COLLECTING VIDEO DATA ON THE MOVE

A guide for video-based vehicle data collection

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Science Museum *of* **Minnesota**®

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Overview

What is this resource?

This resource outlines the considerations and process used to collect data in a vehicle environment. As part of a National Science Foundation grant, researchers at the Science Museum of Minnesota used video and audio recording to capture families' experiences listening to and engaging with podcast media, and each other, while driving and riding in their vehicles.

We tested a variety of video and audio recording systems, reflected carefully on the safety and ethical implications of this research, and identified the best options for our research team to capture this data without compromising the safety of research participants, adhering to state vehicle laws, and creating as natural listening experiences as possible.

We've outlined this process through this guide to support future research efforts within the car space and act as a starting point for anyone interested in collecting data in this kind of environment.

Our study context

We had two phases of video-based data collection with participants, Phase 1 was researcher-led and Phase 2 was participant-led.

- Phase 1: Researchers worked with participating families to set up the equipment in their vehicle and families were recorded as they drove around for up to an hour while listening to a podcast. When they were done listening, they returned to the original location where researchers were waiting.
- Phase 2: Participants were trained by research staff to set up equipment in their vehicle to record on their own. Participants took the equipment home and set up the equipment in their vehicle to record when they were going to listen to a podcast over the course of a 2-3 week period. They returned the equipment and recorded data to researchers after that period of time.

Phase 1 allowed us to test and refine our data collection protocol and develop a less complex protocol for Phase 2 when participants were collecting video data on their own. This resource is a result of our learning from these two phases.

Collection Considerations

Planning for vulnerability

We took care to consider the need for car data collection and to fully plan for participant vulnerabilities. The car is a private space, and a space where individuals may feel nervous or uncomfortable sharing with researchers.

Reinforcing participant autonomy

We took intentional steps to provide participants with control and choice throughout the study, recognizing that the car is a personal space. We focused on:

- Providing multiple opportunities for participants to share if they wanted any video or audio removed from the study.
- Supporting participants for parts of the technology set up so researchers didn't have to enter their vehicle.
- Explaining that we aren't watching or listening in the moment (there isn't a livestream), so we won't see moments they'd like removed.

Creating a natural environment

We emphasized that we weren't looking for certain behaviors, outcomes, or conversations, recognizing that family dynamics are on display in a video study. We made sure to:

- Place cameras in places that were not directly in front of children in the backseat.
- Remind participants they aren't being judged or evaluated, and that we aren't looking for specific parenting behaviors or family engagements.

Explaining all risk

Vehicle studies have added risk for both the researcher and participant so we took additional precautions. As participants were being asked to use their personal vehicle as part of a research study, there may be additional risks that are not part of a typical data collection.

Safety considerations

We explored safety considerations at multiple points throughout the study. We'd encourage others to consider these questions when planning a car data collection:

- What rules and regulations exist in your state around items attached windshields?
- Are there specific weather conditions that can make driving unsafe?
  - We did not do any data collection if it was raining, icy, snowing, or if it was dark out (before or after sunset).
- Are there specific restrictions in your state around participants using or touching the technology while driving?
  - Participants were asked not to touch any of the equipment while driving including any cell phones.
- What kinds of liability concerns must be addressed?
  - This is something to discuss with the relevant parties at your institution to help understand what the concerns might be and how to address them. In our case, we reviewed all of our protocols with our Director of Public Safety and the museum's legal counsel to ensure we were always thinking about safety and liability issues.
  - We took a photo of participants' driver's license and insurance card for their vehicle and sent then to our Director of Public Safety. Participants also signed a consent form agreeing to adhere to the rules and laws governing the safe operation of a motor vehicle in Minnesota.

We provided participants with a safety reminders form that they could bring with them if they had questions. That card is included below.

Safety reminders we shared with participants:

- The driver must be 18 years of age and have a valid driver's license.
- Participants will not touch the GoPro camera while the vehicle is moving.
- Participants should not record if it is raining. If it begins to rain while recording participants should pull over, stop the recording, and remove the equipment.
- If the podcast episode is played on a device (phone, iPod, etc), the driver will not touch the device while driving. If there is not a passenger in the car who can handle the device and participants would like to pause or rewind the episode, the driver will pull the vehicle over and put it in park before doing so.
- Participants should follow all of the rules and laws governing the safe operation of a motor vehicle in Minnesota including the wearing of a seatbelt.
- Anyone in the vehicle during the recording **must** have completed a consent form.

