A Survey of the Equipment in Paris-Brest-Paris 2007

by Mark Vande Kamp, Jan Heine and Alex Wetmore

Most randonneurs ride bikes that they have adapted to their purposes, and there are many opinions on what makes a good randonneur bike. During a typical randonneur brevet, riders use a variety of equipment, from sturdy touring bikes equipped with fenders, multiple racks, and generator lights, to superlight bikes equipped only with minimalist battery lights (hereafter referred to as racing bikes). They share the road with tandems and a variety of recumbents. There are distinct regional differences in randonneuring equipment, which evolve as riders copy what they see working well for others in their club.

As a result of this diversity, it is not immediately apparent what the "average randonneur" rides, or whether such a rider even exists. Beyond anecdotal evidence, we do not know whether some equipment choices work better than others, and whether they affect the outcome of a long ride.

A survey of PBP participants

Are riders on bikes with fenders more likely to finish a rainy event? Are riders on racing bikes faster than those on fully-equipped, but heavier bikes? Do superlight bikes suffer from more equipment failures? Do other equipment choices affect success in long rides?

Paris-Brest-Paris (PBP) 2007 offered a unique opportunity to address these questions: 1557 riders, or 30.2% of all participants, did not finish (DNF) the ride within their chosen time limit (80, 84 or 90 hours). This DNF rate is almost twice that of other recent editions of PBP, probably as a result of unusually rainy and windy conditions. The DNF rate is roughly the same as in 1956 and 1961,[1] when it was equally rainy and windy.[2] It appears that inclement weather affects the finishing rate of randonneurs in PBP by putting riders and their equipment to a rigorous test.

To take advantage of this opportunity, we conducted a survey of participants in this year's PBP. The survey was announced through various Internet newsgroups, as well as through the bulletin boards of regional chapters of Randonneurs USA (RUSA). 488 PBP riders responded, of which 296 were members of Randonneurs USA. The latter figure represents more than 50% of the 588 RUSA members who started PBP. This excellent response rate allows us to describe the equipment used by RUSA members; therefore, we limited our analysis to the RUSA members who rode in PBP 2007.

Summary

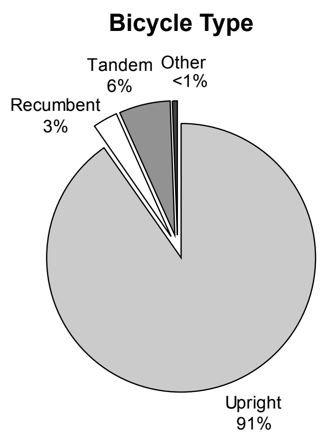
- RUSA randonneurs used a variety of equipment in PBP.
- Most randonneurs are not entirely happy with their equipment, especially with racks/bags, lights and clothing.
- Most equipment choices have little influence on finishing time and DNF (Did Not Finish) rate.
- Lack of fenders was associated with DNF due to problems from road spray.
- We found no consistent evidence that racing bikes are faster than fully-equipped bicycles in PBP.

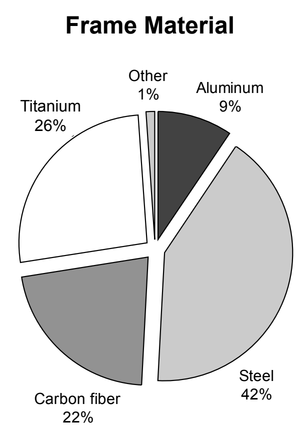
When checking for response bias, we found that RUSA riders who did not finish PBP were less likely to respond than those who finished, perhaps because they were less interested in revisiting their PBP experience. Also, PBP riders who subscribed to Bicycle Quarterly were more likely to respond than riders who did not subscribe to the magazine. We corrected for these biases in our analysis of the responses. After correcting our dataset, we checked the number of supported riders against the official rate of support among RUSA riders. Both are 13%, which bolsters our confidence that we have corrected successfully for response bias.

After tabulating the various equipment choices, we looked for relationships between a variety of equipment choices, riders' finishing times, and DNF rates. We checked these relationships for statistical significance.[3] Unless noted specifically, only statistically significant relationships are reported here.

