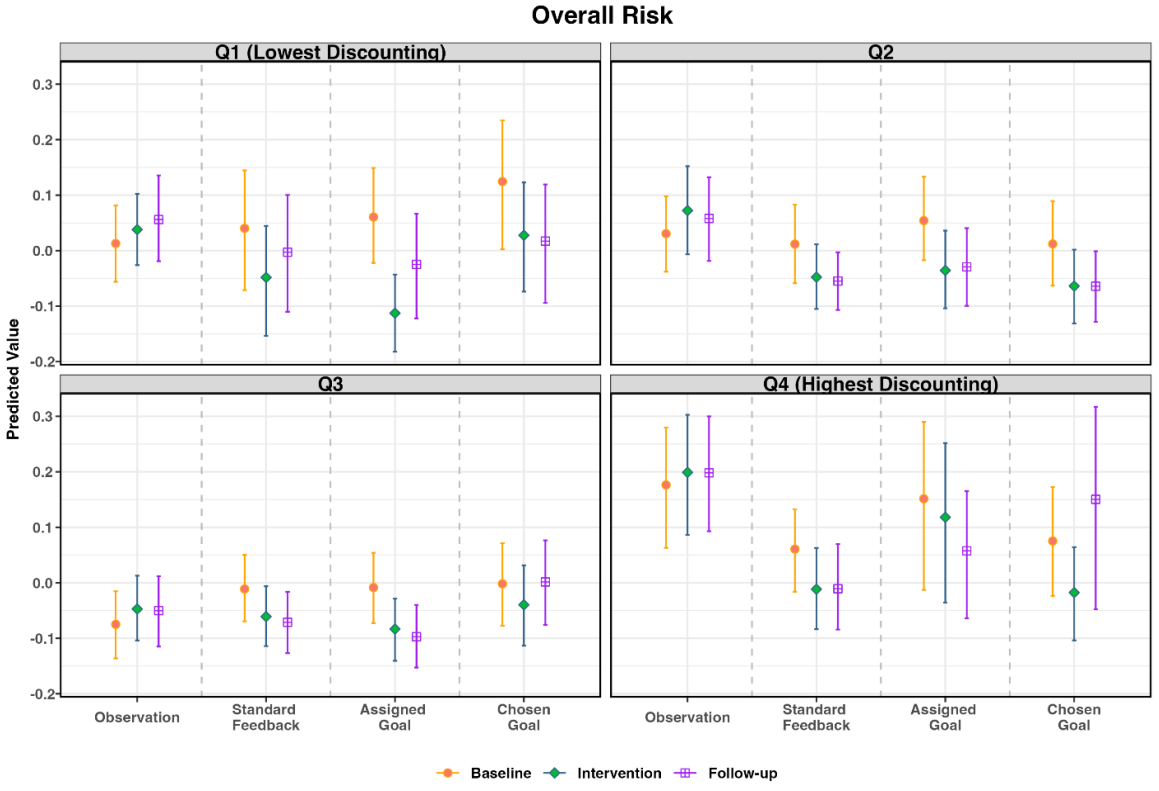


Figure 19. Overall driver safety score and composite risk score by study arm and Big Five trait, openness to experiences. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

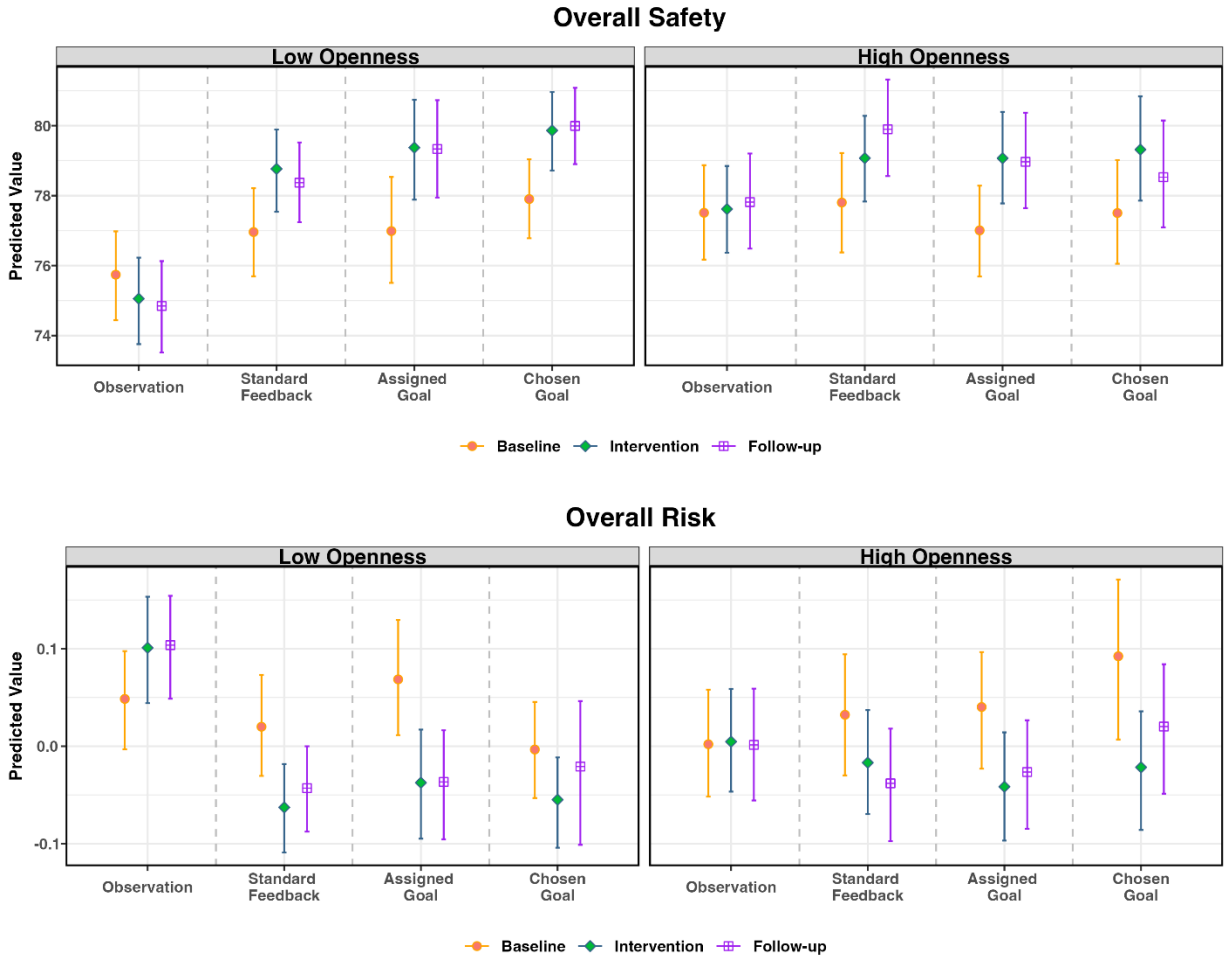


Figure 20. Overall driver safety score and composite risk score by study arm and Big Five trait, conscientiousness. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

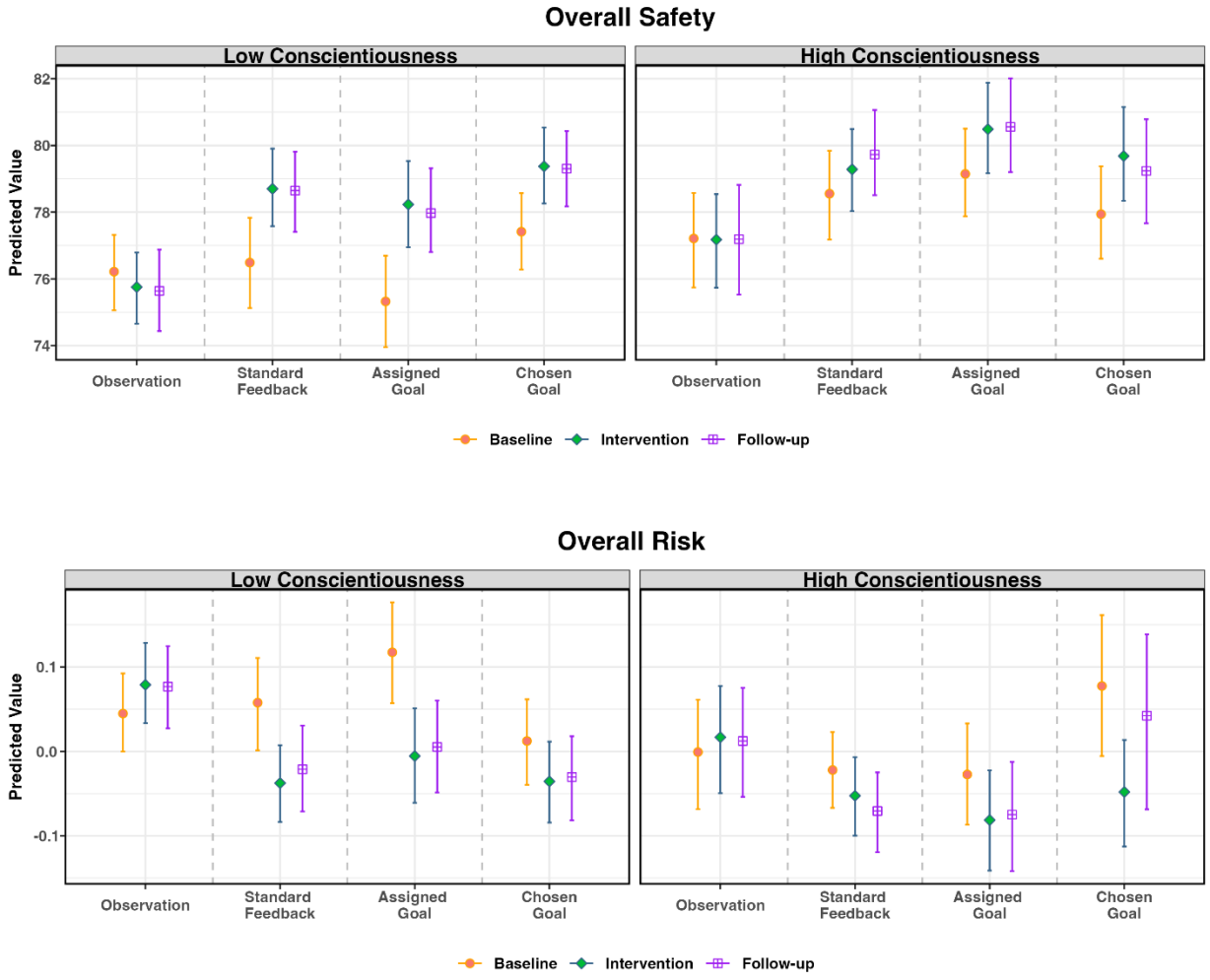


Figure 21. Overall driver safety score and composite risk score by study arm and Big Five trait, extraversion. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

