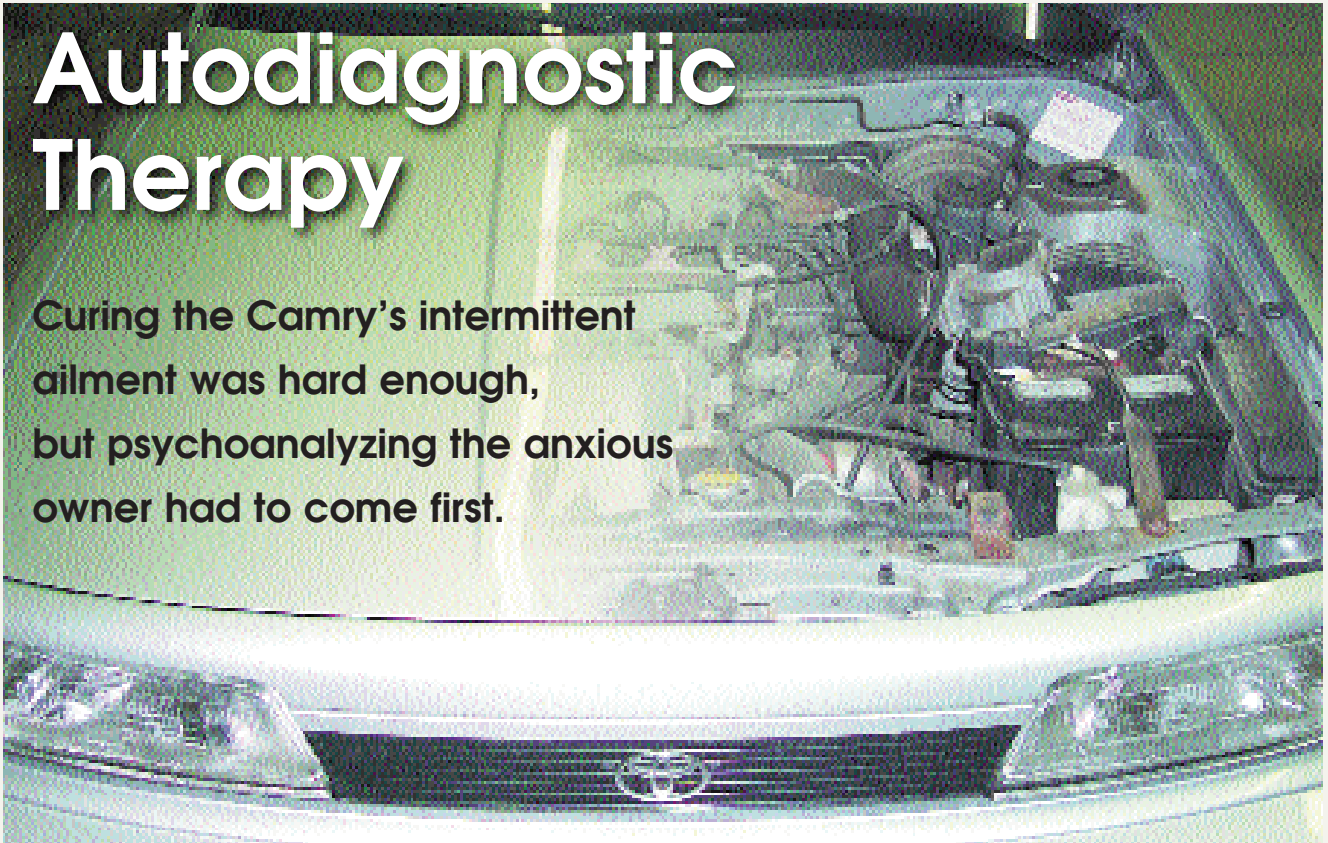


# Autodiagnostic Therapy

Curing the Camry's intermittent ailment was hard enough, but psychoanalyzing the anxious owner had to come first.



## Autopsychology: The Art

It looked very sharp for a nine-year-old car. The still shiny '91 Camry came in running fine, on its own with no obvious problems – no misses, no smoke, nothing scraping, banging, flapping, clanking or dragging. It was clean as a whistle and rustless entirely. So why did the man behind the wheel look so very anxious?