Bicycle type

Most RUSA riders used upright bicycles. 6% of RUSA riders were on tandems. A few riders used recumbents. Steel was the most common frame material, followed by titanium and carbon fiber, with aluminum a distant fourth.

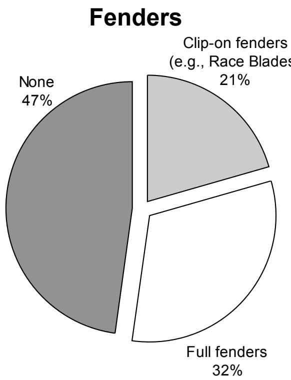


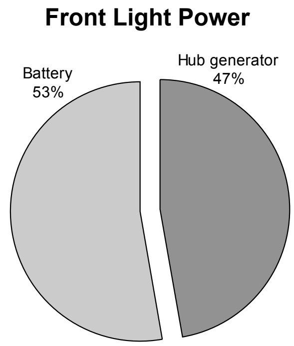


From tricycles to carbon fiber recumbents (background), riders in PBP 2007 used a large variety of equipment.

Fenders

A little more than half the riders used some type of fenders. The weather forecast predicted large amounts of rain for the ride, which may explain the number of riders with clip-on fenders. If the forecast had been for drier conditions, we suspect that fewer riders would have attached clip-on fenders to their bikes.





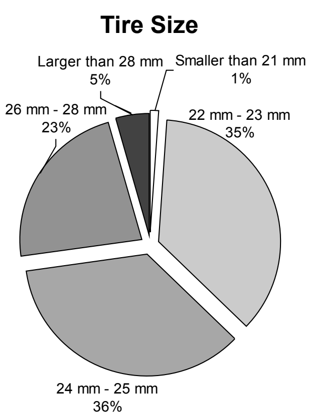
Lights

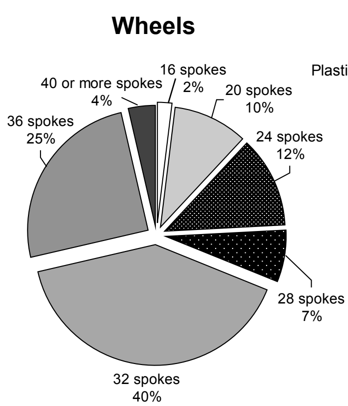
A little over half the riders used batteries to power their primary front lights, and the remainder used generator hubs. Sidewall generators were not used by any RUSA riders in our sample. Riders who used batteries replaced them 1.5 times on average. 19% never changed their batteries, suggesting that some modern battery-powered lights can provide enough run time for an entire 1200 km brevet. However, we did not ask whether these riders used multiple lights, switching from one to the next as the batteries drained.

Wheels

Despite the many rough roads encountered during PBP, most riders favored tires narrower than 26 mm. Only 4.5% used tires wider than 28 mm.

A majority of RUSA riders opted for standard wheels with 32 or more spokes, but one quarter used wheels with 24 spokes or fewer.



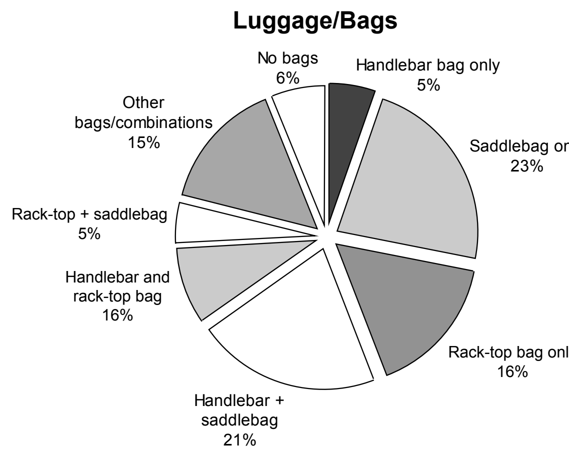


Luggage

The vast majority of riders used some type of luggage to carry the necessities of the road. Riders carried an average of 1.9 bags. More than half of the riders used a saddlebag, often in combination with other bags.

