Impressions after riding a Segway HT: Part 2

From two hours of riding on a Segway, I found that it is remarkably stable, rugged, and versatile. It's not anything like a bicycle or scooter. It's closest to walking. It bodes well for active mechanics.

What I learned

Here are some questions and my current feeling about the answers. I assume you've read other, basic accounts of using it, so I won't go into all the details.

What does riding a Segway feel like?

The first thing that struck me when seeing a Segway up close was how rugged and un-toy-like it looked. The demo units had the finish of good, professional power tools, and that solid feel. They were solid and robust like a downhill ski boot. (The shiny plastic fenders helped with that image.)

Stepping onto a Segway is like stepping up onto a podium -- one of those low-rise portable stages used at conferences in ballrooms. It is very stable, with ever so slight a rock and give -- a combination of the wide tires (like a mountain bike's) and the active mechanics. (I define "active mechanics" as using servos and computers with software reacting to sensors instead of analog mechanical or electro-mechanical devices.) The Segway feels as if it had four wheels with the brakes on. The handlebar and the height makes it feel like you're behind a lectern on that podium. Looking forward, you don't see the two wheels. In my mind, it always had four. (How else could it feel so stable?)

If you lean forward, it starts moving, much as an old model railroad train starts up when you give it power. If you lean back a bit, it slows down or stops, again much like a model train from my youth. The feeling I got was of a variable speed drill. You have very responsive control of the motor, and it has that step-step-step feel of a servo motor with a "whirring" sound. **It always feels in control, never like it's coasting.** That, and the low center of gravity (80 pounds under me rather than me balanced on a lightweight bike or something), distinguished it from other small personal transport devices. It reminded me of my few times on a jet ski on a lake (without the bumping or waves): When you stopped telling it to go, it slowed down very authoritatively. (It uses engine braking to recharge the batteries.) Unlike skiing or riding a bike or driving a car, the Segway uses the natural balance motions of walking to control forward, stop, and back. It is closest to walking as an activity, even when going 12 mph. Turning is less natural, using a twist motion -- which some of us have learned as an accelerator control on other devices.

The Segway is incredibly stable, whether standing still or moving. You don't feel at all like it will fall. **I felt as stable as walking, and more so than if I was running**, especially on dirty sidewalks. (I compared the feelings when doing an exercise run on similar paths the next morning. Interestingly, I felt better running after using the Segway, probably because my image of my body was now of smoothly moving so effortlessly on those paths. It trains you to think walking is natural as opposed to using an automobile or bike.) It glides around like you were on rails. While I say the unit reminds me of the feeling of ski boots (not being in them, just the construction), it has the feeling of being unconstrained like running shoes.

Some people have likened the feeling to skiing. As a novice to intermediate skier, I'd say it feels like me skiing on the novice "bunny" slopes with complete control, but not as much body/feet bending to do things. In fact, Gary said that it works fine on bunny slopes in the snow.

Isn't it just like a bicycle or a scooter?

The Segway is not at all like a bike or a scooter. Those are devices you push, and then operate while coasting, and then use a brake. They are only somewhat vertically stable when moving above a certain speed. I've ridden a bike throughout most of my life, yet I felt safer and more in control on a Segway within minutes. The Segway does not operate in that region where you're rolling free any more than walking does. The Segway is just as stable standing still as moving -- there is no need to always keep moving or else put your feet down.

With normal mechanical devices like a bike or car, there is an entire range in which you can operate its controls (e.g., steering, balancing, clutch). Learning to use the device is learning to operate only in the "sweet spot" in the range where it is sort of linear to get it to do what you want. Outside of that sweet spot it behaves non-linearly, and you may get dangerous behavior. For example, on a scooter or bike, if you turn the handlebar a little too far the wheel will stop rolling and the device stops suddenly and you fall off. **With the Segway, almost the entire range of motion that feels OK to you as a person is the sweet spot.** You have to push it way too far (like leaning really far forward, much after it starts pushing back) before it goes nonlinear. You have to consciously want to. They programmed it to give some indication (noise or push back) when you approach those limits, much like a physical barrier or tone (if there could be one) before the "red line" for a manual shift car.

With a bike, skis, or similar device you learn non-intuitive moves with your body to stay balanced. **If you get on with differently balanced weight** (for example, carrying something on your back) or pick something up, **you have to "relearn" your moves**. That can be dangerous, because the bounds of the sweet spot may change and your old moves may be too ingrained, leading you into the dangerous "nonlinear" areas. Even walking or hiking can lead to this problem. (Have you ever had balance problems climbing hills with a backpack?) Because the Segway works by looking at your center of gravity -- watching you instead of having you parrot some learned unnatural dance -- if you suddenly have differently balanced weight you don't have to "relearn" your dance. It's still stable. So, when carrying something it doesn't have that instability of a bicycle or even walking. If you can stand up so you don't fall over if you were on the ground, it handles it fine. Quite different than a bike.

[I added this paragraph a year later.] I rode on a Segway briefly in May 2003, and tried this to demonstrate this stability. I took my 10+ pound computer bag and swung it out at arm's length while standing on the Segway. As long as I could stand straight that way on the ground, the Segway let me do the same on it without rocking or anything -- it was just like standing on the ground. If I did that on a bike, I'd probably fall right over.

