

Stairs of Saclay

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ABSTRACT

The Plateau of Saclay has a geographical specificity that cannot be found in any other student Campus in France. There is an altitude difference of almost 100 meters between the highest point of the Campus and the nearest subway station. To solve this issue, 2 paths were created to deserve the RER (city train) stations “Le guichet” and “Lozere”, each one using numerous steps and slopes.

The 2 adverse paths have created many debates and even a cultural war: what is the most pleasant and what is the one that hurts the most. This debate is most often not based on scientific evidences.

Introduction

Context

The two stairs are comparable on a wide variety of metrics, hence the endless debate on which is better. They both:

- are the only way to access the RER from a number of engineering schools (Telecom Paris, Centrale SUPELEC, ENS, ENSTA, Polytechnique ...)
- cross the protected park “Eugène Chanlon

These factors make them the only 2 viable ways to go from the Plateau to Paris’ Center.

For reference, here are the two alternatives side by side on google-maps:

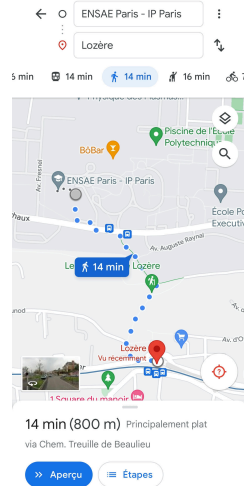


Figure 1: the google route for L

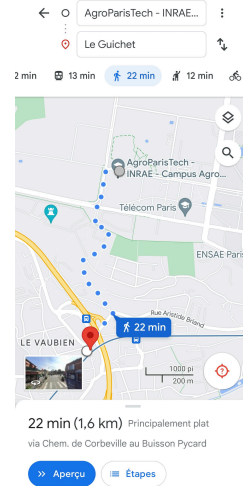


Figure 2: the google route for G

We can already notice some interesting facts:

- The Lozère path (L in the following) is a lot shorter than the Guichet (G). This is actually misleading, because the itinerary chosen by google maps is sub-optimal.
- They are labeled “Principalement plat” (french for mainly flat), which is a very imprecise approximation.

The more details paths are detailed later in this paper.

Questions

To best compare the two paths, a lot of questions have to be answered, on a wide variety of subjects:

- How do we rate the quality of the hiking experience for L and G ?
- Which one between L and G is most energy-consuming ?
- What is the risk of injury for each one of these paths ?

Goals

Here is a summary of the steps involved to answer the questions:

- choosing the geographical boundaries of the stairs
- measuring how the two stairs compare according to different sociological metrics
- creating an accurate model of the geometry of the stairs
 - evaluating the number of steps
 - measuring the steepness of the slopes of the two paths
 - gathering all other relevant geographical data
- evaluating the consequences of the 2 paths on health, in particular
 - risk of injury
 - energy-consumption

The 2 paths

The first difficulty of the study is actually to define what the paths are.

Do we take into account only the steps ? What about the steep slopes then ?

The choice was made to use the following criteria:

- the experience of “stairs” starts when you can see the first step
- it end when you reach the RER station and you can rest on a chair¹

Below are a detailed geographical explanation of L and G

Lozere

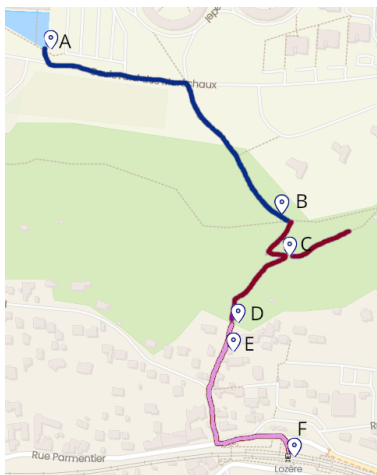


Figure 3: The L path

This is the detailed path between the station “Lozere” (F) and the nearest school “ENSAE” (A)

From highest point to lowest:

- $A \rightarrow B$: 435m walk
- $B \rightarrow C$: first half of the stairs
- $C \rightarrow D$: second, longer half
- $D \rightarrow E$: steep slope
- $E \rightarrow F$: more gentle slope

According to the preceding criteria, this study will focus on $B \rightarrow F$. It is known as the “Sentier Edmme François Jomard” or the “Sentier de l’école polytechnique” in the literature.