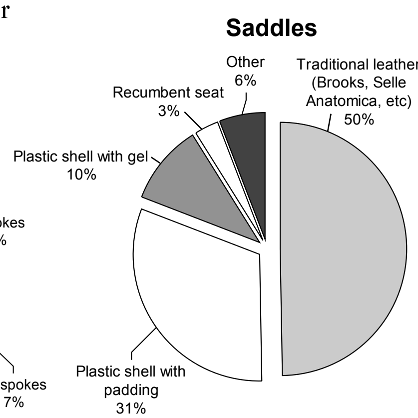
42% of riders used a handlebar bag, even though the bags are not easy to find in bike shops, and few bikes have a geometry that is optimized for them. Many combined the handlebar bag with a saddlebag, which often is used to carry heavy items, keeping the handlebar bag light and limiting its effects on the bicycle's handling.

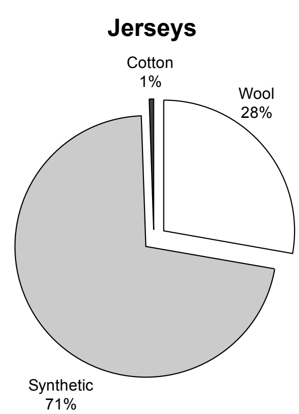
Panniers were used by fewer than 15% of riders. Almost half the riders used backpacks or hydration packs (not shown in chart).



Saddles and jersey material

In recent years, traditional materials have made a strong comeback in the areas of jerseys and saddles. In PBP 2007, half of the RUSA riders used a traditional leather saddle (Brooks, Selle Anatomica, etc.), and more than a quarter used wool jerseys.





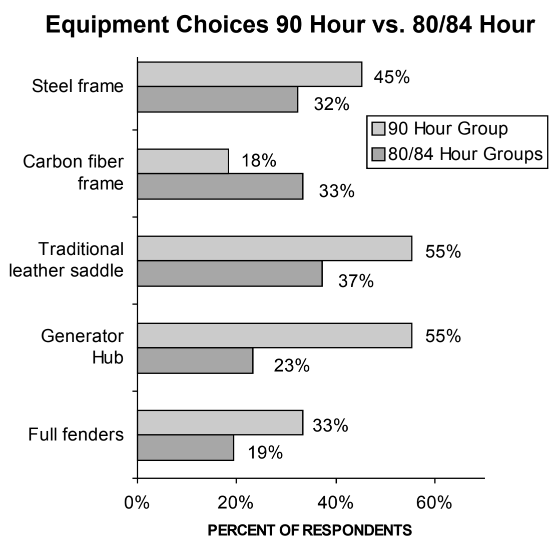
Three percent of RUSA riders used recumbents in PBP 2007. ▷

Experienced riders vs. novices

To check for differences between experienced riders and those new to randonneuring, we asked how many brevets 600 km or longer riders had completed in their lifetimes so far.[4] We found no significant differences in equipment choices or DNF rates between novices and experienced randonneurs.

Equipment differences for different start groups

Riders in PBP are given the choice of three time limits (80, 84, and 90 hours). Our survey found that the equipment used by the 90-hour riders differed somewhat from that used by the 80/84-hour riders. More of the 80/84-hour riders were outfitted in ways consistent with current racing practice. They used slightly narrower tires and were more likely to have a support crew. The chart below shows several other differences.



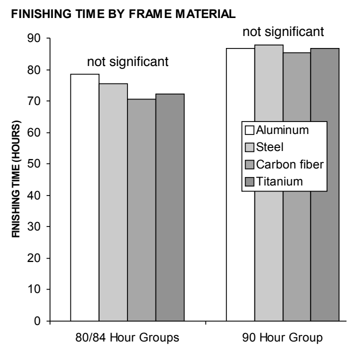
One might assume that the "racing" equipment used by the 80/84-hour riders is responsible for at least some of their speed. If that is the case, then riders who use this type of equipment should be faster than other riders, regardless of their start group. The next set of analyses tested those relationships.