“Can you hook up your computer ‘thingy’ to my car and tell me what’s wrong?”

“That depends,” I started the familiar explanation (you’ve surely gone through the same story many times). “Why don’t you tell me what kind of problem you’re having first, so I have some idea where to start?”

“But you can just use your scanner-scope whatchamacallit to find whatever is wrong with my car. Why not just do that?”

“Well,” I continued the story, “it’s not that simple when you go to the car doctor’s. Almost any car with years and miles on it could use a thousand dollars work of various kinds without any of the money being wasted, though you seem to have kept up with yours. And you have good rubber on your wheels, too. But you still have to tell me what you want solved and fixed, just as if you’d gone to your medical doctor’s office –

You can’t just plunk down on his chair and say ‘cure me,’ you have to tell him what you’re feeling, stick out your tongue and say ‘ah.’ You have to describe your aches and pains or other symptoms. If your throat hurts or your foot’s sore, you have to tell him. You have to let him know what you want cured of, or he can’t even begin. Ditto for me. I’m a car doctor, not a magician or a mindreader. Do your brakes pull to one side? Is your engine hard to start? Does your transmission shift oddly? Do you hear a strange noise? I don’t know what to test for until you tell me that kind of thing.”

**“Just use your scanner-scope whatchamacallit to find whatever is wrong with my car. Why not just do that”**

“Ah, man! What kind of story is that?” the carowner groaned. “This is really gonna cost me, ain’t it? The guy down the street said he wants *fifty dollars an hour* and a minimum of one hour! That seems awfully steep just to figure out what’s needed to fix a car. And not even to fix it!”

"I charge a dollar a minute, so if it takes me an hour to solve your problem, I'll be more expensive than your guy down the street. But if it takes me forty-nine minutes or less, it will be cheaper."

"But how do I know how long it will take?"

"You don't. Neither do I. Neither does the guy down the street. You're paying me or him or somebody to find what is wrong. That could be in the first thing we check or the last. Two different good mechanics solving the same problem will usually take two different amounts of time. There's no way to know in advance. Especially since you still haven't told me *anything* about the car. So I still don't know your symptoms."

I thought of telling him how medical doctors have only two models to work with, male and female, and not many changes over the years. Spare parts can be more of a problem, of course, and the fixes get gradually better. But the problems and the models stay the same. But I didn't say that. No use spooking him any more than necessary. After all, you have to pay medical doctors whether their diagnosis is right or not and regardless of whether their therapy cures your disease.

"OK," the carowner said, "At least you're honest. What do you want to know?"

"What's it doing that it didn't use to? Or what's it not doing that it did before?"

"Well, what's this cost me so far?"

"The only one it's cost anything yet is me, standing here talking with you for the sport of it. You don't owe me anything yet, but either the clock starts soon, or I'm back to work. I have half a dozen cars I'm working on right now for people who did tell me what they want. We just went over this, didn't we? Until I know what's wrong with your car, how can I tell what to fix? Until you tell me what you've noticed, I can't even start on that. After that, it all depends how long it takes to figure it out and fix it and what parts you need, if any." It was a put-up-or-shut-up, I admit, but I really did have cars waiting for work. Even if I hadn't, I'd just as soon sit in the back and read the paper as long as I'm not getting paid anything.

"OK," he finally cracked, "it seems to stall out from time to time, for no reason I can see. It used to do it every couple of weeks, but now it's doing it almost every day. I guess it's getting worse."

"Good," I explained, "because that means it should be easier to find what's wrong now than it was before, when the problem was rarer. Is the stalling more frequent when you first start the engine up at the beginning of the day or later on, when the engine is warm?" What a relief, I thought to myself. At least we're chasing a possible problem rather than beating around a bush trying to decide whether to chase it or not.

"First thing," I said, "let's see whether I can get the car to stall the way you describe. Once I can duplicate the problem, I can start on the solution. Can you think of any conditions corresponding to when the engine stalls? Is it right after you start, while you're driving along, at a stoplight waiting for the green or what?"