How does a Segway fit in among regular walking and standing people?

As you can see from the photos, we used the Segways indoors in tight quarters, with people milling around schmoozing and not paying attention to the units. There were tall art objects, chairs, and other obstacles. No problems, and this was with novices. **People on the Segways were about as intrusive as someone on crutches or holding a wheeled piece of luggage -- that is, not much at all.** Not like a bike or motor scooter. The motors are basically silent. The ability to control them well let the riders navigate around people like a walker or runner. If you bump into people (we tried it many times) it was no worse than bumping into people as a person. Actually it was better, because the bumping causes the handlebar to move back and that does a braking action, unlike a person who would just continue forward with their momentum. The wide tires distribute weight, so running over a toe isn't too bad. (It doesn't mess up grass much on a golf course, either, I hear.) The units we used **raise you off the ground, so tall people have to be careful about bumping their heads** on branches and things that they didn't previously need to watch out for. Like someone running through a crowd pushing people with their elbows, **an impolite person can be impolite on a Segway**, too. Social norms will probably develop for different locales. The fact that you don't have to keep moving to keep from falling off (as you would with a bike or scooter) will lessen the tendency to push the limits of decency when encountering people in your path.

What situations can you use it in? Won't snow and rain mess it up? What about sidewalk curbs?

Gary told us in his talk a bit about the testing being done by the **U.S. military's Special Operations people**. They have souped up units, going very fast, carrying lots of weight, and push them to their limits. (I'd assume that Special Ops people don't get nice sidewalks to ride on.) He wasn't allowed to show us pictures, but imagine this: Big guys who seem like they eat gravel for breakfast, fully decked out in their normal gear, standing on Segways with lower handlebars, no lights, etc., barreling out of a transport plane in the dark at full speed faster than you can run. I imagine these guys grew up on mountain bikes and skateboards, and are fearless. I imagine such stories will help their image of being rugged, and the testing being done will let them extend their knowledge of its capabilities.

Being built by aircraft and automotive engineers with their parts, even a normal Segway is not a delicate thing like a laptop computer. Think rugged like skis and ski boots. Your walking reflexes will stop you before it breaks. To go off a street curb, you just ride perpendicularly towards it, bend your knees, and go over. (I did it a few times.) The wide tires help cushion the drop, like on a mountain bike, though there is no suspension. The Segway can take a 3 foot drop I'm told, but with my old knees I probably shouldn't try it. (Apparently they learned you can hurt the tires by shooting them with a gun.) Slippery terrain like gravel, sand, snow, etc., are handled amazingly well by the

tires and active mechanics. Ice needs special tires. Gary says it can run under water (it's sealed, the steering twist control works by moving a magnet over a sensor, etc.). The limit to bad weather is what the rider wants to wear, just like walking. The aviation and medical instrument background of the engineers also leads to the heavy redundancy and other reliability and safety elements of its design. Again, different than I'm used to for personal electronic devices, like personal computers.

I rode it on deep gravel that I would never ride on with a touring bike, and even be scared of in a mountain bike (I've only ridden one of those a bit in such situations, though).

One thing Gary had me try was to ride to the bottom part of a ramp (about 20% grade), with one wheel up on the ramp and one wheel on the flat floor, and then make the Segway turn in place 360 degrees. He said that was one of the toughest jobs for the computation. It worked fine. I just had to bend my knees appropriately as one side went up and then the other and it adjusted fine.

While it clearly can do more than normal people would need, that's no different than a car or bike. Knowing my car can go through the outback or race doesn't mean I will, nor my mother.

Did you find any limits or problems?

We encountered a few unusual situations worth describing. Since it tries to always stay under your center of gravity, if you step back slowly when getting off and shift your weight to your back foot before touching the ground, it will dutifully roll back to stay underneath you and keep your weight from being off its platform. If you don't actually touch the ground it will just roll back until you touch down. With my experience folk dancing, stepping without shifting weight was easy, but some may find it strange. Getting on requires the confidence to just put your weight directly on it. That's probably why they have someone help you the first time until you learn to trust it.

When going up a rutted gravelly hill and then turning, David Reed had the unit slip a bit on the gravel or something. He, a skier, instinctively leaned forward to compensate. The Segway quickly moved forward. He instinctively leaned back real far. It quickly rolled back. We watched in horror for a second while he seemed in a two foot oscillation (he's over 6 feet tall). Then he remembered: "It tries to always stay under you." He stopped trying to "help" it balance and just stood straight. It stopped immediately and he never even needed to jump off.

At one point I was riding on a narrow sidewalk when I had to maneuver over two cuts in the sidewalk for wheeled access, a drainage indentation in the sidewalk, and a very tight turn around the corner of the building, all within a few feet. Bobbing up and down over the drainage cut, I turned a little too tight and started to almost scrape the wheel against the building. Embarrassed that as a Boston Driver I was about to scratch his nice device, I jumped off. I pulled it a bit to the right, jumped back on and continued. The twist steering can take a while to get used to in such weird situations when set too sensitive (I should have been on a less sensitive setting). That may have been the only "crash" of the two days out of 60 people or so.