¹By theory of reciprocity, since they are steps visible from the RER station and benches at the top of the stairs, this definition is coherent)

Le guichet

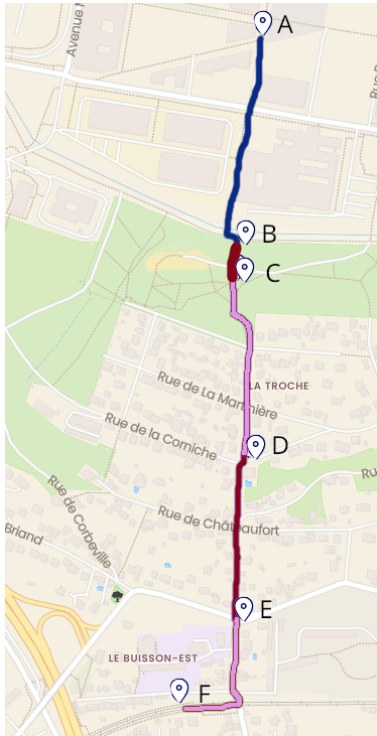


Figure 4: The G path

This is the detailed path between the station “Guichet” (F) and the nearest school “Agro Paris-Tech” (A)

From highest point to lowest:

- $A \rightarrow B$: 477m walk
- $B \rightarrow C$: first stairs inside the forest
- $C \rightarrow D$: walk inside the park
- $D \rightarrow E$: 2 consecutive stairs
- $E \rightarrow F$: gentle slope

Again, the study will focus on $B \rightarrow F$. It is also known as the “passage du buisson”

A sociologic study

First, the 2 routes are fairly different regarding their sociological influence on the inhabitants.

We will use a number of well-established metrics to compare L and G .

Accessibility

Bikes

Thank's to a special ramp and good signalitic, L has a great bike integration.



One-leg people

Unfortunately L lacks a guardrail between C and D , making it almost impossible for one-leg people to climb these stairs.

G does have a guardrail for each one of the stairs.

results

metric	<i>L</i>	<i>G</i>
distance from the nearest school	435m	477m
access for bikes	20%	0%
access for one-leg people	1%	0.00001%

Biodiversity

The two path share a great biodiversity, both between *B* and *D*.

results

metric	<i>L</i>	<i>G</i>
biodiversity score	70%	70%
number of bins in total	2	3
number of bins per kilometer	10	6

Design and signaletics

Signaletics

L

From the station to the end of the stairs, *L* has a very-high quality guidance.



There is even a line painted on the floor to guide the user.



G

In comparison, *G* does not have any indication on how to reach the Plateau from the station.

Light

Both routes have fairly good lighting, even in the middle of the night.

That said, G has an issue that can be considered a public health issue. The lights near point C never stop blinking, at a frequency of 3.5 Hz.

It is a major risk of epilepsy.

results

metric	L	G
number of signs near the station	4	0
user interaction score	90%	50%
number of lights	17	16
risk of epilepsy	0%	200%

conclusion

L is globally better integrated inside the territory of Palaiseau.

Unfortunately the only schools that benefit this access are ENSAE, ENSTA and Polytechnique.

All other schools are closer from G , which is why we can't compare them on that ground.

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In the following, we will assume the user is a student from Telecom Paris that is at the same distance from the start of L and the start of G .

A geometric study

Types of steps

L

In *L*, there are 3 different types of steps.



Figure 8: type of step between B and C

dimensions: 18cm x 30cm



Figure 9: another type of step near C

dimensions: 10cm x 55cm



Figure 10: type of step between C and D

dimensions: 10cm x 45cm

G

For *G*, there is one single universal type for the steps.



dimensions: 15cm*25cm

Geolocalisation

First, let's detail the position of each one of the points in spherical coordinates.

L

point	Latitude	Longitude	altitude (m)
B	48.7085°	2.21173°	157
C	48.708008°	2.211559	126
D	48.7074	2.21093	113
E	48.7068	2.2106	93
F	48.706	2.211	90

G

point	Latitude	Longitude	altitude
B	48.7103°	2.19416°	152
C	48.7110°	2.1952	148
D	48.70713747°	2.19531833°	94
E	48.7069°	2.19528°	89
F	48.7059°	2.19510°	77

Thank's to GPS, we were able to reconstruct the exact path with the corresponding altitude.

The path was taken from *A* to *F*, going down the stairs.