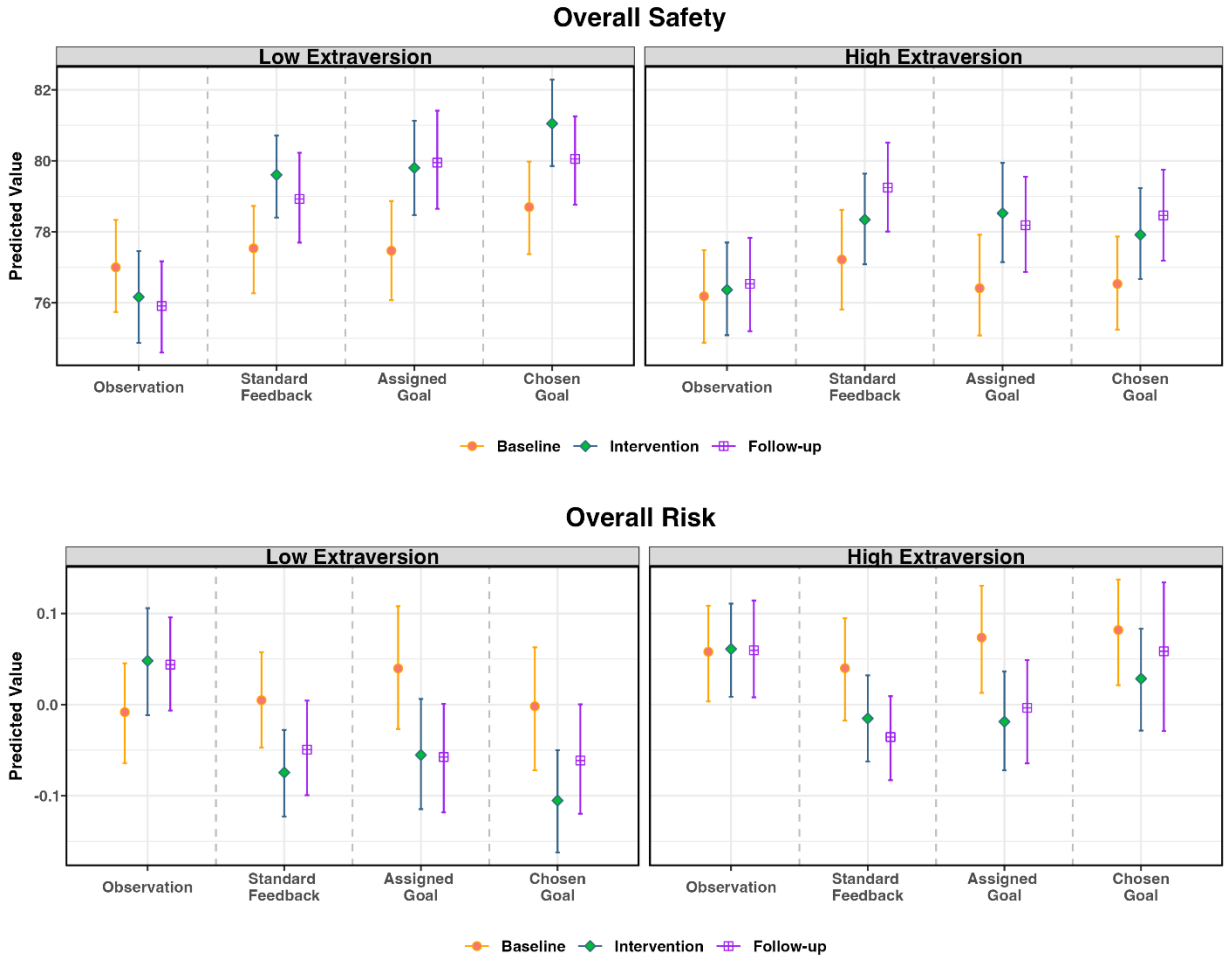


Figure 22. Overall driver safety score and composite risk score by study arm and Big Five trait, agreeableness. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).

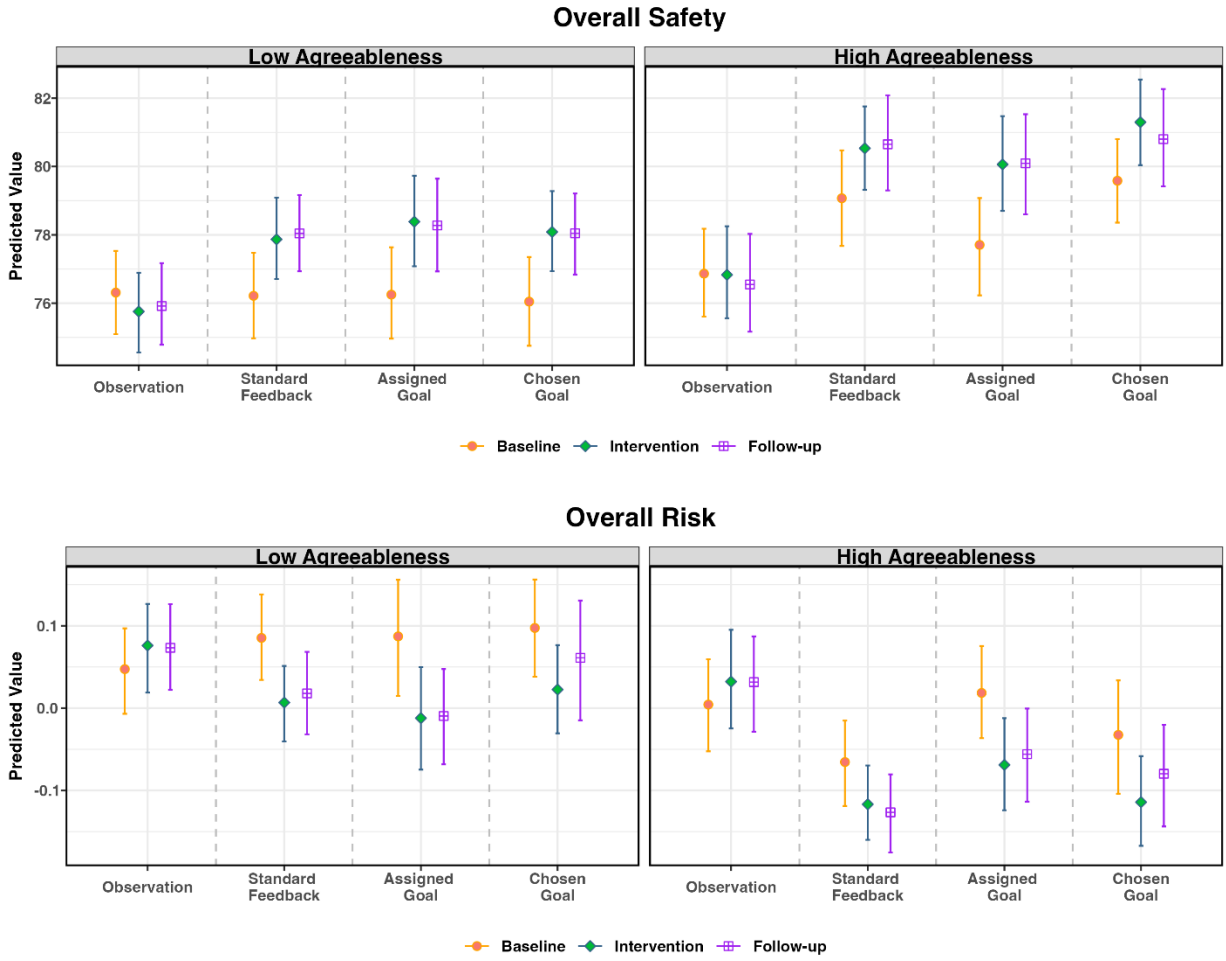
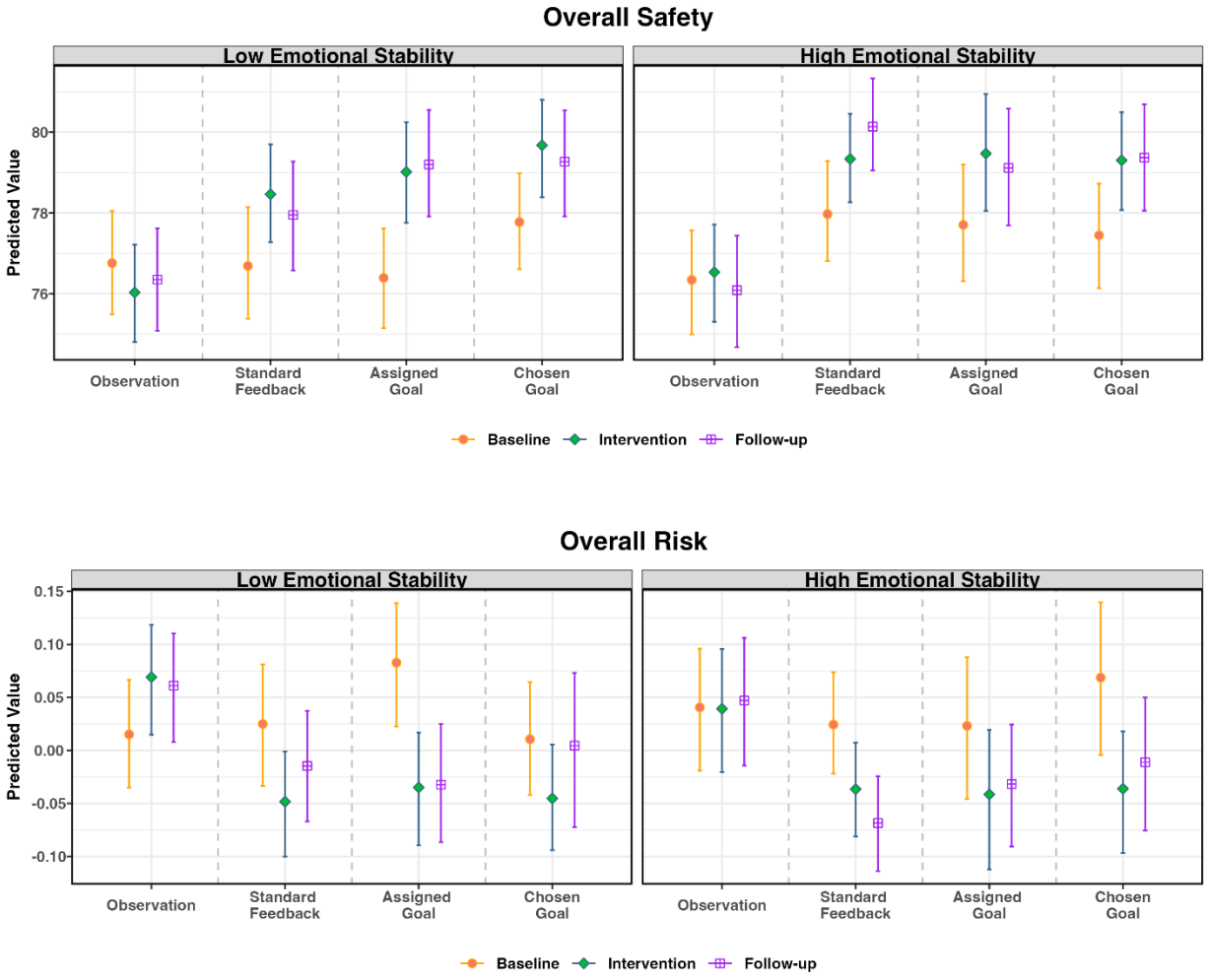