Equipment Overview

We collected both video and audio data in the car to fully capture the participant experience. We decided to collect separate audio, based on our pilot testing, as video cameras by themselves did not capture sufficient audio for our research purposes, given the various loud background noises in a car environment.

This guide mentions the technology that we used, but there may be newer models or better technology on the market, as well as alternatives to the equipment we selected. We included a list of the technology that we used below as a reference, but we hope this guide provides a helpful framework for video data collection regardless of the technology used.

Our equipment list

We've included the equipment that we used below as a reference.

Video recording equipment
- Hero8 Action GoPro cameras (Note: these are no longer manufactured by GoPro)
- Micro SD card
- Hero8 GoPro batteries & charger
- USB - USB-C cable
- Suction cup mounts attach the camera to a window

Audio recording equipment: Microphones
- RODE Wireless GO II microphone set
- Travel charging case (Note: RODE creates an updated model)
- USB - USB-C cable

Audio recording equipment: Phase 1 portable recorder
- ZOOM H6 multitrack recorder
- AA batteries
- MicroSD card
- ZOOM EXH-6 dual XLR/TRS combo input capsule
- Hosa technology pro stereo breakout cable - dual XLR to single 3.5 mm cables

Audio recording equipment: Phase 2 portable recorder
- TASCAM 2-channel 32-bit float recorder
- AA batteries
- SD card
- Dual 3.5 mm cable (TASCAM only)

Video equipment

Selecting a camera

We opted to use GoPros for several reasons due to the car environment.

1)   They are durable: GoPros are created to be dropped, bumped, and jostled; all things that happen when in a car.
2)   They capture in a wide-angle lens: This ensured that even if the camera wasn't positioned perfectly, the lens captured most of the car environment.
3)   They're user-friendly: GoPros have only two external buttons (a power and a record button), so it's easy to manage.

Camera attached to suction cup mount

The **GoPro Hero8 Cameras** were the most recent GoPro camera available at the time of the study. We opted to use the most recent GoPro model as they had the longest battery life and were most compatible with the GoPro phone application, which allowed for checking camera angles and starting/stopping video without requiring the research team to enter a family's vehicle.

Camera setup

We've outlined how we set up the GoPros to maximize storage, battery life, and the vehicle environment.

Check batteries and settings

- We only used batteries if they were at 95% charged or above to give the cameras the longest recording life.

In order to maximize battery life, we turned off all non-essential settings. For our GoPros, this meant turning off WiFi, muting the beep volume, disabling the GPS, and turning off hypersmooth boost. Different GoPro models have different interfaces and processes to change settings, and we suggest exploring the settings for ways to conserve battery life.

We also changed settings to minimize any potential participant impacts on technology:

- Turned on 'Screen lock mode': This locked the screen so that if someone accidentally touched the screen, it didn't change any settings or open the camera.
- For part of our study (Phase 2) we turned on the "QuikCapture" feature of GoPros. This meant that recording automatically started when the camera was turned on. We used this feature when asking participants to start and stop their own recordings to reduce complexity.

Format SD card

Formatting the SD card ensures that it is ready to be used by the camera. Since SD cards can go in different kinds of devices, formatting them optimizes their storage, erases data, and checks compatibility. This was an important step to make sure that we had maximized storage capacity, and we recommend formatting the SD card before every collection following directions in the user manual.

Select angles

We created two different camera setups: 1) a *windshield assembly* to attach a camera to the windshield under the rearview mirror to capture the front seats, and 2) a *back window assembly* to attach a camera to one to the windows in the back to capture those in the backseat. To attach the GoPro to the window, we used a *suction cup mount.* The suction cup mount is the same for both setups, but configured differently. Instructions for setting up the two assemblies are on the next page.

Attaching cameras to mount

The cameras attached to the suction cup mount via two folding fingers on the bottom of the camera. We used GoPros as they are designed to attach to external mounts.

Suction cup mount

Folding fingers

Back window assembly
- We assembled two configurations for the back window camera: one for the driver-side window and one for the passenger-side window. This allows the camera to angle out and capture the entire backseat.
- We opted to attach the camera to the window opposite the child, if only one child is in the backseat. This reduced distractions for the children.

Windshield assembly
- The camera is placed on the suction cup mount so that it is upside down.
- The camera attached directly under the rearview mirror.