"No," the anxious motorist responded, frowning his brow, "it just seems to happen at the most inconvenient times." I began to suspect he was one of those patients who doesn't want to tell you anything for fear that would make the problem worse and the bill more expensive. I'd have to show him that speaking up was the right thing to do.

### He didn't want to say anything for fear that would make the problem worse and the bill more expensive.

"All right," I offered, "let's try a road test with you driving. But just to reassure you before we set out, let me connect the scanner and see whether the car's computer has stored any trouble codes for your problem."

"That's what I wanted you to do in the first place!" he was almost angry.

I pulled the codes and found nothing beyond the all-clear.

"The computer says there's nothing wrong with your car at all."

"That's impossible! It stalls out!" he said. Now he was angry.

"Which is exactly what I was trying to explain to you. Sometimes, often in fact, problems occur the computer either can't detect or detects and identifies with the wrong cause. If something shuts off the computer, for instance, it's just as though it went to sleep and missed everything that happened while it was napping. Or suppose you just run out of gas. In most cars the computer doesn't know that. It doesn't have information about how much gas is in the tank; it just assumes there's gas anytime it turns on the fuel pump. That's why we have to do actual diagnostic tests beyond what the computer says, if anything."

The light, I could see, was beginning to dawn. "So things can happen in the car the computer doesn't know about?"

"For sure. In fact, when they build the computers in the first place they test them on the assembly bench. The computer can't even tell it's not connected to a car. It just takes certain information in, calculates what to do and sends certain commands out to various actuators like fuel injectors and ignition coils."

“OK,” the motorist said. “Come to think of it, the stalling may happen more often shortly after I start the engine in the morning. Not right away, but after I get moving for a mile or so and come to a stop. It doesn’t do it once I’ve been driving for ten or twenty minutes.”

Now this was the first piece of useful information. This meant the problem might be temperature-related, but wasn’t related to the higher temperatures of normal operating condition.

“Good! Good!” I said, “but tell me more. Is there anything else you do or notice it does when the engine stalls? Anything at all might be helpful, even if it doesn’t seem obvious. For instance, when do you start in the morning, what’s the drive like?”

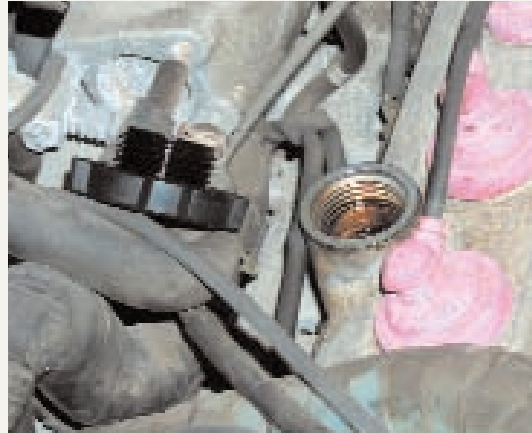
“I set off to work just before daybreak,” he said. “I just start up, turn on the lights and heater. Because there’s usually dew on the car, I hit the wipers and rear defroster. Flip the radio to the traffic-report station and start driving. Then it just shuts off like with a key. No sputtering or shaking, just off.”

That added up to quite an electrical load on a cold engine, with a battery just depleted from the startup crank and cold from sitting overnight. But by this time, I sensed he’d decided I wasn’t either a crook or a stumblebum, so I suggested to him we let the car sit outside with the hood up and cool down for several hours. That’s about the only way short of leaving it overnight to duplicate the conditions when the stalling occurred. He agreed and called a friend for a ride home. Aha! Psychological work done; automedical diagnosis still to continue.

## Automedicine: The Science

So much for reassuring the owner, now I had to solve the stalling problem and fix the car. I walked away from it for the rest of the morning to do other jobs and to let it cool down enough to run my tests. In the back of my mind his description added up to some sort of ignition problem rather than, say, fuel supply. Or perhaps a system sensor input that worked both spark and fuel.