Figure 23. Overall driver safety score and composite risk score by study arm and Big Five trait, emotional stability. Top panel: Mean adjusted overall safety score (100 is safest). Bottom panel: Mean adjusted overall risk composite z-score (higher is riskier).



Acceptability and Engagement

Exit survey completion was high: 95.9% of all randomized participants completed it, and there were no differences in completion rate between study arms, $P = 0.40$. Results for the exit survey, which included self-reported acceptability and other measures, are summarized in Table 3.

Net Promoter Score

Overall NPS was 45. For reference, scores above 20 are considered “favorable” and scores above 50 are considered “excellent” (Carpenter, 2025). The Observation arm had an NPS of 43, Standard Feedback 49, Assigned Goal 49, and Chosen Goal 40.

Acceptability of Intervention Measure

Overall mean (SD) AIM was 4.4 (0.6) on the 1–5 scale. For reference, an AIM of 4 and above is generally considered good (Hamm et al., 2023). There was no difference between study arms on this measure of acceptability, $P = 0.32$.

Helpfulness of Program

Respondents in the treatment arms were more likely than control to "agree" or "completely agree" that the program "helped them be a safer driver," $P < 0.001$. About half the control respondents expressed some agreement with this statement versus more than three-quarters of treatment respondents.

Desire to Continue in Program

Overall, 91.0% of respondents agreed or completely agreed that they would "like to continue being in this program." There was no difference between study arms, $P = 0.22$.

Helpfulness of Intervention Components

Overall, 53.9% of respondents found the weekly text-message driving feedback "very" or "extremely" helpful to their driving; 45.8% found the weekly dashboard to be this helpful; 49.1% for the weekly text-message driving tips; and 67.4% for the potential to earn money. There were no differences between study arms for any of these four intervention components, Ps > 0.13.

Behaviors They Tried to Improve

Overall, 47.0% of respondents said they tried to improve smooth acceleration in Week 1, 45.4% said gentle braking, 41.0% safe speeds, and 23.9% driver focus. Chosen Goal respondents were less likely to try to improve gentle braking, $P = 0.038$, and safe speeds, $P = 0.004$, than the other two treatment arms, and were also less likely to say that they did not try to improve any behaviors, $P = 0.049$. Standard Feedback respondents were more likely to try to improve smooth acceleration than the other two treatment arms, $P = 0.026$. Treatment arms differed on the number of behaviors they reported trying to change in Week 1, $P < 0.001$: Standard Feedback tried to change 1.7, Assigned Goal 1.6, and Chosen Goal 1.4.

Table 3. Exit survey responses

Mean (SD) unless otherwise noted	Overall	Observation	Standard Feedback	Assigned Goal	Chosen Goal
n (% of total)	1379 (95.2)	348 (93.5)	354 (95.9)	340 (95.5)	337 (95.7)
NPS	45.2	42.8	48.6	48.8	40.4
AIM	4.4 (0.6)	4.5 (0.6)	4.4 (0.6)	4.5 (0.7)	4.4 (0.6)
Program helped be safer					
Completely disagree	21 (1.5)	8 (2.3)	3 (0.8)	4 (1.2)	6 (1.8)
Disagree	87 (6.3)	28 (8.0)	26 (7.3)	19 (5.6)	14 (4.2)
Neither agree nor disagree	285 (20.7)	127 (36.5)	55 (15.5)	54 (15.9)	49 (14.5)
Agree	573 (41.6)	108 (31.0)	166 (46.9)	153 (45.0)	146 (43.3)
Completely agree	412 (29.9)	77 (22.1)	104 (29.4)	109 (32.1)	122 (36.2)
Missing	1 (0.1)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)
Like to continue program (n)		53	75	77	80
Completely disagree	6 (0.4)	1 (0.3)	2 (0.6)	3 (0.9)	0 (0.0)
Disagree	19 (1.4)	2 (0.6)	7 (2.0)	5 (1.5)	5 (1.5)
Neither agree nor disagree	97 (7.0)	21 (6.0)	29 (8.2)	19 (5.6)	28 (8.3)
Agree	395 (28.6)	96 (27.6)	102 (28.8)	94 (27.6)	103 (30.6)
Completely agree	861 (62.4)	228 (65.5)	214 (60.5)	218 (64.1)	201 (59.6)
Missing	1 (0.1)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)
Big Five traits*					
Extraversion	4.3 (1.6)	4.4 (1.5)	4.3 (1.6)	4.2 (1.7)	4.3 (1.7)
Agreeableness	5.1 (1.2)	5.1 (1.2)	5.0 (1.2)	5.1 (1.3)	5.1 (1.2)
Conscientiousness	5.7 (1.2)	5.7 (1.2)	5.6 (1.2)	5.8 (1.1)	5.7 (1.1)
Emotional stability	5.0 (1.4)	5.0 (1.3)	5.1 (1.4)	5.0 (1.4)	4.9 (1.4)
Openness to experiences	5.5 (1.1)	5.6 (1.1)	5.4 (1.1)	5.6 (1.1)	5.4 (1.1)
Self-reported crash, prior 18 weeks	72 (5.2)	18 (5.2)	17 (4.8)	17 (5.0)	20 (5.9)
Delay discount rate, median [IQR]†	0.00335 [0.00112, 0.00671]	0.00194 [0.00112, 0.00671]	0.00335 [0.00112, 0.00671]	0.00335 [0.00112, 0.00671]	0.00335 [0.00112, 0.00671]
Helpfulness—text message feedback					
Not at all	37 (3.6)	n/a	13 (3.7)	9 (2.6)	15 (4.5)
Slightly	120 (11.6)	n/a	50 (14.1)	34 (10.0)	36 (10.7)
Moderately	291 (28.2)	n/a	101 (28.5)	96 (28.2)	94 (27.9)
Very	304 (29.5)	n/a	105 (29.7)	101 (29.7)	98 (29.1)
Extremely	252 (24.4)	n/a	76 (21.5)	90 (26.5)	86 (25.5)
Did not see	26 (2.5)	n/a	9 (2.5)	9 (2.6)	8 (2.4)
Missing	1 (0.1)	n/a	0 (0.0)	1 (0.3)	0 (0.0)