Screw insert

Folding finger attachment

Audio equipment: Microphone

Selecting a microphone

We opted to use RODE Wireless Go II microphones for our study. A set of RODE Wireless Go II microphones includes two microphones (transmitters) and one receiver. We opted to use these microphones for several reasons:

1) They are wireless: We found that wireless microphones were less noticeable and less distracting for participants. This was particularly important for children in the vehicle, as there wasn't a cord in their way to notice or play with.
2) They had built-in clips: They were able to attach directly to the seatbelt with no additional parts.
3) They have a long battery life: The microphones are able to record up to seven hours of audio data with a single charge.
4) They have internal storage: The microphones store an internal copy of the audio input which could be downloaded and merged with other audio tracks if needed.

Each set of two microphones is paired with a receiver. The receiver has a screen which lets you know if the mics are on and transmitting to the receiver. The receiver is connected to a recording device, which in our case was a ZOOM or TASCAM recorder.

Microphone   Receiver

Charging Case

While not necessary to carry out the study, as two individual mics and the receiver can be charged with individual cables, we also used a portable charging case. This was convenient as we were traveling and wanted to charge the mics and receiver without access to power. The charging case is charged ahead of time and acts like a power bank.

Charging case

Microphone setup

To prepare the microphones, we verified a few key settings to streamline the process. The RODE microphones are managed through a desktop app called RODE Central that can be downloaded to a computer. Within the RODE central app, we adjusted a few settings to support a smooth recording process:

- **Set record to "Always"**: This means that once the microphones were turned on, they began recording internally. This simplified the process; once the blue light was on, recording was happening.
- **Set recording to Broadcast Quality (Uncompressed):** We used uncompressed audio for the highest quality. A compressed recording would take less storage space, but be a slightly lower quality.
- **Use windscreens:** We attached fuzzy windscreens to the microphones to improve sound quality by reducing background noise.
- **Label microphones:** We found it helpful to label the microphones with participant names. This made it easier to keep track of the audio inputs and to ensure that we knew who was speaking later on if listening to the audio with no video. We had a document where we kept track of which two mics were paired with which receiver in our set up and where each participant was sitting in the vehicle.

| Attachment point for fuzzy to microphone | Fully assembled microphone |

Each receiver connects to two microphones that will be displayed on the receiver screen. The microphone(s) and the receiver must be paired to transmit the audio to the recorder. Pairing the devices ensures that the receiver is able to find and receive the audio that the microphone is picking up. We paired the microphones and receiver following instructions in the RODE user guide.

Audio equipment: Recorder

Selecting a recorder

We used two different kinds of recorders for our study. In Phase 1, we used a ZOOM H6 Multitrack recorder (referred to as ZOOM recorder going forward). In Phase 2, we used a TASCAM 2-channel 32-bit float recorder (referred to as TASCAM recorder going forward). We opted to use the ZOOM recorder when we were able to set it up as researchers, as it was more complex to set up, and we used the TASCAM recorders when we asked participants to set them up on their own.
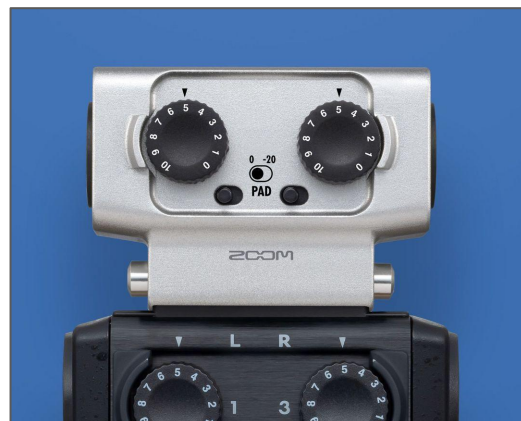
ZOOM recorder

We opted to use the ZOOM recorder in Phase 1 for a few reasons.

1) **Input from up to 6 audio tracks:** the ZOOM recorder allowed for input from four microphones via two receivers, and we purchased an XLR/TRS input capsule that enabled us to have input from an additional two microphones and a receiver. This allowed us to record a total of six people in a vehicle simultaneously onto one track which streamlined editing.
2) **More sensitive audio control:** The ZOOM recorder allowed for more control over the audio settings and produced a higher sound quality compared to the TASCAM.

We used the ZOOM recorder when researchers were managing the audio system as it required some training on how to use and adjust the audio input settings.

ZOOM H6 multitrack recorder

XLR/TRS input capsule

Audio equipment: Recorder

TASCAM recorder

We opted to use a TASCAM recorder in Phase 2 of the study. Each TASCAM connects to one receiver, and records audio from two microphones. If there are more than two participants in the vehicle, additional TASCAMS are needed (one TASCAM per two microphones and receiver). In our study, we used two TASCAMS. We had a front seat TASCAM and a back seat TASCAM to capture audio from up to four participants.