I’m very devoted to checking the basics, since that’s the place you’ll find most problems and their solutions. Not all basics are likely sources of intermittent problems, however. Worn piston rings or valves or jumped timing, for instance, don’t come and go early in the morning as the engine is coming up to operating temperature. Contaminated fuel can be an intermittent problem, if the problem corresponds to running the tank close to empty, when the contamination reaches its highest concentration level. But that wasn’t the pattern here.



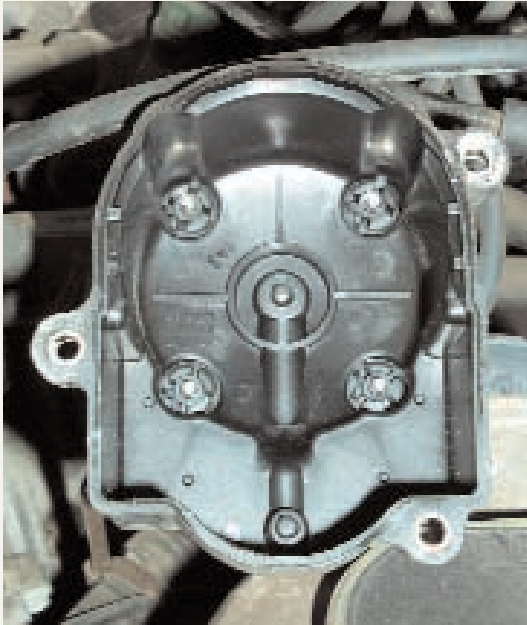
*Clean on the outside didn’t mean clean on the inside. If the Camry had been to the oil change as often as it ran through the carwash, things might have been different for the driver.*

But one basic approach that’s almost always the right thing to do was a visual inspection. I lifted the clean, shiny hood, a hood you could eat lunch off of without a worry. What a surprise to see the engine compartment! This was clearly a car that had seen many more car washes than oil changes. That doesn’t necessarily tell you what’s wrong, of course, though I made a mental note to clean those battery cables before returning the car to the owner.

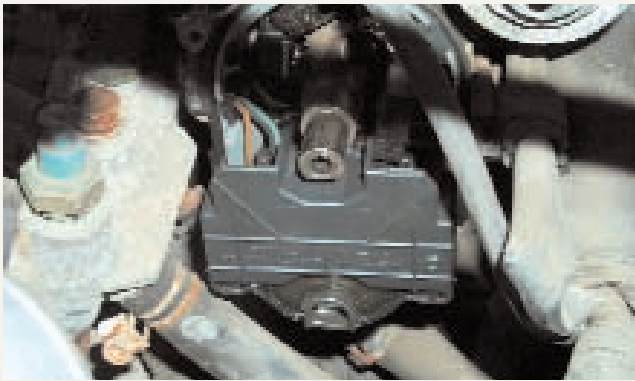


*The ignition rotor showed some evidence of insulation breakdown, but not enough to replace it yet. This was not the cause of an intermittent stall.*

Many cars with ‘deferred maintenance’ first start to collapse inside the distributor, where the rotor and the cap are such close friends. I didn’t expect to find cracks or hard carbon tracks, but I suspected I might find the kind of discoloration that shows occasional trips of the secondary voltage into the distributor shaft or shell. Neither of them was a jewel, but neither of them looked bad enough to condemn yet. The coil also showed no signs of spark leakage.



*While the outside was pretty gritty, the inside, business part of the distributor cap was clear of any kind of spark leak residue. No ailments here, either.*