Mean (SD) unless otherwise noted	Overall	Observation	Standard Feedback	Assigned Goal	Chosen Goal
Helpfulness—weekly dashboard					
Not at all	58 (5.6)	n/a	22 (6.2)	14 (4.1)	22 (6.5)
Slightly	133 (12.9)	n/a	50 (14.1)	43 (12.6)	40 (11.9)
Moderately	263 (25.5)	n/a	92 (26.0)	85 (25.0)	86 (25.5)
Very	253 (24.5)	n/a	87 (24.6)	84 (24.7)	82 (24.3)
Extremely	220 (21.3)	n/a	69 (19.5)	75 (22.1)	76 (22.6)
Did not see	102 (9.9)	n/a	34 (9.6)	37 (10.9)	31 (9.2)
Missing	2 (0.2)	n/a	0 (0.0)	2 (0.6)	0 (0.0)
Helpfulness—safe driving tips					
Not at all	62 (6.0)	n/a	20 (5.6)	19 (5.6)	23 (6.8)
Slightly	173 (16.8)	n/a	59 (16.7)	54 (15.9)	60 (17.8)
Moderately	264 (25.6)	n/a	93 (26.3)	93 (27.4)	78 (23.1)
Very	284 (27.5)	n/a	103 (29.1)	86 (25.3)	95 (28.2)
Extremely	223 (21.6)	n/a	71 (20.1)	78 (22.9)	74 (22.0)
Did not see	23 (2.2)	n/a	8 (2.3)	8 (2.4)	7 (2.1)
Missing	2 (0.2)	n/a	0 (0.0)	2 (0.6)	0 (0.0)
Helpfulness—financial incentive					
Not at all	26 (2.5)	n/a	8 (2.3)	9 (2.6)	9 (2.7)
Slightly	98 (9.5)	n/a	44 (12.4)	23 (6.8)	31 (9.2)
Moderately	183 (17.7)	n/a	61 (17.2)	66 (19.4)	56 (16.6)
Very	279 (27.1)	n/a	98 (27.7)	89 (26.2)	92 (27.3)
Extremely	415 (40.3)	n/a	137 (38.7)	138 (40.6)	140 (41.5)
Did not know	28 (2.7)	n/a	6 (1.7)	13 (3.8)	9 (2.7)
Missing	2 (0.2)	n/a	0 (0.0)	2 (0.6)	0 (0.0)
Behaviors tried to improve					
Driver focus	246 (23.9)	n/a	90 (25.4)	78 (22.9)	78 (23.1)
Gentle braking	468 (45.4)	n/a	168 (47.5)	166 (48.8)	134 (39.8)
Smooth acceleration	485 (47.0)	n/a	187 (52.8)	148 (43.5)	150 (44.5)
Safe speeds	423 (41.0)	n/a	153 (43.2)	156 (45.9)	114 (33.8)
None of the above	34 (3.3)	n/a	17 (4.8)	12 (3.5)	5 (1.5)
# of behaviors tried to improve	1.6 (0.9)	n/a	1.7 (1.0)	1.6 (1.0)	1.4 (0.8)

Note. NPS = net promoter score; AIM = acceptability of intervention measure; IQR = interquartile range.

**Each trait could range in value from 1 to 7 (highest).*

† Discount rates could range in value from 0.000110 to 24, with higher values indicating a preference for more immediate rewards. For reference, the median discount rate observed in the treatment arms corresponds to a preference for $500 now versus $1,000 in 1 year, whereas the somewhat lower median in the control arm indicates a preference for $1,000 in 1 year; discount rate did not significantly differ by study arm, P = 0.34.

Unenrollment Rates

Overall, four participants (0.2%) unenrolled after the intervention period began: one each in the Observation, Standard Feedback, and Chosen Goal arms.

SMS Messages Disabled

In addition to those who unenrolled, 0.8% of participants disabled study text messages—a rate that did not vary by study arm, $P = 0.76$.

Dashboard Engagement

Overall, participants engaged with the dashboard a mean (SD) of 23.4% (25.7%) of weeks. Engagement was lower among Standard Feedback participants—19.2% (23.3%)—than among Assigned Goal—26.1% (26.6%)—or Chosen Goal—25.2% (26.7%), $P < 0.001$. Given that Standard Feedback participants received all four behavior scores each week via text message and the dashboard did not provide a graphical depiction of a car gaining or losing upgrades, there were fewer reasons for these participants to engage with the dashboard.

Median dashboard engagement was 15.4%; participants at the median were classified as "engaged" (56.2%) and those below were classified as "non-engaged" (43.8%). Exploratory analyses found significant engaged × period interactions for overall safety, $P < 0.001$; overall risk, $P = 0.010$; safe speeds, $P = 0.005$; speeding, $P = 0.031$; smooth acceleration, $P = 0.030$; gentle braking, $P < 0.001$; and hard braking, $P = 0.001$. For each of these outcomes, engaged participants improved their driver safety more. The interactions for driver focus, handheld phone use, and rapid acceleration were not significant, Ps > 0.21.

Goal Engagement

Goal engagement was high, with Chosen Goal participants having a focus behavior set a mean (SD) 91.7% (23.9%) of intervention weeks and a score goal set 85.5% (28.3%) of weeks—for a composite goal engagement score of 87.6% (24.9%).

Median goal engagement was 100%; participants at the median were classified as "engaged" (65.5%) and those below were classified as "non-engaged" (34.5%). Exploratory analyses found a significant engaged × period interaction for the safe speeds outcome, $P = 0.029$, with engaged participants improving their safe speeds score more relative to baseline. None of the interactions for the primary outcomes or other secondary outcomes were significant, Ps > 0.09.

Discussion

Summary of Findings

In this national randomized controlled trial designed to simulate the feedback and incentives offered to drivers by UBI programs, there were five key findings. First, all treatment arms improved their overall driver safety as measured by a smartphone telematics app. Second, reductions in speeding, hard braking, and rapid acceleration—but not in handheld phone use—were observed. Third, there was only weak evidence that focusing drivers on one behavior at a time with a discrete weekly goal was more effective than the standard UBI feedback on multiple behaviors. Fourth, safety improvements were generally sustained after the interventions ended. Fifth, these safety benefits were experienced regardless of age, sex, or race/ethnicity.

Improvements in Overall Safety

Participants in all three treatment groups improved their overall driver safety on two telematics-based outcomes: an average of behavioral safety scores used for insurance rating purposes and a standardized average of the rates of risky behaviors underlying these scores. To control for the possibility that drivers would improve simply because they were being observed, or with the passage of time, all comparisons were made relative to drivers randomly assigned to an observation-only control group. Analyses also controlled for baseline driver safety and several pre-specified covariates.

Reductions in Risky Behaviors

All three treatment arms showed decreased rates of speeding, hard braking, and rapid acceleration, but not handheld phone use. Depending on the treatment arm, participants reduced their rate of speeding by 11%–13%, hard braking by 16%–21%, and rapid acceleration by 16%–25% relative to control. Although the relative reduction for any one risky driving behavior was smaller than has sometimes been reported for an incentivized behavioral intervention (Ebert, Xiong, Khan, et al., 2024; Ebert et al., 2025), it is notable that participants successfully changed on all three behaviors—a substantial aggregate reduction in risky driving.

That handheld phone use remained the same was unexpected. Prior research has found that drivers given feedback and incentives can reduce their handheld phone use (Delgado et al., 2024; Ebert, Xiong, Khan, et al., 2024). One explanation for the present null result is that the behavior scores provided to participants were not normalized. The mean baseline scores for the four behaviors were 93 (driver focus), 71 (safe speeds), 67 (gentle braking), and 76 (smooth acceleration). Consequently, from the outset few (4%) Assigned Goal participants were assigned to work on driver focus, and across study arms only about one-quarter of participants said they tried to improve in this area. The

seemingly good driver focus score of 93 is belied by the underlying behavioral metric: at baseline, participants engaged in handheld phone use 6.3% of drive time. In contrast, the 4.0% of drive time they sped corresponded to a lower score of 71. Based on these results, it is recommended that UBI programs first normalize any behavior-specific scores before providing them as feedback.

Standard Feedback vs. Assigned or Chosen Goal

Although there was some evidence that assigning participants a behavior to focus on and a goal to work toward led to greater improvements in overall safety, this difference was not statistically significant after adjusting for the number of comparisons. There was no evidence in the overall sample that letting participants choose their focus behavior and goal led to greater improvements.

One possible explanation for the similar results across the three treatment arms is that all were provided with all four behavior scores at the outset and via the dashboard. Despite study instructions, participants were ultimately free to focus on only one behavior at a time or attempt to change multiple behaviors at once. Based on exit survey responses, the approaches deployed by participants in the three treatment arms may have been more similar than intended. Standard Feedback participants chose to focus on an average of 1.7 behaviors in Week 1, similar to Assigned Goal's 1.6 behaviors and not much greater than Chosen Goal's 1.4 behaviors. Future research could provide a cleaner superiority test of the Assigned Goal and Chosen Goal treatments by only providing these participants with information relevant to the focus behavior at hand.

Sustained Behavior Change

During a 6-week follow-up period, participants in the treatment arms generally continued to drive more safely than control, though some of the behavior-specific comparisons were no longer statistically significant. This finding of sustained safety improvements even after feedback and incentives stopped suggests that participants who improved their driver safety cared about doing so for reasons beyond the incentive money and developed habits over the 12-week intervention period that enabled them to carry on without external feedback. The lasting improvements also mean that these interventions are more cost-effective than they otherwise would be.

The sustained improvements will be of special interest to insurance companies concerned about the potential moral hazard of awarding discounts to drivers who, after an initial rating period of "being on their best behavior," revert to their typical less-safe behavior when no longer monitored. Somewhat mitigating this concern, the present study suggests that, for at least 6 weeks beyond their rating period, drivers likely continue to exhibit improved safety behaviors.

Treatment Moderators and Equity Considerations

There was no statistically significant evidence that treatment effects varied by age, sex, and racial/ethnic subgroups. However, the Standard Feedback intervention modeled after existing UBI programs and the Assigned Goal intervention were more effective among urban and suburban drivers than among rural drivers. It should be noted that: (a) the percentage of rural drivers in the sample was small (<13%); (b) adjusting for number of tests would render this result non-significant; and (c) by chance, rural drivers in the treatment groups tended to be safer drivers at baseline than those in the control group. Therefore, the rural moderation result should be interpreted cautiously.