We opted to use a TASCAM in phase 2 as we were asking participants to turn on and manage the recording, and the TASCAM is a simpler setup than the ZOOM recorder. However, there were a few limitations due to the TASCAM:

1) Less control over the input volumes, leading to a slight reduction in recording quality.
2) Separate audio tracks for the participants, instead of all audio feeds mixed into one, as we were able to with the ZOOM recorder. This meant additional work had to happen after data was collected to mix the two audio tracks from the separate TASCAM recorders into one, so we could listen to the vehicle conversations simultaneously.

TASCAM recorder

Setting up the Equipment

Connecting the receivers to the recorder

To connect the recorder to the receivers, we used dual XLR to single 3.5 mm cables to connect the receivers to the ZOOM recorder, and we used a dual 3.5mm cable to connect a receiver to a TASCAM recorder. The *audio box* held the recorder and the receiver(s), and traveled with participants in the vehicle.

Final audio box with ZOOM   Final audio box with TASCAM

Audio box tips and tricks

- **Prep the recorder:** We only used recorders when battery life was at 95% or above, and formatted the SD card before each use.
- **Store receivers and recorders together:** We placed the connected receivers and recorders in a clear storage bin (audio box) so they remained attached and unbothered while they were in the vehicle with study participants.
- **Keep the audio box near the participants:** The audio box must stay physically near the microphones to ensure the receivers and microphones stay connected, so it traveled with participants in their vehicle.
- **Provide ventilation:** To avoid overheating, we made holes in the box for ventilation.
- **Handle cords with care:** The ZOOM recorder attaches to the receivers using 3.5mm - Dual XLR cords, which are very fragile. We were careful to avoid bending the cords aggressively. If the audio begins to sound fuzzy, it may be due to damage in the XLR end of the cords.

Dual XLR Cord

Preparing for vehicle set up

Below is how our equipment looked prior to setting up in a vehicle for data collection. We had the cameras assembled, with fresh batteries and formatted SD cards, as well as labeled, charged microphones, and a fully assembled audio box.

Video recording equipment
- Cameras with window mounts

Audio recording equipment
- Microphone(s)

Audio recording equipment
- ZOOM assembled audio box **OR**
- Multiple TASCAM assembled audio boxes (1 box per two microphones and receiver set up)

Audio setup

Microphones

Once everyone is seated in the car, we powered on and passed out microphones. We double checked that participants were using the microphone labeled with their name and the fuzzy windscreen was attached.

- **Clip to seat belts:** We found that attaching the microphone to the seat belt worked better than attaching it to clothing. It kept the microphone close to participants' faces, but didn't pull on shirts or collars.
- **Keep microphones near receivers:** Waiting to pass out the microphones until everyone is seated in the car helped ensure that the microphones stayed physically near the receivers and remain paired.
- **Avoid noisy foods:** Crunchy foods or foods with wrappers can impact the audio quality while recording. While we encouraged participants to behave naturally, we asked them to avoid making extra noise in this way.

Attached microphone

Car environment considerations

Once the microphones were attached, we tested and adjusted the audio levels for the car environment to ensure a quality recording. The car environment introduces various variables that can impact the noise levels and quality of the recording once the participants begin driving such as road noise, the heating and cooling system, open windows, radio volume, loud and soft voices, and more.

Testing the ZOOM audio in a vehicle environment

Once all participants were in the vehicle with microphones, seatbelts on, and the doors closed, we tested the audio.

1. For the testing phase, we stood close to the vehicle with the ZOOM audio box to ensure the receivers and microphones stayed paired, with headphones attached to the recorder.

2. We worked to mimic the driving data collection conditions as much as possible.
   a. **Turn on the vehicle:** We asked participants to start the car. Some vehicles have louder engines, which can impact the sound quality.
   b. **Turn on AC or heat:** We asked participant to adjust the heating or cooling to the level they will have it while driving.
   c. **Play the podcast or radio at a regular volume:** Participants played the radio at the volume they would consider a normal level when driving. We kept this going throughout the test, so they had to talk over it, like they would be doing during data collection. After the test, we asked the family not to turn up the radio's volume if possible while driving.
   d. **Open any windows:** If participants planned to open any windows during the drive, we asked them to do so during the test. We recommended they avoid opening windows during data collection if possible.

