

Research questions

1. Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS?
2. Do drivers of vehicles with TPMS have knowledge of and/or experience with recalibration of TPMS?
3. Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?
4. Do owners decide not to repair TPMS due to the cost of repair, or other reasons?
5. What is drivers' acceptance of the TPMS?
6. What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?
7. How often and for what reasons are TPMS light(s) disabled?
8. How often do TPMS need recalibration and what are the methods used to recalibrate?
9. What are the main reasons that TPMS need repairs?
10. What are the TPMS component parts that are commonly replaced?
11. What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?
12. Do the answers to these questions differ by vehicle age, type, or mileage, or by demographics?
13. What is propensity of miscalibration in indirect TPMS?

Mapping of survey questions to research questions:

Driver Interview Form

Survey Question (by respondent group)	Research Question
All approached	
What is the model year of this vehicle? Is the model year of this vehicle 2006 or later? Is this vehicle a short-term rental or part of a car sharing service, such as a Zipcar? Are you the main driver of this vehicle? Are you mainly responsible for having this vehicle repaired or serviced, other than just refueling? Is the main driver of this vehicle, or the person responsible for its upkeep, here with you? To your knowledge, is this vehicle equipped with a tire pressure monitoring system, known as TPMS,—whether or not it is currently working? Ok, to start my partner will get some basic information from the door jamb.	Screeners for eligibility
(in conjunction with vehicle inspection form) Let's check your vehicle's dash to see what lights are coming on. Can my partner do that now, while we are talking? Afterward, you can fuel your car while we finish the survey.	(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?
To your knowledge, is the TPMS system in this vehicle "direct", using sensors in the wheels, or "indirect", using sensors in the anti-lock braking system?	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS?
Looking at these pictures – and allowing for minor variations in style – please point to those items that	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash

<p>you have seen on your vehicle's dash at any time in the past, either when starting the engine or later when the vehicle was running. What does this light/these lights mean to you?</p>	<p>lights used in TPMS?</p>
<p>How important is it to you that your next personal vehicle be equipped with a TPMS system? Would you...</p>	<p>(5) What is drivers' acceptance of the TPMS?</p>
<p>Disabled TPMS</p>	
<p>You said earlier that your vehicle is equipped with TPMS, but during our vehicle inspection we were not able to confirm that your vehicle has a functioning TPMS system. Has the TPMS system in this vehicle been disabled? Based on the model year of your vehicle, it should have been manufactured with a TPMS system, but during our vehicle inspection we were not able to confirm that your vehicle has a functioning TPMS system. Has the TPMS system in this vehicle been disabled? Who disabled the TPMS system in this vehicle? What was done to disable the TPMS system in this vehicle? How much did it cost to disable the TPMS system? What was the primary reason you decided to disable the TPMS system in this vehicle?</p>	<p>(7) How often and for what reasons are TPMS light(s) disabled?</p>
<p>Indirect TPMS extended interview</p>	
<p>When was the last time you used a pressure gauge to check the tire pressure in the tires on this vehicle?</p>	<p>(3) Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?</p>
<p>Did you know that the Tire Pressure Monitoring System on this vehicle needs to be recalibrated on occasion? Are you aware that you can recalibrate the Tire Pressure Monitoring System yourself? Do you know how to recalibrate your Tire Pressure Monitoring System? Have you ever recalibrated your Tire Pressure Monitoring System on this vehicle in the past? Which of the following were reasons that you recalibrated this vehicle's TPMS? (list..) If you have had this vehicle serviced or have had the tires changed, did the facility or dealership recalibrate your Tire Pressure Monitoring System?</p>	<p>(2) Do drivers of vehicles with TPMS have knowledge of and/or experience with recalibration of TPMS?</p>
<p>Malfunctioning TPMS extended interview</p>	