Taken together, these moderation results should alleviate equity concerns that participating in a UBI program might only benefit the safety of certain advantaged groups. However, there are two other related concerns that this research does not address. The first is differential pricing: even if different groups experience similar safety benefits, if one group is observed to engage in more risky driving behavior, their future insurance policies will be more expensive. The second is differential enrollment: if drivers in a certain group are less likely to participate in a UBI program, they will be less likely to reap its safety benefits.

Intervention Acceptability and Engagement

Across a range of self-reported and behavioral metrics, the interventions delivered to treatment arms were very acceptable. Engagement with the weekly dashboard sent to treatment groups was relatively low—unsurprising given that the dashboard provided supplementary information unnecessary for successful participation. Chosen Goal participants showed high engagement with the goal setting process, with a majority having a behavior chosen and a goal set for all 12 weeks of the intervention.

Engagement and Behavior Change

Although the primary analysis was intention to treat, meaning that all participants were included regardless of their engagement with the interventions, exploratory analyses considered whether—as prior research has shown (Pinals et al., 2024)—more engaged participants improved their driver safety more. Indeed, treatment participants who viewed more of the weekly dashboards sent to them via text message showed greater improvements in driver safety on most outcomes. Among Chosen Goal participants, those who were fully engaged in the goal setting process showed greater improvements in safe speeds but not the other outcomes.

Limitations

The present research had limitations. First, although its simulated UBI program bore many similarities to typical UBI programs—including duration, delivery of feedback on multiple driving behaviors, and an end-of-period financial incentive for safer driving—there were differences that could affect whether its results generalize to these programs:

- Participants received feedback primarily via a weekly text message, whereas, depending on the program, UBI customers might receive feedback by push notification or by opening their app to view feedback. Results may not generalize to customers who are not actively sent feedback.
- Participants were scored on four driving behaviors selected for their presumed changeability, whereas customers are usually rated on more than four behaviors, some of which may be more difficult to change. In addition, although there was little evidence that providing feedback on four behaviors at a time was detrimental to behavior change, it could be that performance begins to degrade when feedback on even more behaviors is provided.
- Participant incentives were administered as a one-time payment, whereas customers receive a monthly discount on their upcoming insurance policy. Participants could earn up to $100, whereas customers save $250 on average over the course of 1 year (AAA, 2021; Martin, 2024). It is unclear how these differences might impact generalizability. For instance, though the present study offered a smaller total reward, it was paid out as a bonus all at once rather than as a small monthly discount—an attractive incentive structure that may have made up for the smaller amount (O'Donoghue & Rabin, 2015). Some research has found that reward size may not matter much for changing driving behavior (Delgado et al., 2024). In fact, in the present study, for all their driving improvements, treatment arm participants earned only $2.67 more on average than control participants would have earned based on their overall safety scores.

A second limitation is that although the present sample was diverse and recruitment targeted younger drivers who are more likely to enroll in UBI programs, participants may have differed in important ways from UBI customers. For example, in one study, 59% of UBI customers were female and 59% had at least some college education (Ebert, Xiong, Khan, et al., 2024), whereas in the present sample 50% were female and 90% had at least some college education. UBI programs tend to attract safer drivers who stand to benefit most financially from participation (Jin & Vasserman, 2021). If the present sample was less safe at baseline than the typical UBI customer, their improvement gains may not be representative of what a typical UBI customer would experience. Given that the present sample was more likely to be male and highly

educated, and that males tend to be less safe and highly educated individuals more safe drivers, the driver safety of the sample compared to UBI customers is unclear.

A third limitation is that although the present sample was large by research standards, the volume of customers enrolled in UBI programs is magnitudes larger. What appears to be a null result in the present study could prove to be a significant difference at scale. For instance, although age was not found to significantly moderate treatment effects, inspection of means by study arm and age suggests that, with a larger sample of drivers above 70, it may become clear that treatments are less effective in this older population. For this reason, it is recommended that programs monitor safety improvements to determine if they are equally distributed across demographic groups. On the plus side, a larger dataset and machine learning might reveal that certain treatments are better for drivers with certain characteristics, enabling programs to deliver feedback that is optimized for each individual (Blette et al., 2023).

Likewise, differences in effectiveness between treatment arms (e.g., Standard Feedback vs. Assigned Goal) that were too small to detect in the present study may be detectable at scale. At a population level, small differences can meaningfully add up, saving lives and reducing costs to insure. If the incremental cost of changing the way a UBI or similar program delivers driver feedback is negligible, and the safety benefits of this change prove reliable with a larger sample, then even small improvements in road safety would justify the change.

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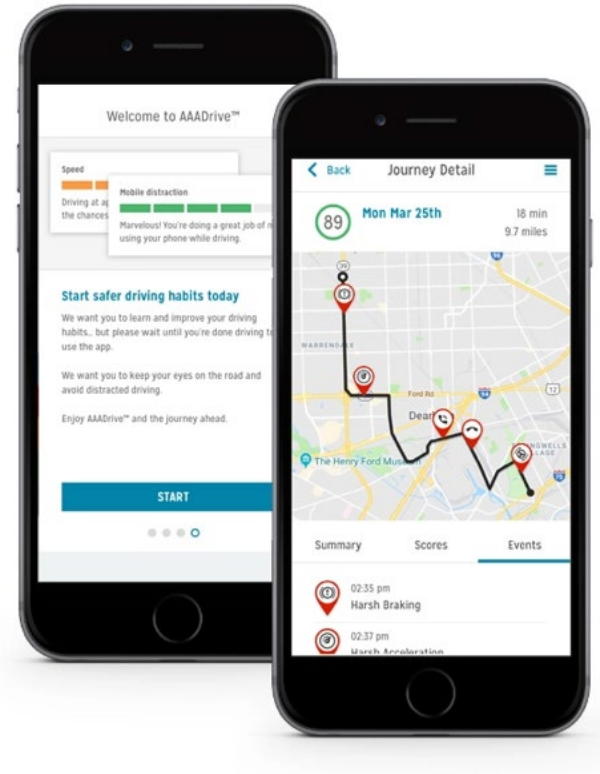
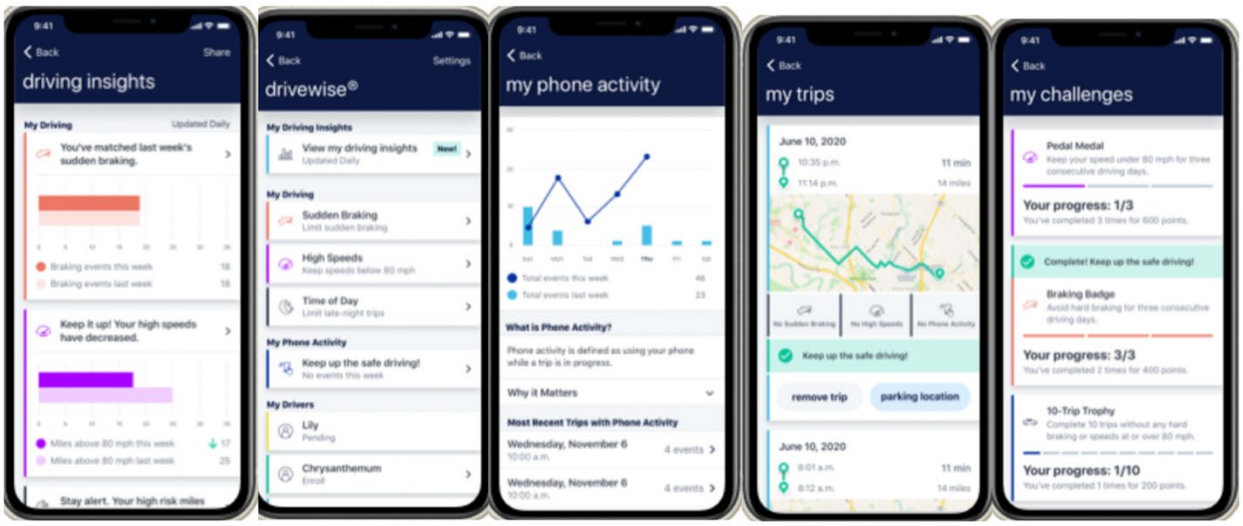
Appendix A: Screenshots of Select UBI Apps