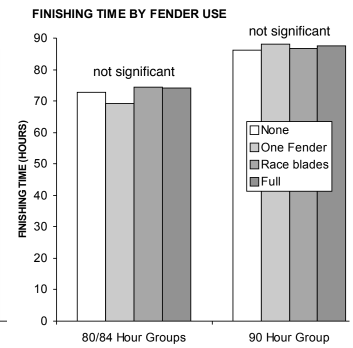
Are racing bikes faster?

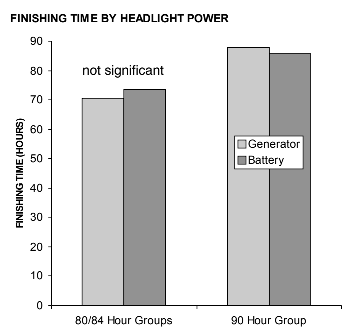
Various tests have shown that equipment choices do affect the on-the-road speed of bicycles. Generator hubs add resistance to the bike.[5] Most bags add aerodynamic resistance. Saddlebags and panniers are less aerodynamic than handlebar bags.[6] A numerical model of PBP predicted that a weight reduction of 1 kg (2.2 lbs.) would result in time savings between 7 and 20 minutes, a more aerodynamic position or aerodynamic wheels would each save about an hour. The biggest change predicted by the model was due to tire rolling resistance, with savings of between 2 and almost 10 hours between "fast" and "slow" tires.[7] Due to constraints on questionnaire length and other factors, our survey could not examine all such variables in detail. For example, we did not ask about the specific type of tires riders used.

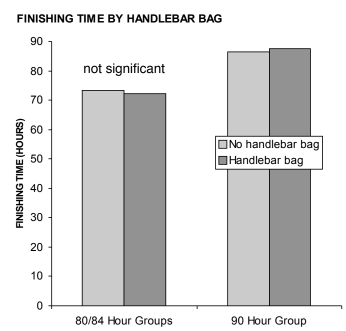
To determine whether we could detect relationships between equipment choices and the actual speed of randonneurs, we looked at relationships between riders' finishing times from the official PBP results and their equipment choices. Each start group was analyzed separately. The 80/84-hour riders in our sample took between 50:00 and 83:14 hours, and the 90-hour group took between 72:15 and 90:00 hours to complete the 1228 km of PBP.

After examining 14 equipment choices for 90-hour riders, we found four correlations with finishing times. Riders using generator hubs were slower than those with battery-powered lights, and riders who used handlebar bags were slightly slower than those without handlebar bags. Also, the more bags riders used and the more spokes their wheels had, the longer it took 90-hour riders to complete PBP (not shown in charts).









However, in the 80/84-hour groups, none of these factors were significant,[8] and the trends were reversed both for generator hubs and for handlebar bags. The 80/84-hour group may provide a better test of the effects of equipment because the riders are similar in their motivations: Most are trying to "do a time." Among these riders with similar goals, racing equipment was not correlated with faster times.

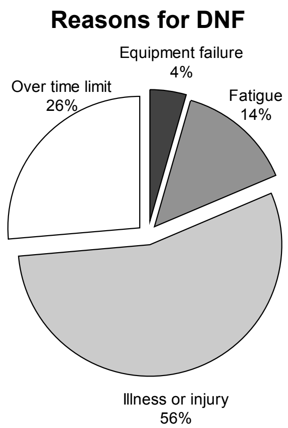
In the 90-hour group, where some of the equipment choices were significantly related to finishing times, riders are less homogeneous. Some riders' main goal is to finish within the time limit. These riders may be more likely to ride fully-equipped bikes with generator hubs. Other riders try to set a personal best. These riders may be more likely to mimic the equipment choices of 80/84-hour riders, favoring racing bikes and minimal equipment. We suspect that the speed differences in the 90-hour group are not due to the equipment itself, but due to the different goals between these two groups of riders.