ATTACHMENT C3
TPMS-ORRC Field Survey - Research Questions Mapping

<p>Are you aware that a TPMS dash light is currently on in your vehicle? What does this light mean to you?</p>	<p>(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS?</p>
<p>How long has this malfunction light been on? If the light has been turning on and off intermittently, please think back to the first time you noticed that the light was on.</p>	<p>(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?</p>
<p>Did any of the following events occur shortly before the TPMS system malfunction light came on? (list...) Did any of the following events occur recently? (list..) Did you install or replace the tire stems or tire pressure sensors yourself?</p>	<p>(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning? (9) What are the main reasons that TPMS need repairs? (10) What are the TPMS component parts that are commonly replaced?</p>
<p>How much did this work cost?</p>	<p>(11) What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?</p>
<p>Has anyone explained to you what needs to be done to make the malfunction light turn off? Who explained this to you? What were you told needed to be done to correct the malfunction?</p>	<p>(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS?</p>
<p>Have you priced the work required to correct the TPMS system malfunction (whether or not you had the work done)? What was the price for this work? Do you have a general idea of what the price to repair the system would be? What is your estimate of the price to perform this repair?</p>	<p>(11) What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?</p>
<p>Do you plan to correct the current malfunction in the system? What is the primary reason you are not planning to repair the current malfunction in the system? Why do you think the TPMS system malfunction indicator is inaccurate?</p>	<p>(4) Do owners decide not to repair TPMS due to the cost of repair, or other reasons? (5) What is drivers' acceptance of the TPMS?</p>
<p>A previous malfunction would be an episode in which the TPMS system malfunction light turned on and then turned off and remained off for at least one week, either by itself or due to servicing the vehicle. Aside from the current malfunction, have there been any previous malfunctions of the TPMS system? Other than the current malfunction, how many times has the TPMS system malfunctioned?</p>	<p>(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?</p>

Low pressure and selected for extended interview	
Are you aware that a TPMS dash light is currently on in your vehicle? What does this light mean to you?	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS?
Since this light came on, have you checked the pressure in any of your tires? Were all of the checked tires properly inflated? How long has the low tire pressure light been on? If the light has been turning on and off intermittently, please think back to the first time you noticed that the light was on.	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS? (3) Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?
Low pressure/extended interview /possible malf.	
Your TPMS system may be malfunctioning. Did any of the following events occur shortly before the low pressure light came on? (list..) Did you install or replace the tire stems or tire pressure sensors yourself? How much did this work cost? Did you perform the work on the braking system yourself? How much did this work cost?	(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning? (9) What are the main reasons that TPMS need repairs? (10) What are the TPMS component parts that are commonly replaced? (11) What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?
TPMS not evident, driver says not disabled	
At any time since you've had this vehicle, have you seen any TPMS dash lights on? When was the last time you noticed a TPMS dash light turned on? Since you've had this vehicle, have any of the following events occurred? (list..)	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS? (6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?
Functioning TPMS and selected for extended int.	
Has the TPMS system malfunction dash light ever been on and stayed on while you were driving this vehicle? When was the last time the TPMS system malfunction light was on?	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS? (6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?
Did you take any action in response to the indicator light?	(5) What is drivers' acceptance of the TPMS?
What needed to be done to correct the malfunction?	(9) What are the main reasons that TPMS need repairs? (10) What are the TPMS component parts that are commonly replaced?
What actions did you take in response?	(5) What is drivers' acceptance of the TPMS?

Did any of the following events occur shortly before the TPMS system malfunction light came on? (list) Did you install or replace the tire stems or tire pressure sensors yourself?	(9) What are the main reasons that TPMS need repairs? (10) What are the TPMS component parts that are commonly replaced?
How much did this work cost?	(11) What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?
Did you perform the work on the braking system yourself?	(9) What are the main reasons that TPMS need repairs? (10) What are the TPMS component parts that are commonly replaced?
How much did this work cost?	(11) What are the maintenance and repair costs of the TPMS, as related to the diagnosed problem?
All extended interviews	
How long have you had this vehicle? Does this vehicle currently have a manufacturer warranty or other vehicle protection/extended maintenance plan? Is this the original manufacturer warranty?	(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning? (time context and does it vary by whether it's under warranty)
Where would you look to find the pressure required for correct inflation of the tires on this vehicle? Do you know how to inflate your tires to the correct pressure?	(3) Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?
Before today, has the TPMS low tire pressure light in your dash ever come on and remained on after driving your vehicle? Did you or someone else add air to one of more tires after this light came on?	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS? (3) Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?
Did the TPMS low tire pressure light continue to stay on even after adding air to the tires and driving?	(3) Do drivers of vehicles with TPMS have knowledge of and/or experience with putting air in tires?
If the TPMS malfunction light turned on, indicating a problem with the system itself, what action would you most likely take in response? How quickly would you try to get the problem fixed? What is the most you would be willing to spend to repair a malfunctioning TPMS system?	(4) Do owners decide not to repair TPMS due to the cost of repair, or other reasons? (5) What is drivers' acceptance of the TPMS?
Who would be able to reset the TPMS system in your vehicle when needed, such as after work has been done to the tires or wheels? What action is required to reset the TPMS system?	(2) Do drivers of vehicles with TPMS have knowledge of and/or experience with recalibration of TPMS? (8) How often do TPMS need recalibration and what are the methods used to recalibrate?