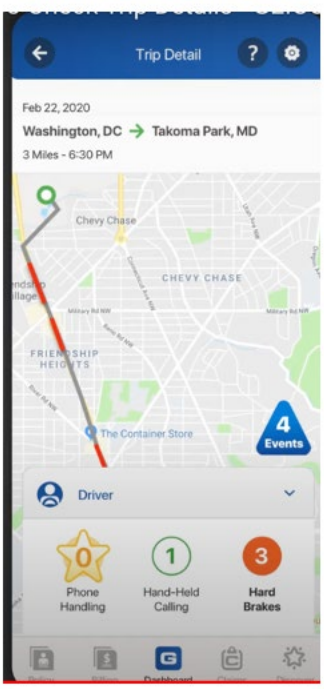
AAA

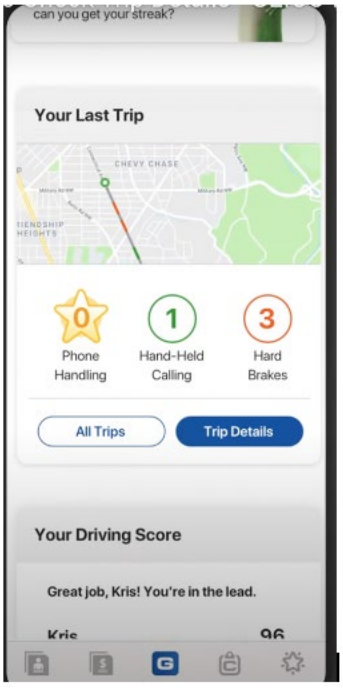


Allstate

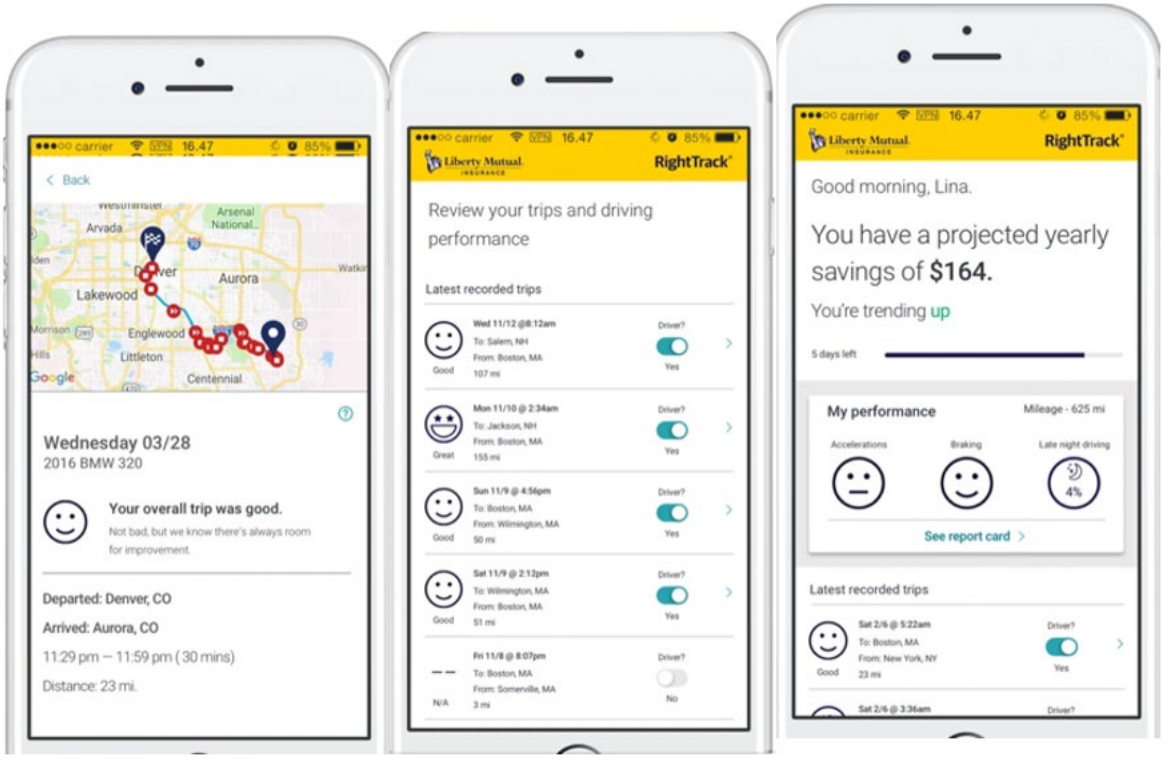


Geico

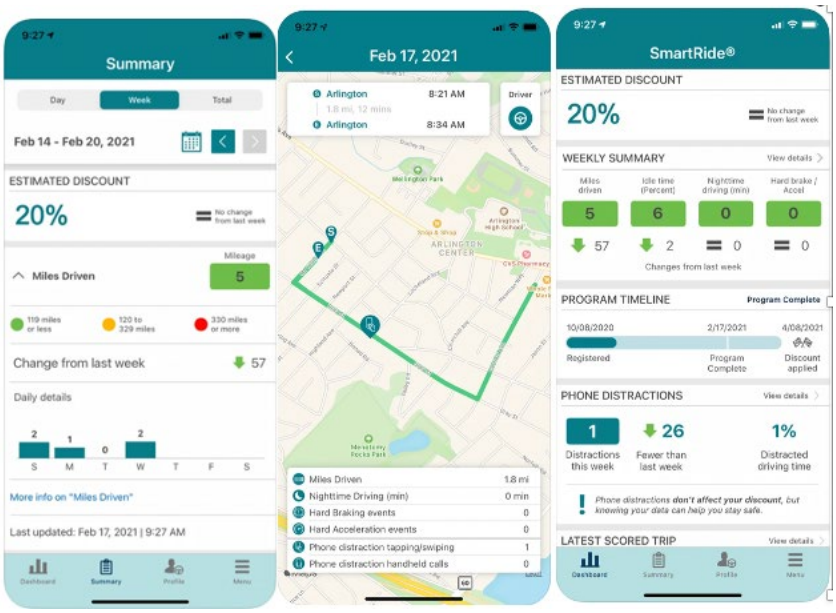




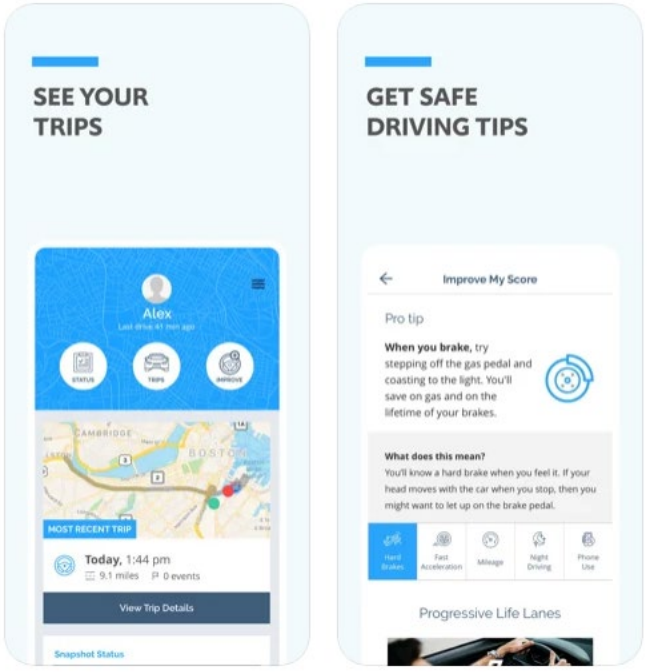
Liberty Mutual



Nationwide



Progressive



State Farm


See Your Driving Scores
9:41
State Farm® Drive Safe & Save™
25
Trips
92
%
186
Miles
2-Week Driving Score
Applied Discount
2017 HONDA ACCORD
$63.45
View Details
Latest Scored Trip
Perimeter Mall to Dunwoody
Dashboard
Trips
Vehicles
More


Have Fun With the Interactive Maps
9:41
Dunwoody
Overall Trip Score
Acceleration
Braking
Cornering
Speed
Phone Use
Poor
Average
Great

Appendix B. Intake Survey

[All questions required a response]

We have 8 questions about you. Your responses will be kept confidential. You may choose not to answer any question by selecting "Prefer not to answer." Afterward, you will be taken to our "Way to Health" platform to provide the contact information required by the study.

What is your ethnicity?
Hispanic
Non-Hispanic
Prefer not to answer

What is your race? (Select one or more options)
American Indian or Alaska Native
Asian or Asian American
Black or African American
Native Hawaiian or another Pacific Islander
White
Other
Prefer not to answer

What sex were you assigned at birth?
Female
Male
Prefer not to answer

How do you currently describe yourself (select all that apply)?
Female
Male
Transgender
Non-binary
I use a different term
Prefer not to answer

What's the highest level of education you have completed?
Less than a high school diploma
High school degree or equivalent (e.g., GED)
Some college, no degree
College degree
Some graduate-level courses, no degree
Post-graduate degree
Prefer not to answer

What is your annual household income?
Under $20,000
$20,000 - $29,999

$30,000 - $39,999
$40,000 - $49,999
$50,000 - $59,999
$60,000 - $74,999
$75,000 - $99,999
$100,000 - $124,999
$125,000 - $149,999
Over $150,000
Prefer not to answer

How many tickets for a moving violation have you received in the last 5 years?
0
1
2
3
4
5
6
7
8
9
10+
Prefer not to answer

How many car crashes have you been in while driving (regardless of who was at fault) in the last 5 years?
0
1
2
3
4
5
6
7
8
9
10+
Prefer not to answer

Appendix C. Safety Tips

Participants received a weekly text message each Monday designed to motivate them to improve a risky behavior and/or provide advice for how to improve. Those in the Assigned and Chosen Goal arms only got messages related to their target behavior for that week. Those in the Standard Feedback arm got messages for a rotating selection of all four behaviors (e.g., wk1—focus, wk2—braking, etc.).

Because participants could, in theory, work on a single focus area the entire 12-week intervention period, each behavior had 12 unique, prioritized messages.

Way to Health kept track of how many messages a participant had received for each behavior, so that it could deliver the next one in the priority queue. For example, if a participant worked on gentle braking for the first 8 weeks, then switched to driver focus, they would get the "Ever hear of Driving Focus..." message (priority #1) rather than the "Guess what surveys say is the most frustrating..." message (priority #9).

The logic and tip messaging for the Standard Feedback arm is provided first; Chosen Goal participants who did not select a behavior to work on were given the same tip that a standard feedback participant would get for that week. Then, messaging for Assigned and Chosen Goal arms are provided. Priority #1 (P1) for a given behavior is the first tip listed; priority #12 (P12) is the last.

Standard Feedback/Chosen Goal participants who did not select a focus behavior

Everyone got the same tip on the same week (Wk) as follows.

[Wk1]

Ever hear of Driving Focus or Do Not Disturb While Driving? These phone features silence calls and notifications while you drive. You can create exceptions for emergencies. Learn how to activate at https://healthcareinnovation.upenn.edu/driving-focus-resources (iPhone) or https://healthcareinnovation.upenn.edu/do-not-disturb-while-driving-resources (Android).