As a counterpoint, a few days ago a close friend of mine took his kid's Razor-like scooter down a long undulating driveway to get the mail. He broke his wrist, needed plastic surgery on a cut under his eye and a paper bag to hide his bruised face and ego. I scuffed one tire. The Segway surely will be involved in

incidents where people will get hurt, but compared to other accepted risks, and even to tripping while carrying groceries or stepping on untied shoelaces, it should be quite acceptable to society. It will be hard to quantify the times people using it don't get hurt when they would have if they had used other modes of transportation (like walking, riding bike, or driving a car). Backing a car out of a driveway or parking space to go to the corner store is not the safest thing, either to pedestrians or other drivers. Is a fall off a Segway more dangerous than an airbag in the face?

What about sitting down, carrying packages, etc.?

Just about any question you ask a Segway person about configurations results in a "Yes, we're working on one like that" or "We tried that and it doesn't feel as good as you'd think -- we have a museum of each attempt."

Isn't it just for fun?

Segway hopes it's mainly for serious use, but some people will inevitably use it for fun. Even the most conservative low-end items get "drafted" for "sport" use: The original VW Bug and the current Honda Civic have always been popular for "hot rod" conversions. Even the mundane packing aid, the bungee cord, has come to symbolize "extreme" activities. Why should active mechanics be any different? Think of this as the microprocessor, not the handheld calculator which was one of its main first targeted uses. Active mechanics used for personal transportation will be used in many, many ways. Most of those will be very beneficial to society in ways other than for fun. Of course, fun is good, too, and is often a necessary ingredient to success. If driving wasn't fun, it wouldn't have caught on as well. Just because something useful is fun during that use, doesn't mean it's bad. Accountants and analysts found the spreadsheet "what-if" recalculating "fun".

Who will want it?

Just about everybody who tries the Segway likes it, and would take one if you gave it to them. That's a good leading indicator. For less than the difference in price between a car with some "cool" attributes and a more "practical" one, I can buy a Segway. I pay that much to get a car with extra carrying capacity for those few times I need it (a minivan). How many times would it help to go a mile or two "on foot" quickly? I can use the Segway to help me carry the food for a picnic to the real off-road places us regular people, who don't live near Utah's national parks, go to.

As a 50-year old, I experienced the Segway as I experienced getting reading glasses: **A way to augment my body back to a healthy youth.** I can carry heavy loads that would hurt my now-sensitive back. If my knees or heart get worse, I can still run or go distances on a hike with younger loved ones. **This will be a very big hit with the 45 and over crowd.** If somebody bumps into Grandpa with it, it will be Grandma, and she votes. For younger people, the Segway opens up new areas that are now within "walking distance", for older people it restores old areas that are missed. People with all sorts of disabilities (MS, Parkinson's, knee injuries, etc.) are begging the Segway company for units. They know it will change their lives, restoring some normalcy.

For mobile electronics, this changes the equation. You don't have to carry everything on your body. You can "carry" 10, 20, 30 pounds of equipment with you, in the car, on a walk, or into the office. That equipment can augment things you wear or hold. Imagine 802.11 from your Segway to you, connected to hundreds of Gigs of disk. The Segway has lots of computing power, anyway. Just leave it where you leave your coat and it's probably close enough.

There are many **industrial applications** where a job entails lots of walking and perhaps carrying and where walking is "wasted" time. The initial Segways are going there.

To see videos of a Segway in action (including running on snow), check out "*See Segway HT in Action*" on their web site. To learn more about how it works technically, Gary recommended an article in Design News. For a reporter's view from the inside, following the development and marketing of the Segway complete with insights into some of the personalities involved, see John Heilemann's "Machine of Dreams" in the May 2002 issue of *Vanity Fair*. To read some more general thoughts about the Segway, read my essay from December 2001: "Thoughts about the Segway HT: Why it's not just a scooter". To see pictures of Segways in use in Atlanta in February 2003, see "Segways in Atlanta".

There are many other aspects of the Segway HT and what it represents that deserve discussion, but that's all I have time for here. I'm sure we'll be hearing much more as other information becomes available. Gary hinted a bit to us about Segway's Stirling engine that with or without the Ginger could have great impact around the world. Remember, this is just the first general product using some of these technologies. There will be many more. Think of the Segway like the first uses of the microprocessor in a calculator, before the personal computer, PDA, flat panel LCD, DSP, GPS, etc. On my run when I saw a Vespa-like motor scooter putt-putt-putting along, I thought of the abacus.

-Dan Bricklin, 10 April 2002

There is a book about the development of the Segway [link to Amazon] called "Code Name Ginger". I wrote a review on my weblog.

-Dan Bricklin, 23 July 2003

A reaction to reading this essay and then purchasing a Segway: "Segways and special needs".

-Dan Bricklin, 12 April 2004

Thoughts about the Segway HT: Why it's not just a scooter Home Part 1
© Copyright 1999-2006 by Daniel Bricklin
All Rights Reserved.