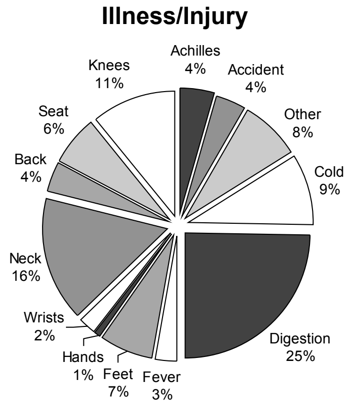
Individual performances may well change with equipment choice; however, the survey results suggest that factors other than equipment choices are more important. During PBP, small gains or losses in on-the-road speed are less important than time spent at controls. Most of the effects of equipment predicted by the numerical model of PBP were very small (a weight reduction of 1 kg would save less than 20 minutes). In contrast, various ride reports suggest that the average rider spends about 15-20 hours at controls.

Riders who did not finish (DNF)

Roughly 30% of RUSA PBP participants did not finish (DNF) the ride. The most common cause was illness or injury. Relatively few RUSA riders at PBP suffered from mechanical problems that made it impossible to continue. Three respondents could not repair a broken light. Two had problems with bearings, one each had problems with a wheel, tires, their chain and their frame.

Among those who suffered from illness or injury, the most common were digestive problems, followed by neck problems. Getting cold, in some cases even hypothermic, caused numerous randonneurs to abandon the ride.





DNF and equipment

To examine whether equipment choices affected DNF rates, we looked at the 90-hour group, since most DNFs occurred among these riders (see below).

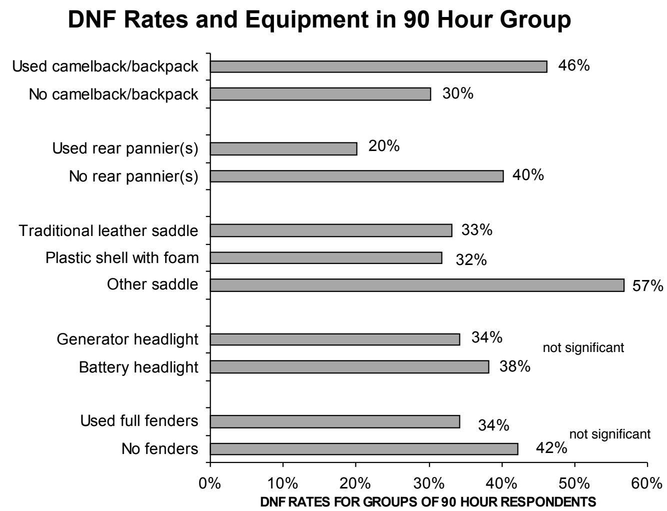
Almost half of the riders wearing a backpack/hydration pack did not finish the ride. The reasons they gave for the DNF primarily were "illness/injury" or "exceeded time limit," but among the illnesses/injuries, there was no clear correlation to a single body part. A backpack may increase the general strain on the body, rather than affecting individual body parts, or riders who use backpacks may also be likely to make other choices that increase their DNF rate.

Conversely, riders who used rear panniers had a very low DNF rate. We do not know why this was the case. The high finishing rate among riders with rear panniers does not appear to be simply a matter of bringing more equipment: Among all riders, there was no significant difference in the number of bags between the riders who finished and those who did not.

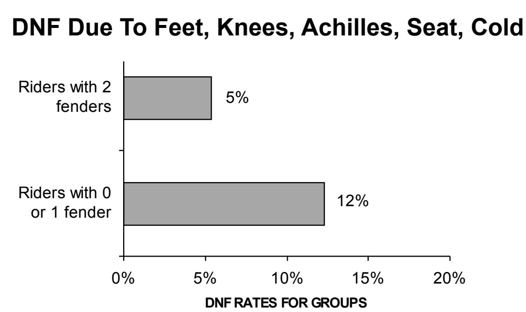
There were no differences in finishing rates between riders of upright bicycles with traditional leather saddles and modern racing saddles, but users of "other" saddles, mostly gel saddles, were almost twice as likely to DNF. However, few of these riders listed saddle problems as the reason for abandoning the ride. A variable that was not measured may be responsible for the relationship.[9] For example, it is possible that riders with less training were more likely to choose a gel saddle.

On average, riders who finished PBP used slightly wider tires than those who did not finish (not shown in chart). We found it interesting that of the four riders in our sample with tires narrower than 21 mm, only one finished the ride.