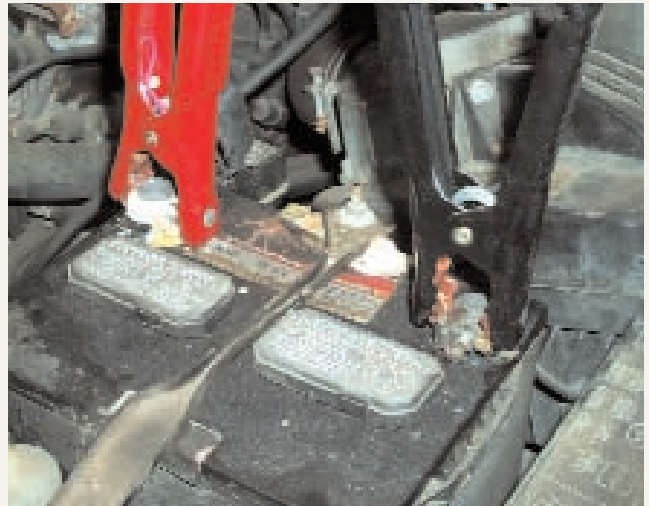


*The ignition coil, integral with the distributor, showed no external signs of problems. Coils can read with the right ohms and fool you once they change temperature, though, so it was still under the car doctor's diagnostic microscope.*

A coolant temperature sensor was a fairly obvious potential malady, so I clipped a meter to the circuit before I tried the cold start. I also went over the injectors cold, measuring the resistance through their coils. I used to look up injector coil resistance very carefully in the books each time, but now I realize that it's most unlikely all the injectors wandered out of resistance in the same way to the same extent.

If I find all the injectors within an ohm of one another, it's likely they're all good. This test is useless, of course, if you have throttle-body injection. If I saw a new set of injectors on an old engine, I admit, I might still look up the specification in case somebody used the wrong set. His were fine, at least cold.

An interesting problem I remembered connected with the ailment of shorted injectors: if you have one injector that's partially shorted internally, that can steal enough current from the other injector fired simultaneously with it to shut the good one down. It is odd to discover and surprising when you understand it, but the defective injector can keep working with the increased current even as its perfectly functional companion injector goes apparently dead. All autodocors have to keep that particular basic – Ohm's Law – in mind anytime we're doing any work with wires. Electricity will take the path of least resistance, regardless of what that means for the system.

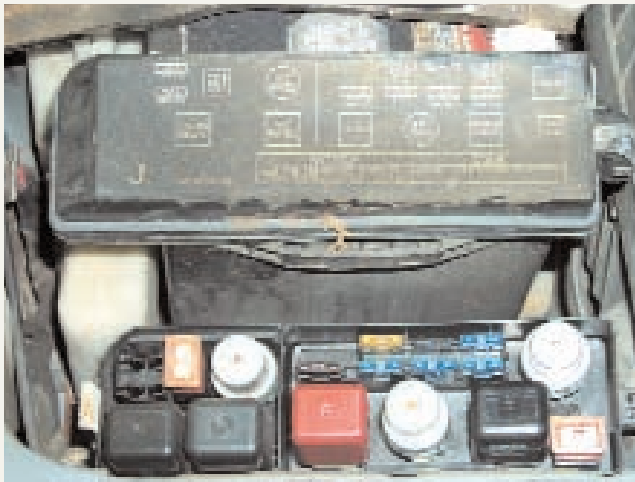


*The description of the problem conditions suggested current draw played a role, so a VAT machine filled in for the vehicle load in a diagnostic pinch. The corrosion on the terminal clamps certainly fit the shutdown syndrome, though.*

The owner's description also made me strongly incline to the diagnosis that electrical current load was a contributing factor, if not the whole story. I don't intend to run out of current load capacity when that might be the malady, so I also connected my shop's VAT machine across the battery. This would keep me informed about the state of battery charge and the system voltage, too. On this car, like most others, if the system voltage or cranking power drops below a certain threshold, the computer and everything connected to it take a snooze.

# Autodiagnostic Therapy

I rigged the scope to monitor all the life-signs, spark and fuel in particular. Most often, of course, vehicle systems will shut the fuel off if anything goes wrong with the engine control system, both for safety and for emissions purposes. But if you've traced the sequence on a scope, you can often find a fraction of a second between when the spark shuts down and when the fuel does, or vice versa. The one that dies first, of course, is the cause, and the other is the effect. I checked inside the main relay box, and all the relays looked clean and functional – I'd pinpoint test them later if that's where the malady pointed.