L

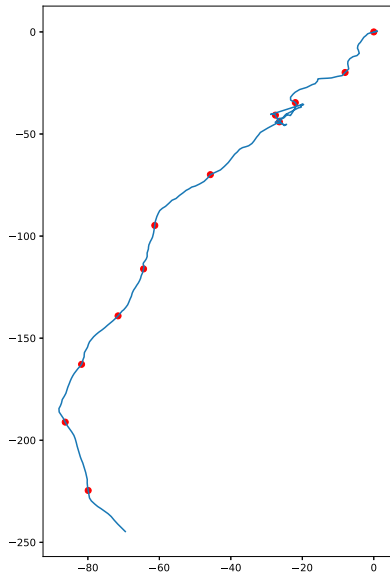


Figure 12: XY itinerary of the L route.
A red dot is 31s

G

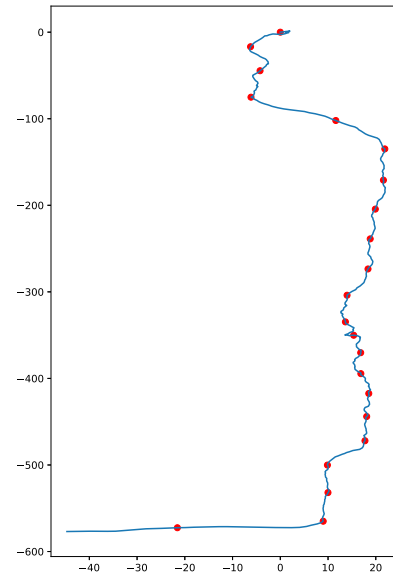


Figure 14: XY itinerary of the G route.
A red dot is 31s

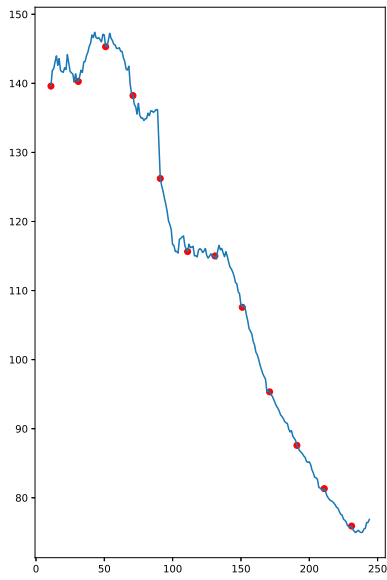


Figure 13: altitude of the L route.
A red dot is 37s

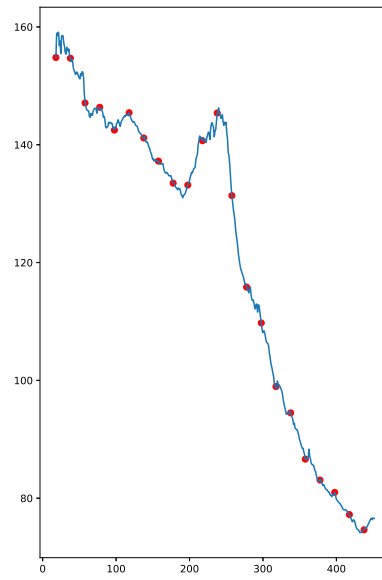


Figure 15: altitude of the G route.
A red dot is 37s

Number of steps

The number of steps with each one of the stairs is an endless debate.

Here is a compilation of different independent measurement by volunteers:

Lozere

$B \rightarrow C$	$C \rightarrow D$
198	94
198	?
197	93
197	?
197	94

average

$B \rightarrow C$	$C \rightarrow D$
197.3	93.5

Guichet

$D \rightarrow E$ (first part)	$D \rightarrow E$ (second part)	$B \rightarrow C$
157	170	?
157	171	39
157	169	39
157	?	?
157	169	39
158	169	39
157	171	39
157	169	39
157	169	39
157	169	?
159	170	40
155	170	39
157	169	39
157	169	39

$D \rightarrow E$ (first part)	$D \rightarrow E$ (second part)	$B \rightarrow C$
157.3	179.5	39.1

The computation of the standard error is left as an exercise to the reader.

Health factors

Energetic study

Thank's to myself and other courageous experimentators, we were able to time the ascent of the stairs.

The goal was to go from F to A

speed	time for L , (s)	time for G , (s)
walking rapidly	331	501
running	233	350

Considering that the efficiency of human muscles is around 25%, we can estimate the energy needed just to climb this height vertically.

We will take an example mass of 70kg for the calculation.

We know that work is $W = \frac{1}{\text{efficiency}} mg \Delta z$

	L	G
altitude difference	67	75
energy	47kcal	54kcal
average power	595W	452W

But the average power does not reflects the impact of this activity on the heart.

G is a lot more demanding because you climb 60m in a row, compared to 40m for L (see figure 13 and 15).

Risks of injury

On major risk that we investigated was the risk of sliding and falling during the descent.

This risk does not exists for G because of the universal anti-slip steps and the absence of steep slopes.

For L , the portion between D and E is very steep and slippery. We conducted the following experiment to understand to which extent.

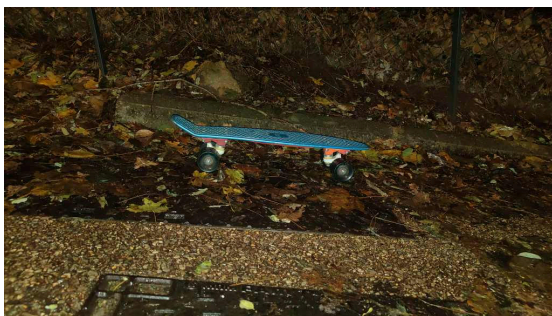


Figure 16: the initial position of the skate

We measured that the skate was able to go down the 17° slope for 21m in 4.96s, so an average velocity of 15km/h.

According to our calculation, if it rains, the friction between rubber and the floor would become equal to the friction of the skate wheels.

Very dangerous.

Conclusion

Please

never talk about stairs to me again.

Shut up and take the bus.