The differences in DNF rates between riders with generator- and battery-powered lighting were not statistically significant. The differences between riders with full fenders and those without fenders in the overall sample also were not statistically significant.



From the onset of this survey, we had planned to examine a specific set of problems that might be related to water spray from the wheels: problems with feet, knees, Achilles tendon, seat and overall cold/hypothermia.[10] In this more specific analysis, the differences were highly significant: Among riders with no fenders or only a single fender, 12.2% did not finish PBP due to one of these specific problems. Among riders with two fenders, only 5.3% did not finish the ride due to these problems, even though many of the riders with two fenders used clip-on fenders that provided only limited protection, and even though not all of these problems are attributable to road spray. This finding suggests that riders without fenders or with only one fender were more than twice as likely to develop problems due to road spray. If this interpretation is correct, then well-designed fenders could be a factor determining whether a significant number of randonneurs finish PBP or abandon the ride.



Among the four people in our sample who did not finish because of seat problems, none used a traditional leather saddle. Two used plastic shells, one used a gel saddle, and one used a recumbent seat. However, these numbers are too small to be conclusive.

Other reasons for DNF

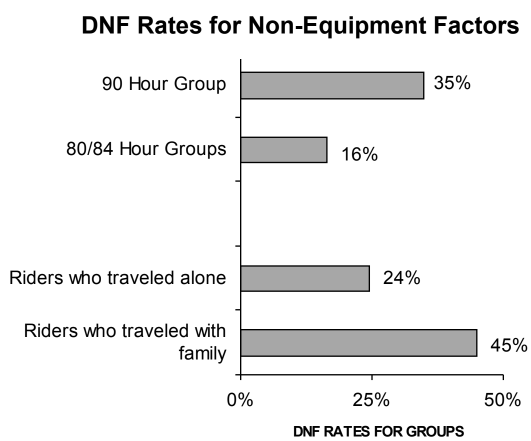
With the exception of the problems associated with road spray, certain saddles, and backpack/hydration packs, the relationships between DNF rates and equipment are either absent or so small that they cannot be detected (probably because other factors, such as training, mental conditioning, or random misfortune had much larger effects). However, we did find a few factors other than equipment that were related to the overall DNF rates.

Unlike in other editions of PBP with more favorable weather, the DNF rate was much higher among 90-hour riders than among 80/84-hour riders. In fact, the 80/84-hour riders had about the same DNF rate as in years with more favorable weather. It appears that the slower riders suffered disproportionately from the unfavorable conditions.

Most of the "excess" DNFs among the slower riders appear to have been due to injuries. It is possible that riders who were slowed by the weather conditions had to push harder than usual to keep ahead of the time limit. The combination of sleep deprivation and adverse weather conditions, experienced especially by slower riders, may have contributed further to the injuries that ended the ride of a relatively large proportion of the 90-hour riders.

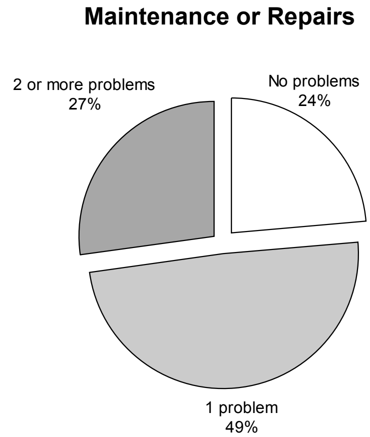
Faster riders had a larger "time cushion" that allowed them to ride slower when the conditions were less than optimal. They also spent less time in the difficult conditions.

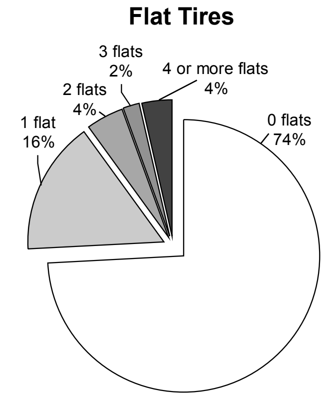
We also found that riders who were accompanied by their families in France had a much higher DNF rate. The reasons for this are not clear. Perhaps riders who combined PBP with a family vacation felt less compelled to continue under inclement conditions, whereas those who came to France with the sole purpose of riding PBP may have been more likely to press on. It is also possible that the distractions of having a family in Paris made it harder to rest and prepare mentally for the long ride. One can speculate about other reasons for this finding.