[Wk2]

If you need to slam on the brake to prevent a crash, please do! But by getting better at defensive driving, you can anticipate the need to brake sooner and avoid a lot of these situations. What counts as a hard brake? You'll know it when you feel it! Your head moves forward as your body is held back by the seat belt.

[Wk3]

Guess what? Smooth acceleration can save you money! Drivers who accelerate fast waste anywhere from 5% to 14% of their gas or battery life. Fast acceleration also wears down a car's engine and tires, and some insurance programs charge more to those who make a habit of accelerating fast. Whenever you can, speed up smoothly.

[Wk4]

Did you know that driving the speed limit can save you big money? On the highway, driving 10 mph above the speed limit wastes 11% to 21% of your gas or battery life. Gas mileage drops above speeds of 50 mph. At today's gas prices, every 5 mph you drive over 50 mph is like paying $0.22 more per gallon.

[Wk5]

The longer you glance at your phone while driving, the higher the crash risk. 1 sec = 2x risk. 5 sec = 9x risk. Texting takes your eyes off the road for about 5 seconds. At 55 mph, that's like driving the length of a football field with your eyes closed!

[Wk6]

Introducing the 3-Second Rule: Keep a safe distance from the car in front of you by counting the seconds between when it passes a still object and when you do. In good driving conditions, this should be at least 3 seconds. In bad weather or visibility, keep an even safer distance—4 seconds or more. When the car in front of you slams on the brakes, you'll have more time to react.

[Wk7]

Did you know that you can get pulled over for accelerating too fast? A traffic officer might cite you for reckless driving, unreasonable acceleration, racing, or "exhibition of speed."

[Wk8]

Instead of driving 10 mph over the speed limit to get to your destination on time, you could try leaving a little earlier. For a 20-mile trip, all you need to do for a leisurely drive is hop in the car 3 minutes earlier!

[Wk9]

It's safest not to use your phone at all when driving. But if you need it, try handsfree. Use voice activation to get directions, play music, make a call, or send a text. This is safer because you can keep your eyes on the road, hands on the wheel!

[Wk10]

Hard braking is ROUGH on your car. Here are all the parts that can get damaged: brake pads, rotors, suspension, tires, drive axles, engine mounts. Replacing these is costly! When you brake, start by gently applying pressure. As your car slows, steadily apply more pressure.

[Wk11]

Today's cars can accelerate MUCH faster than your parents'. Some electric cars can even go 0 to 60 in 2 seconds! But just because you *can* go this fast doesn't mean you *should*. Safety experts recommend switching from "sport" to "eco" mode, which will take the edge off your acceleration.

[Wk12]

Sticking to the speed limit gives you more time and space to react to the unexpected. This means you can safely avoid hitting the car, pedestrian, object, or animal that's suddenly in front of you. You will also see an immediate jump in your safe speeds score.

Assigned Goal/Chosen Goal

Driver Focus

[P1]

Ever hear of Driving Focus or Do Not Disturb While Driving? These phone features silence calls and notifications while you drive. You can create exceptions for emergencies. Learn how to activate at http://besafir.org/do-not-disturb (iPhone) or https://www.besafir.org/do-not-disturb-android (Android).

[P2]

The longer you glance at your phone while driving, the higher the crash risk. 1 sec = 2x risk. 5 sec = 9x risk. Texting takes your eyes off the road for about 5 seconds. At 55 mph, that's like driving the length of a football field with your eyes closed!

[P3]

It's safest not to use your phone at all when driving. But if you need it, try handsfree. Use voice activation to get directions, play music, make a call, or send a text. This is safer because you can keep your eyes on the road, hands on the wheel!

[P4]

Handling your phone while driving more than doubles crash risk. Pick your playlist or turn on navigation *before* you hit the road. This will help your driver focus score!

[P5]

When driving, you might have an urge to check your phone. This is normal! You can't change the urge, but you can choose how you respond. Tell yourself, "I'm feeling an urge to check my phone, but I will wait until it's safe."

[P6]

By not talking on the phone, your chance of a crash goes down 75%. By not texting, your chance goes down 88%! If you don't want to be tempted to use your phone, put it in a place where you can't get to it. Out of sight, out of mind.

[P7]

Have a phone mount in your car? Check that it's in your line of sight and remember to put your phone in it when you get in the car. Handsfree phone use is safer than handheld.

[P8]

Did you know that all but two states ban texting while driving? That's because texting while driving is as dangerous as driving drunk. Fines vary by state but can be as much as $10,000! If you need to text, wait until you're at your destination, or safely pull over first.

[P9]

Guess what surveys say is the most frustrating part of driving? It's seeing another driver use their phone. Just by putting down your phone you can avoid stoking road rage!

[P10]

Distracted driving can hurt your wallet. Drivers who avoid handheld phone use have fewer crash claims and can save money if they're in a usage-based insurance program.

[P11]

Every day 1,000 people in the U.S. are injured because of distracted driving. Don't be a statistic: Keep your hands on the wheel, eyes on the road, and mind focused on driving.

[P12]

You've probably heard of a "designated driver." Well, you can also have a "designated texter." Ask a passenger to use their own phone to send messages, play music, and look up information so you don't have to!

Gentle Braking

[P1]

If you need to slam on the brake to prevent a crash, please do! But by getting better at defensive driving, you can anticipate the need to brake sooner and avoid a lot of these situations. What counts as a hard brake? You'll know it when you feel it! Your head moves forward as your body is held back by the seat belt.

[P2]

Introducing the 3-Second Rule: Keep a safe distance from the car in front of you by counting the seconds between when it passes a still object and when you do. In good driving conditions, this should be at least 3 seconds. In bad weather or visibility, keep an even safer distance—4 seconds or more. When the car in front of you slams on the brakes, you'll have more time to react.

[P3]

Hard braking is ROUGH on your car. Here are all the parts that can get damaged: brake pads, rotors, suspension, tires, drive axles, engine mounts. Replacing these is costly! When you brake, start by gently applying pressure. As your car slows, steadily apply more pressure.

[P4]

Hard braking → skidding → loss of control. Brake smoothly to stay in control of your vehicle. Especially when the roads are slick.

[P5]

Usage-based insurance programs care about how often you brake hard because this can be a sign of "tailgating." Keep a safe driving distance and you'll need to brake hard less often. And this can mean insurance savings.

[P6]

When you see a stop sign or yellow or red light in the distance, practice taking your foot off the accelerator earlier and coast to a stop. This will take care of a lot of hard brakes. You'll also save on gas/energy and reduce wear on your brakes—and improve your gentle braking score.

[P7]

When you spot a potential hazard, prepare to brake by lifting your foot off the accelerator and hovering over the brake pedal. If you do need to brake, your reaction time will be quicker, and you won't have to brake as hard.

[P8]

It takes time to decide to step on the brake. Then, more time for the car to grind to a halt. The faster you're driving, the further you travel before coming to a complete stop. At 70 mph, it takes 315 feet to stop. That's the length of 9 full-size school buses!

[P9]

Did you know braking distance DOUBLES when the road is wet and goes up 10X in snow and ice?! In poor conditions—drive slow and keep your distance.

[P10]

A big cause of hard brakes? Changing lanes. Before changing lanes, take your time, make sure there's lots of space for your vehicle, and always use your turn signal.

[P11]

When a car is tailing you closely, it's best to change to the right lane. If you're stuck in your lane, it's important to avoid braking hard. You don't want to get hit from behind or anger the tailgater! Leave plenty of space in front of you so you can brake gently.

[P12]

Think about the driver *behind* you and BRAKE EARLY AND SMOOTHLY. They'll see your brake light come on sooner and this will give them more time to brake. By braking gently and giving the driver behind you more time to brake, you'll be less likely to get rear-ended!

Smooth Acceleration

[P1]

Guess what? Smooth acceleration can save you money! Drivers who accelerate fast waste anywhere from 5% to 14% of their gas or battery life. Fast acceleration also wears down a car's engine and tires, and some insurance programs charge more to those who make a habit of accelerating fast. Whenever you can, speed up smoothly.

[P2]

Did you know that you can get pulled over for accelerating too fast? A traffic officer might cite you for reckless driving, unreasonable acceleration, racing, or "exhibition of speed."

[P3]

Today’s cars can accelerate MUCH faster than your parents’. Some electric cars can even go 0 to 60 in 2 seconds! But just because you *can* go this fast doesn’t mean you *should*. Safety experts recommend switching from “sport” to “eco” mode, which will take the edge off your acceleration.

[P4]

When you want to pass another driver, it may be tempting to floor the accelerator. Safety experts recommend passing more gradually. This will also improve your smooth acceleration score!

[P5]

Fast acceleration can be a sign that you’re feeling aggressive. If you find yourself stressed, frustrated, or angry, consider a more relaxed, cooperative approach to driving. Leave early to give yourself more time. Put on happy tunes. Remember that other drivers are people like you. Support drivers who want to pass or change lanes. When another driver upsets you, give them the benefit of the doubt.

[P6]

Jackrabbit, verb: “to begin to move rapidly or suddenly.” If you floor the accelerator when the light changes, you burn 37% more fuel! A jackrabbiting gas car also spews 8x the carbon monoxide. Be green and accelerate smoothly.

[P7]

Another tip for smooth acceleration: If a car is trying to pass you, don't suddenly speed up to stop them. This can cause an accident!

[P8]

Aggressive driving—including fast acceleration—can be contagious. If another driver is driving aggressively, here are tips to stop things from getting worse: Stay calm. Be considerate. Only use your horn for safety. Avoid eye contact and “rude” gestures. Keep your distance. Focus on your own driving and getting to your destination safely.

[P9]

Did you know that 1 in 3 people are prone to motion sickness? That passengers are more likely to get car sick than drivers? Keeping your passengers happy and healthy: just one more reason to accelerate smoothly!