3. One by one, we sound checked each mic, while other participants were quiet.
   a. **Ask the first participant to speak at a normal volume**. It's helpful to provide a prompt for them to answer. For example, we asked participants to share their favorite thing to do in the summer.
   b. **While they are speaking, note the high and low levels on the LED screen for that mic and adjust the to optimum levels**. We found the best quality when the audio was between -12 and -10 dB when someone was talking. When no one was talking, the participant's levels generally bounced between -18 and -32 dB when the podcast was playing in the background (this helped ensure it wasn't playing at a volume that was too loud). We adjusted audio based on our recorder's user guide.
   c. Move to the next participant and repeat the process.

4. We reminded participants to speak how they typically would, and that they don't need to speak into the microphone by bending their neck or turning their head.

5. After the sound check is complete, we began recording and placed the audio box in the vehicle.

Video setup

We attached cameras to the windshield and a single backseat window. We also took steps to reduce distractions for participants.

- **Checked state laws for windshield camera placement:** We placed the windshield camera in accordance with Minnesota state laws around having items on the windshield. We'd suggest checking with your state to ensure that you are not attaching the camera in a way that could result in a violation.
- **Placed camera opposite children if possible:** When there was only one child in the backseat, we placed the camera on the window opposite they are sitting so it wasn't right next to the child. If there were two children, we just decided which side to place the camera on.
- **Covered front images:** Our cameras had small images on the front that displayed the video feed. We used a small piece of paper to cover them, as we noticed children watching themselves or making faces at the camera.

Camera with covered screen

We used a window mount from GoPro designed to connect the camera to a window using a suction cup. The instructions for attaching are outlined below.

Step 1

With lever up and unlocked

Step 2

Firmly press in the center button

Step 3

Slide lever over and down locking it into place.

Windshield camera mounts

When attached, our cameras were upside down, facing the front seat. From this view, there is also a limited image of the backseat. To align with state laws, the camera was directly below the rearview mirror.

Windshield camera

Windshield camera (side view)

Back window camera mounts

The back window cameras were attached to extend and turn slightly back. The setup varied slightly based on which side the camera is attached to.

- Camera placed in upper corner of the rear window
- Suction cup pointed to the rear of vehicle
- GoPro camera pointed to the front of the vehicle

Back window camera: driver side

Back window camera: passenger side

To adjust the backseat camera, loosen the screws gently to pull the camera forward or backward. It should be angled out slightly, but the wide lens will capture the whole backseat.

Final check before recording

We used a short checklist prior to beginning a data collection to ensure that we had started recording across all of the technology and to help us double check that we had not missed a step. During phase 2, we provided participants with a note card that outlined the final checks before a listening experience. A copy is included below for your reference.

Before the listening experience...

Check the following before you leave:

- ❏ Are all the microphones turned on (the blue lights are on)?
- ❏ Are all the GoPros turned on and recording (the red light is blinking)?
- ❏ Are both the recorders turned on and you've hit Record?
    - ❏ ZOOM: The screen says "REC"?
    - ❏ TASCAM: The red light is a steady red and the screen says "REC"?
- ❏ Are both receivers turned on (the screens are on)?
- ❏ Have you checked the GoPro camera positions?

After the Collection

Removing equipment

We found it worked best to first ask participants to turn off and remove the microphones, then stop the recorder and power off, and then stop video recording and remove the cameras. This was due to the fact that the microphones would continue to record even if the recorder was turned off, so we powered them down first to avoid inadvertent recording.

We provided families with a reminder note card for this process, which is included below

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When you are done listening...

When you are done listening and talking about the podcast episode, please stop recording. This is important as the microphones have limited storage capacity.

- ❏ Turn off your microphones (press and hold the power button for a few seconds). Are all the blue lights off?
- ❏ Turn off the GoPros (press the red button). Are the red lights off?
- ❏ Turn off the recorders (press and hold the power/home button for a few seconds). Are the screens off and blank?
- ❏ Turn off the receivers (press and hold the power button for a few seconds). Are the screens off and blank?

Data handling and equipment storage

After collecting data, there are several steps to ensure data is downloaded properly and the technology is cared for. Slight adjustments may be necessary based on an individual's computer system and capabilities. The GoPros and recorders use SD cards, which follow the same data downloading process as other types of technology.

Download audio and video files

Follow the directions from your chosen technology to remove the data from the SD cards or devices.

Store equipment

Proper technology storage will prolong the life of the different video cameras, recorders, and microphones. From our experiences and working with our technology team, we learned how to properly store video and audio recording equipment.

- Remove batteries from devices prior to storing. Keeping a battery in a device depletes the battery's overall lifespan and can erode the technology.
- Store cords and cables hanging up (not wrapped or coiled). Cables that are kinked or coiled tightly for long periods of time may lose their conductivity quickly and will be worn down unevenly, which can impact connectivity.