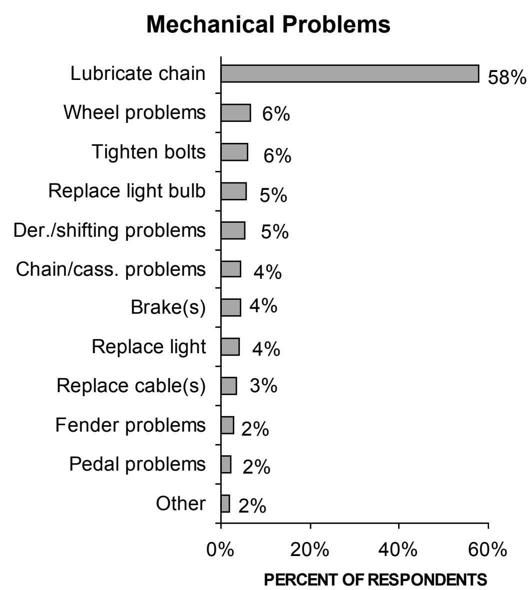
Bike problems

A ride over 1228 km of hilly roads with rough surfaces, in the rain, is probably the hardest test for road bicycles that can be found today. 76% of riders had at least a minor mechanical problem that required maintenance or repair. 27% had two or more separate maintenance or repair problems. Flat tires, on the other hand, were relatively rare: 74% of riders had no flat tires at all, and only 6% had three or more flat tires.





Among the mechanical problems, the most common were chains that required lubrication. Beyond that, smaller numbers of riders had problems with their wheels, lights, cassettes and derailleurs. Several randonneurs had to tighten bolts. Several serious failures occurred, including two broken cranks and one broken pedal spindle, thus affecting 1% of the 296 survey participants.



Lighting solutions included this custom-made front rack that carried two generator-powered headlights, but no bag. ▷

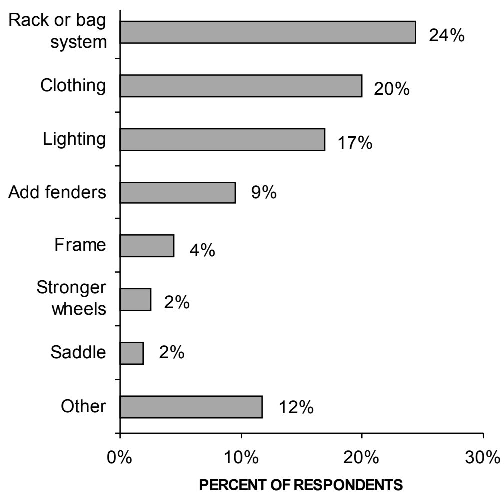
Did the equipment meet riders' expectations?

Only 37% of riders were completely happy with their equipment in PBP 2007. Experienced riders were just as likely as novices to be dissatisfied with their equipment. This suggests that riders are trying different equipment year after year without finding solutions that are fully satisfactory.

The complaints mostly pertain to the components that are specific to randonneuring. There were almost no complaints about derailleurs, brakes and wheels, indicating that the parts found on modern bikes have reached a high level of performance and reliability. The same cannot be said about racks, bags and lights.

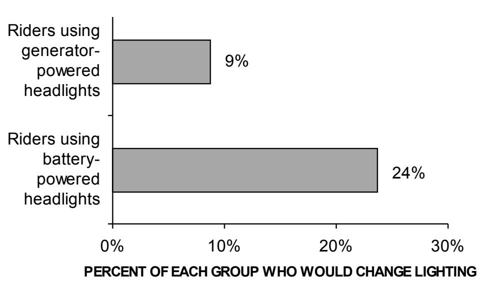
Almost a quarter of PBP participants would change their bag/rack system. Users of rear rack-top bags were the most unhappy with their bags: 33% would change their bag/rack system. Many riders also were dissatisfied with their clothing. Of those without fenders, about 18% would add fenders to their bikes. Contrasting this, only three riders (2%) in our sample who had fenders would remove them, if they were to do the ride again.