[P10]

Accelerating too fast can lead to skidding and loss of control. By accelerating gradually, you'll maintain control of your vehicle. This is extra important when roads are wet or icy.

[P11]

Some more advice for smooth acceleration: If you keep a safe following distance from the car in front of you—at least 3 seconds in good conditions—you will be able to maintain a steadier speed, with less hard braking and accelerating.

[P12]

An oldie but goodie Driver's Ed tip is to ease up on the accelerator when taking corners. This will help you stay in control of your vehicle. 3 steps: 1) slow down gradually as you approach the bend in the road; 2) maintain a safe, steady speed as you turn; 3) accelerate gently as you start to leave the corner.

Safe Speeds

[P1]

Did you know that driving the speed limit can save you big money? On the highway, driving 10 mph above the speed limit wastes 11% to 21% of your gas or battery life. Gas mileage drops above speeds of 50 mph. At today's gas prices, every 5 mph you drive over 50 mph is like paying $0.22 more per gallon.

[P2]

Instead of driving 10 mph over the speed limit to get to your destination on time, you could try leaving a little earlier. For a 20-mile trip, all you need to do for a leisurely drive is hop in the car 3 minutes earlier!

[P3]

Sticking to the speed limit gives you more time and space to react to the unexpected. This means you can safely avoid hitting the car, pedestrian, object, or animal that's suddenly in front of you. You will also see an immediate jump in your safe speeds score.

[P4]

The average speeding ticket costs $150. But this is just the beginning. A speeding ticket typically triggers an insurance rate increase lasting 3 years. On average, this means paying $1,200 more for insurance!

[P5]

When you're speeding other drivers and pedestrians have a hard time judging your distance to them. They might try to change into your lane or cross the street in front of you when there isn't enough time. Driving the speed limit makes EVERYONE on the road safer.

[P6]

Speeding contributes to 1 in 3 motor vehicle fatalities and is responsible for more than 12,000 deaths per year in the U.S. Think it's safe to speed when there aren't many cars on the road? Consider: almost half of all driver fatalities happen in crashes that don't even involve another car.

[P7]

Do you sometimes catch yourself speeding when you're on the highway? Try setting your cruise control for the speed limit. Just watch out for slower cars in front of you, and for changes in the speed limit.

[P8]

Your Word of the Day: VELOCITATION. This is when your brain gets used to driving fast speeds on the highway. When you get off the highway, you mistakenly feel like you're driving too slow. As you approach an off-ramp, remind yourself about velocitation and pay close attention to your speedometer.

[P9]

High speeds make crashes much worse. Increasing your speed from 55 to 75 ups the chances of being in a fatal crash by 39%. Also, when a pedestrian is hit by a car going 25 mph, their chance of death is 10%; when the car is going 55 mph, well, we shudder to think...

[P10]

A survey asked what causes the most traffic deaths. Respondents ranked speeding last, behind road rage and distracted driving. The reality is this: speeding is one of the TOP causes of traffic deaths.

[P11]

Speeding doesn't just make it harder for you to stop; it also reduces your ability to navigate bends in the road. You've probably experienced this when you've taken a turn too fast.

[P12]

Speeding makes other mistakes more dangerous. If you're driving 60 mph and get distracted for 1 second, that's like driving 88 feet with your eyes closed. But if you're speeding at 80 mph, that's 117 feet without seeing the road or other cars!

Appendix D. Sample Weekly Dashboard

Weekly Progress Report

Your goal was a **Gentle Braking** score of at least **80**. Your score of **82** means you **achieved** this goal.

Way to go! You earned the climate-controlled seats upgrade!

Overall Safety: 81

Your starting Overall Safety score was 77.

		Start	Best	Last	Avg
	Driver Focus	91	93	93	92
	Gentle Braking	60	82	82	74
	Smooth Acceleration	71	73	68	71
	Safe Speeds	85	88	84	86

100=safest. Here's what each score measures:

- **Driver Focus**—How rarely you use your phone while driving
- **Gentle Braking**—How rarely you slam on the brake
- **Smooth Acceleration**—How rarely you floor the accelerator
- **Safe Speeds**—How rarely you go 10 mph over the limit

Overall Safety is the average of these four scores.

To learn more, watch this clip: https://w2h.us/safedriving_learnmore

Questions? Please email waytodrive@pennmedicine.upenn.edu

Only click "Complete" if you don't wish to access this dashboard again this week.

Appendix E. Exit Survey

[All questions required a response]

We're interested in the "safe driving program" you've been in for the past 12 weeks—including any messages or payments you received, but not the experience of installing the app.

How likely are you to recommend this safe driving program to a friend or colleague?
[dropdown 0-10 scale, with 0 labeled "Not at all likely" and 10 labeled "Extremely likely"]

Please rate how much you agree or disagree with each of the following statements.
[Scale: 1=Completely disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Completely agree]

I approved of this safe driving program.
This program appealed to me.
I liked this program.
I welcomed this program.
This program helped me be a safer driver.
I'd like to continue being in this program.

[Next 4 items NOT delivered to control group]

Next, we'll ask about specific parts of the program. Rate how helpful you found each.

Each Sunday for 12 weeks, we sent text message feedback on your driving. How much did this feedback help your driving?
Not at all
Slightly
Moderately
Very
Extremely
I did not see these texts

We included a link to a "weekly dashboard" with detailed feedback and emailed you this dashboard, too. How much did this dashboard help your driving?
Not at all
Slightly
Moderately
Very
Extremely
I did not see the dashboard

Each Monday for 12 weeks, we sent text messages with tips for safer driving. How much did these tips help your driving?
Not at all
Slightly

Moderately
Very
Extremely
I did not see these tips

<u>You could earn up to $100 for driving safely</u> during the 12 weeks. How much did the potential to earn money help your driving?
Not at all
Slightly
Moderately
Very
Extremely
I did not know I could earn money

[All participants]

What suggestions do you have for improving our safe driving program?
[free response text box]

[Arm 2-4 participants (NOT control group) were prompted with the following info from the first week of the trial and given a select-all. Then, they were provided two arm-specific questions on a different screen.]

Think back to the beginning of the program. Here were your scores:

Overall safety 75 (100 is best)
a) Driver focus 71
b) Gentle braking 61
c) Smooth accel 79
d) Safe speeds 91

For that first week, which behavior or behaviors did you try to improve? Select all that apply.
Driver focus
Gentle braking
Smooth accel
Safe speeds
None of the above

[Standard feedback (arm 2)—new page]

Two more questions about the beginning of the program, when these were your scores:

Overall safety 75 (100 is best)
a) Driver focus 71
b) Gentle braking 61
c) Smooth accel 79

d) Safe speeds 91

How did you choose which behavior(s), if any, to try to improve?
[free response text box]

Did you set any score goals for any behaviors or overall safety? If so, describe your goals and how you set them.
[free response text box]

[Assigned goal (arm 3)—new page]

Two more questions about the beginning of the program, when these were your scores:

Overall safety 75 (100 is best)
a) Driver focus 71
b) Gentle braking 61
c) Smooth accel 79
d) Safe speeds 91

It was recommended that you focus on [initial focus behavior]. How did you feel about this recommendation?
[free response text box]

Your [initial focus behavior] score was [initial focus behavior score]. You were given a goal of [initial score goal]. How did you feel about this goal?
[free response text box]

[Chosen goal (arm 4)—new page]

Two more questions about the beginning of the program, when these were your scores:

Overall safety 75 (100 is best)
a) Driver focus 71
b) Gentle braking 61
c) Smooth accel 79
d) Safe speeds 91

[First question if they chose a behavior in Wk1]
When asked to choose a behavior to focus on, you chose [initial focus behavior]. Why did you choose this behavior?
[First question if they didn't choose a behavior in Wk1]
How did you choose which behavior(s), if any, to try to improve?
[free response text box]

[Second question if they set a goal in Wk1]
Your [initial focus behavior] score was [initial focus behavior score]. You set a goal of [initial score goal]. Please tell us how you chose this goal.

[Second question if they didn't set a goal in Wk1]
Did you set any score goals for any behaviors or overall safety? If so, describe your goals and how you set them.
[free response text box]

[All participants]

Next are pairs of personality traits that may (or may not) apply to you. Please rate how much you agree with each of the 10 statements.

[Scale: 1=Disagree strongly, 2=Disagree moderately, 3=Disagree a little, 4=Neither agree nor disagree, 5 = Agree a little, 6 = Agree moderately, 7 = Agree strongly]

I am extraverted, enthusiastic.
I am critical, quarrelsome.
I am dependable, self-disciplined.
I am anxious, easily upset.
I am open to new experiences, complex.
I am reserved, quiet.
I am sympathetic, warm.
I am disorganized, careless.
I am calm, emotionally stable.
I am conventional, uncreative.

We're almost done! The next 5 questions will ask you to choose between receiving different amounts of money either right now or in the future. These are hypothetical choices, but please choose your answers as if they were real.

[Options presented depended on the options a participant chose. Below is a sample sequence for a hypothetical participant]

Which would you rather have?
$1000 in 3 weeks
$500 now

Which would you rather have?
$1000 in 2 years
$500 now

Which would you rather have?
$1000 in 4 months
$500 now

Which would you rather have?
$1000 in 8 months
$500 now

Which would you rather have?
$1000 in 6 months
$500 now

Over the past 18 weeks, how many car crashes have you been in (while driving or as a passenger, regardless of who was at fault)?
[dropdown with 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+ as options]

Are you interested in being contacted about future research opportunities by the UPenn research team?
Yes
No

[Message upon completion]

Thank you for your responses! In the next few days, you will be paid $15 on your ClinCard for completing the survey. Please remember to keep the Way to Drive app installed and collecting data for 6 more weeks. Each week the app is collecting your trips you will earn $5.