*Relays can be tricky, failing at unpredictable times and sometimes seeming to work when they didn't. Nonetheless, it's always worth a quick glance to see whether one of them has grown feet of corrosion.*

With everything in place, it was time for the acid test. I turned the key, and the engine started immediately, running normally and with no miss or falter. Following the owner's description, I started turning on electrical accessories, the lights, blower, wipers and rear defroster. Suddenly the engine stopped dead! It had happened too quickly, and I wasn't watching all the meters! I'd have to try it again and hope it hadn't warmed beyond the point when the stumble occurred.

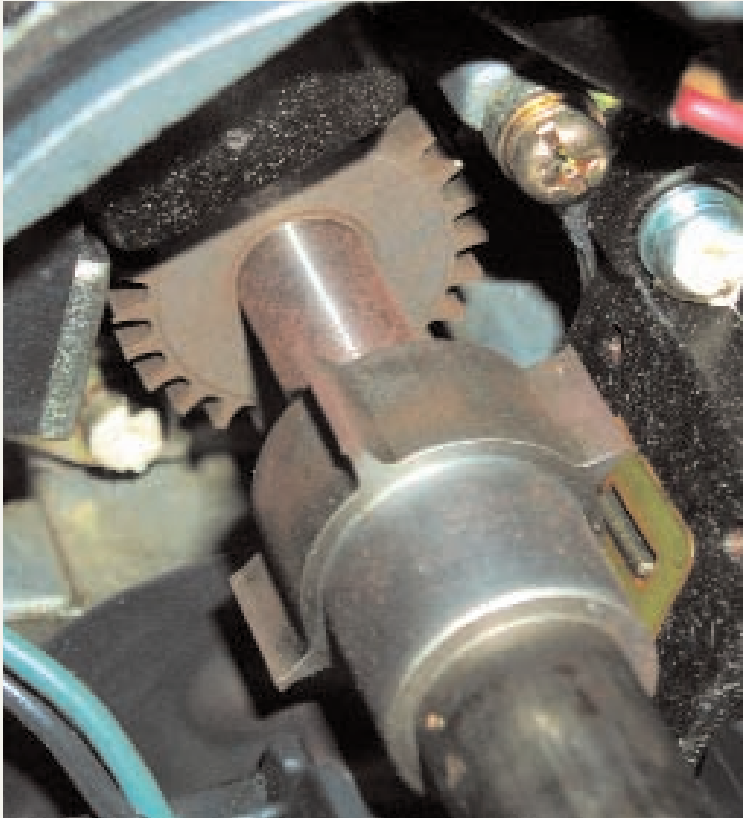
Double-checking all the hookups, I repeated everything I'd just done. I confidently expected the engine to expire just as I touched the switch for the rear window defroster, so I was watching all the test equipment as I pushed the button. Nothing! Nada! Zilch! It kept running as if nothing had happened. It looked as if I'd have to wait another couple of hours to try the test again with a cold engine.



*Somehow I knew the problem had to be in the distributor, and not in the secondary windings. The camshaft position sensor and the crankshaft position sensor or rpm sensor are both on the distributor in this vehicle.*



*The camshaft position sensor serves mostly to sequence the fuel injection. Most systems using the cam sensor in that way may not start if it fails, but don't tend to stall once underway because of a problem with it.*



*The germ causing the disease! The crankshaft position sensor, hiding in the base of the distributor cup, lost its signal at certain combinations of temperature and electrical load, possibly related to an intermittent bad ground inside the distributor housing. Transplanting this organ saved the patient.*

But I decided to try one more test. Reasoning that it only made basic sense that if some electrical load could cause the stumble at just the right temperature, maybe enough electrical load could cause the same stumble at almost any temperature. I started twisting the dial of the VAT 40. It went to 300 amps draw on the starter and charging system, holding 10.1 volts even under that draw. The engine kept running normally. So I repeated the test once more.

Success! This time the engine shut off like a light, and I could see from the scope that the first thing to drop out was the crankshaft position sensor signal. Once out of the system it showed higher than normal resistance through its pickup coil. Patient prognosis? Good news! ■

— Lou Reichardt