Changes Riders Would Make



Riders with battery-powered powered headlights were almost three times as likely to be dissatisfied with their lighting as riders with generator-powered headlights.

Riders Who Would Change Lighting



Few riders would change their saddle, indicating that most riders have found a saddle that is comfortable for them. Of the riders in our sample who would change their frames, about half want a lighter frame, whereas the other half would replace their carbon fiber bikes, presumably with something heavier. Perhaps these riders should swap bikes? One rider wants to change to a recumbent.

Conclusion

RUSA randonneurs use a variety of equipment. A "typical" randonneur bike does not exist. A few trends begin to emerge where randonneurs are diverging from "mainstream" cyclists: About half use traditional leather saddles, half use generator hubs, and more than a quarter wear wool jerseys.

Overall, randonneurs were not entirely satisfied with their equipment. Users of rear rack-top bags and battery-powered lights are likely to look for alternatives. Even experienced randonneurs commonly found their equipment to be unsatisfactory. However, users of generator-powered headlights and fenders were comparatively happy with these equipment choices.

The bike industry has achieved a high degree of performance among the "basic" functions of the bike (drivetrain, brakes, frames). For example, we found little evidence that wheels with few spokes (≤24) had more problems than "standard" wheels with 32 or more spokes. However, randonneurs are not satisfied with the "accessories" that are essential for their sport (bags, racks, lights, clothing). RUSA riders in PBP were able to fix most equipment problems they encountered on the road, but 4% were unable to finish PBP when their bikes stopped working properly.

For the most part, randonneuring is a sport where outcomes are determined by the riders and not by the equipment. Other factors appear to be much more important than equipment choices. Although riders without fenders were much more likely to have serious problems related to road spray during this rainy PBP, there are many individual riders who did not use fenders and finished PBP without problems.

These results are of interest not only to randonneurs, but to all riders who participate in long events. We found no consistent evidence that bikes with racing-oriented equipment provided a speed advantage over more completely equipped bicycles, among riders with similar goals. Considering this, it makes sense to use the bike that is most comfortable, most reliable, and that best protects the rider from rain and road spray. Unsatisfactory equipment can be a distraction, whereas a perfectly working bike can contribute greatly to the enjoyment of the ride.

Notes: This article was reviewed by Jane Swanson, Ph.D., Protected Areas Social Research Unit, University of Washington.

1 http://www.rusa.org/newsletter/02-04-07.html, status 11/1/2007, lists 29% for 1956 and 30% for 1961. Between 1966 and 2003, the DNF rates ranged between 10 and 22%.
2 Déon, B., 1997: Paris-Brest et Retour. Self-published. 397 p.
3 Statistical significance measures the likelihood that a particular result is due to chance alone. The standard criterion is that the obtained result would occur no more than 5 times out of 100, if chance alone were at work.
4 To reduce the influence of outliers, we compared the square root of this number with various factors.
5 Heine, J. and A. Oehler, 2005: Testing the Efficiency of Generator Hubs. Vintage Bicycle Quarterly Vol. 3, No. 4, p. 28.
6 Hale, J., J. Heine, M. Vande Kamp and A. Wetmore, 2007: The Aerodynamics of Real-World Bicycles. Bicycle Quarterly Vol. 6, No. 1, p. 1.
7 Heine, J., 2006: Randonneuring Basics, Part 3: How to Make Your Bike Faster. Bicycle Quarterly Vol. 5, No. 1, p. 42.
8 Statistical significance depends on the size of the observed difference, the number of observations collected, and the consistency of the observations. This explains why some small differences within the 90-hour group are statistically significant, while some larger differences in the 80/84-hour group are not.
9 However, patterns of relationships make some explanations much more plausible than others. A survey of this type cannot, technically, determine the causal relationship (or absence of causality) for any of the correlations we observed.
10 We combined these factors, because there were too few mentions of each individual factor to allow testing for statistical significance.