Phone Compass vs GPS Heading: What's the Difference and When Each One Fails

Your phone has two completely different ways to tell you which direction you're facing — and most apps silently switch between them without warning. Here's what's actually happening under the hood.

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Two Technologies, One Needle

Pull up a navigation app on your phone and it confidently shows you a heading. But that arrow could be coming from one of two completely different sensors — and knowing which one is active makes the difference between trusting your phone in the backcountry and getting quietly misled in the middle of a city block.

How the Magnetometer Works

Your phone contains a tiny magnetometer — essentially a digital compass chip that measures the strength and direction of the surrounding magnetic field. It reads the Earth's magnetic field and converts that into a bearing. The critical word here is *reads*: the magnetometer is passive. It works whether you're standing still, sitting on a rock, or moving at any speed. It needs no GPS signal, no cell coverage, and no internet connection.

The trade-off is sensitivity. Magnetic fields are everywhere, and not all of them are Earth's. A car dashboard, a steel bridge support, a pocket full of keys, a nearby speaker, even a phone case with a magnetic clasp — any of these can deflect the magnetometer reading by dozens of degrees. The magnetometer is measuring the total local field, not just Earth's. When local interference is strong, the compass heading becomes unreliable.

Apps like **NorthPin True North Compass** address this directly by displaying the live µT (microtesla) reading alongside the heading. A typical outdoor reading is around 40–60 µT. When you see the value spike toward 100 µT or higher, something magnetic is nearby and distorting your compass. That's the interference detector doing its job — giving you the information to move away from the source before you trust the bearing.

How GPS Heading Works

GPS calculates your heading completely differently. It doesn't measure magnetic fields at all. Instead, it computes your direction by comparing successive position fixes: if you were at point A three seconds ago and you're at point B now, you must be heading in the direction A→B.

This approach has one absolute requirement: you must be moving. A GPS chip can't tell you which direction you're facing when you're standing still, because your position isn't changing. Most navigation apps require a speed of roughly 5 km/h (3 mph) or more before GPS heading becomes reliable. Below that threshold, the position fixes are too close together and measurement noise overwhelms the direction signal.

The advantage of GPS heading is that it's immune to local magnetic interference. Metal buildings, vehicles, and magnetic accessories have no effect on a GPS-derived course. On a highway or a straight trail where you're moving at a consistent speed, GPS heading is often more stable and accurate than the magnetometer.

The Silent Switch — and Why Your Heading Can Flip

Here's where it gets confusing. Most navigation apps blend the two sources automatically using a sensor fusion algorithm. While you're moving at speed, they weight GPS heading heavily. When you slow down or stop, they shift back to the magnetometer. This transition is usually invisible — there's no indicator telling you which sensor is driving the needle.

The result: you're walking slowly through a parking garage, GPS heading fades out, the magnetometer picks up interference from the concrete-reinforced ceiling, and your heading jumps 60 degrees. The app didn't break. It just switched sources at the worst possible moment in the worst possible environment.

Some apps handle this better than others. A dedicated compass app that clearly commits to the magnetometer — and gives you tools to assess its quality — is more predictable than a general-purpose navigation app silently toggling between sensors.

Practical Scenarios

Standing at a Trailhead

You're stationary, studying a paper map and trying to orient it to the terrain. GPS heading is useless here. You need the magnetometer. Step away from your car, hold your phone level, and look at the µT reading in NorthPin. If it's within normal range, the bearing is trustworthy. If not, walk ten meters from any vehicles or metal structures and check again.

Driving Navigation

At highway speeds, GPS heading is excellent and the magnetometer is essentially irrelevant. Your navigation app will naturally favor GPS, and rightfully so. The only time you'll notice compass weirdness while driving is in multi-story parking structures or near large steel bridges.

Camping and Off-Trail Navigation

This is where compass quality matters most. You may be moving slowly, stopping frequently to check your position, or standing still while you decide on a route. GPS heading will drop in and out. The magnetometer is your primary source. Before relying on any bearing, perform the figure-eight calibration that NorthPin walks you through — it remaps the chip's internal correction and removes accumulated soft-iron error. Do it once at the start of a hike and your readings will stay consistent for the day.

Which Should You Trust?

Neither sensor is universally better. They serve different situations. A good rule of thumb: if you're moving at walking pace or faster and well away from metal, GPS and magnetometer readings should agree within a few degrees. If they're diverging significantly, something is wrong — either you're moving too slowly for GPS to compute a reliable heading, or the magnetometer is picking up local interference.

The best approach is to use a compass app that doesn't hide the details from you. NorthPin shows you the live µT field strength, the raw 0–360° heading, and lets you toggle True North mode so you're always working with the same reference — whether you're reading a topographic map that uses magnetic north or navigating by geographic north. It's free, works fully offline, and carries no ads. Understanding what your phone is actually measuring is the first step to trusting it in the field.

Download NorthPin free for iOS or Android — no ads, no tracking, and it works fully offline.

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