To your knowledge, is the TPMS system in your vehicle legally required to be functioning properly?	(5) What is drivers' acceptance of the TPMS? (does acceptance vary by belief about legality) (6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning? (does upkeep vary by belief about legality)
All participating	
Now I just need to ask you some basic demographic information. What is your age? What is the highest level of education you have completed? What is your home ZIP code?	(12) Do the answers to these questions differ by vehicle age, type, or mileage, or by demographics?

Vehicle Inspection Form - all fields collected by inspector observation

Respondent Group Questions	Research Topic
All approached	
Body type of vehicle Make of vehicle Language spoken Age of driver (group) Sex of driver Number of ADULT occupants (if ages are unclear, count all as adult) Number of CHILD occupants (if ages are unclear, count all as adult) Is there damage to the vehicle? Is the vehicle equipped with a rear hitch? Is the car a hybrid or electric? Fuel type purchased Where was payment for fuel made?	From all approached: Non-response analysis (did non-respondents differ from respondents in significant ways) From respondents: (12) Do the answers to these questions differ by vehicle age, type, or mileage, or by demographics?
All participating	
Scan Vehicle Identification Number (database only retain first eleven characters)	Eligibility screener, and capture make, model, model for: (12) Do the answers to these questions differ by vehicle age, type, or mileage, or by demographics?
Has an attempt been made to cover up any indicator lights on the dash (e.g., with tape)?	(1) Do drivers of vehicles with TPMS have knowledge of and/or experience with the dash lights used in TPMS? (4) Do owners decide not to repair TPMS due to the cost of repair, or other reasons? (5) What is drivers' acceptance of the TPMS? (7) How often and for what reasons are TPMS light(s) disabled?

<p>Select all TPMS-related indicator lights or readouts visibly illuminated on the dash Are any other indicator lights (other than TPMS indicators) illuminated in START (III) position?</p>	<p>(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning?</p>
<p>Odometer reading</p>	<p>(12) Do the answers to these questions differ by vehicle age, type, or mileage, or by demographics?</p>
<p>Does the vehicle contain visible equipment that could cause electromagnetic interference (e.g., radar detector)? [Toll collection tags do NOT count as electromagnetic interference equipment]</p>	<p>(6) What are the propensity and reasons for vehicles with TPMS to have the malfunction light on/the system not functioning? (Possible interference to TPMS signal – could cause malfunction light to come on)</p>
<p>Does the vehicle appear to have one or more spare tires (mini- or full-size) or non-matching wheels installed?</p>	<p>(9) What are the main reasons that TPMS need repairs? (spare may interfere with TPMS)</p>
Indirect TPMS extended interview	
<p>VEHICLE INSPECTOR: ENTER TIRE SIZE AND PRESSURE RECOMMENDED BY MANUFACTURER; SEE DRIVER-SIDE DOOR JAMB/DRIVER-SIDE DOOR POST. IF ONLY ONE SIZE IS LISTED ON THE PLACARD, THEN ENTER THAT SIZE AND PRESSURE; IF MORE THAN ONE TIRE SIZE IS LISTED ON THE PLACARD, THEN ENTER ALL LISTED TIRE SIZES AND PRESSURES ON THE PLACARD. ENTER ACTUAL TIRE SIZE THAT MOST CLOSELY MATCHES PLACARD RECOMMENDATION.</p> <p>INSPECTOR: (USING SUPPLIED TIRE PRESSURE GAUGE) MANUALLY READ THE TIRE PRESSURE FROM THE IDENTIFIED TIRE. (USING THE SUPPLIED PYROMETER) MANUALLY CAPTURE THE TIRE TEMPERATURE FROM THE IDENTIFIED TIRE.</p>	<p>(13) What is propensity of miscalibration in indirect TPMS?</p>
All Direct TPMS	
<p>What is the condition of the valve stem on the X tire/of what material is the valve stem on the X tire made? What is the condition of the valve cap on the X tire/ of what material is the valve cap on the X tire made?</p>	<p>(9) What are the main reasons that TPMS need repairs? (direct TPMS may have sensors involved with valve stems)</p>