



# User Interaction Mining: Discovering the Gap Between the Conceptual Model of a Geospatial Search Engine and Its Corresponding User Mental Model

Dagoberto José Herrera-Murillo<sup>1</sup> (A), Javier Nogueras-Iso<sup>1</sup>, Paloma Abad-Power<sup>2</sup>, and Francisco J. Lopez-Pellicer<sup>1</sup>

<sup>1</sup> University of Zaragoza

<sup>2</sup> Spanish National Center for Geographic information

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# Outline

1. Introduction
2. Methodology
3. Results
4. Final remarks

# 1. Introduction

# Geographic Information Infrastructures (GII)

- Geographic Information Infrastructures are relevant examples of **Open Data ecosystems**
- The success of a GII depends greatly on the effectiveness and efficiency of their **catalog and geospatial search engines**
- The design of a geospatial search engine should be **user-driven**
- A user-centric open data platform requires UI/UX research, design and testing methods where the user interacts with the platform in **realistic usage scenarios**

Scenario in a typical geospatial search engine

The screenshot shows the 'Información Geográfica de España' website. The search bar contains 'herrera' and shows 1407 results. The results list includes:

CATEGORÍAS	MTN 25	Result
Cartografía General (459)	MTN 25	MTN25 - Hoja 0439-3 Herrera de los Navarros
Conjunto de Datos (250)	MTN 25	MTN25 - Hoja 0439-4 Venta de Herrera
Poblaciones (2)	MTN 25	MTN25 - Hoja 0756-1 Herrera del Duque
Imágenes Aéreas y de Satélite (48)	MTN 25	MTN25 - Hoja 0165-2 Herrera de Pisuerga
Cartografía Temática (457)	MTN 25	MTN25 - H...
	MTN 25	MTN25 - Hoja 0790-1 La Herrera

The map on the right shows the location of Herrera, with a search bar 'Buscar en esta zona' and various map controls.

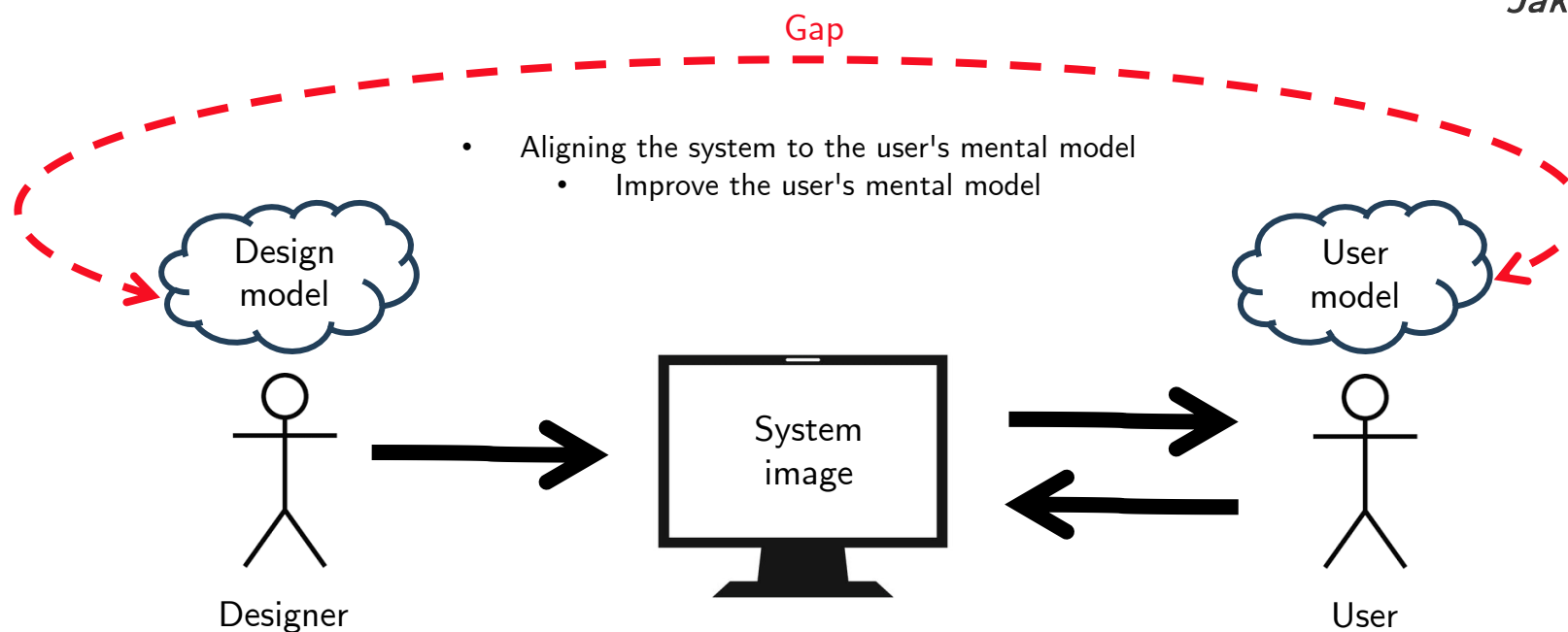
Has it been correctly designed?

# Objective of this work

- We want to identify potential **mismatches** between the mental models of various user groups and the conceptual model of the designers of a data portal
- Mental models: one of the key concepts of UX design

"A mental model is what the user believes about the system at hand"

*Jakob Nielsen*



Source: Norman, D.A.: The Design of Everyday Things. Basic Books, New York City (2002)

# Visual metaphor



**Design  
model**

**User  
model**

Source: van der Aalst. (2012). Process Mining How are my systems used and when do they fail?  
<https://processmining.org/old-version/files/bc2012es-process-mining-wvda.pdf>

# Our proposal

- Design a method to identify the potential **mismatch** between the conceptual model of designers and the conceptual models of users

Data portal managers can improve the user experience by aligning or complementing mental models

- A method based on **usability evaluation**

Representative users perform a search task in a think-aloud session guided by a moderator

- **Use case** to test its feasibility

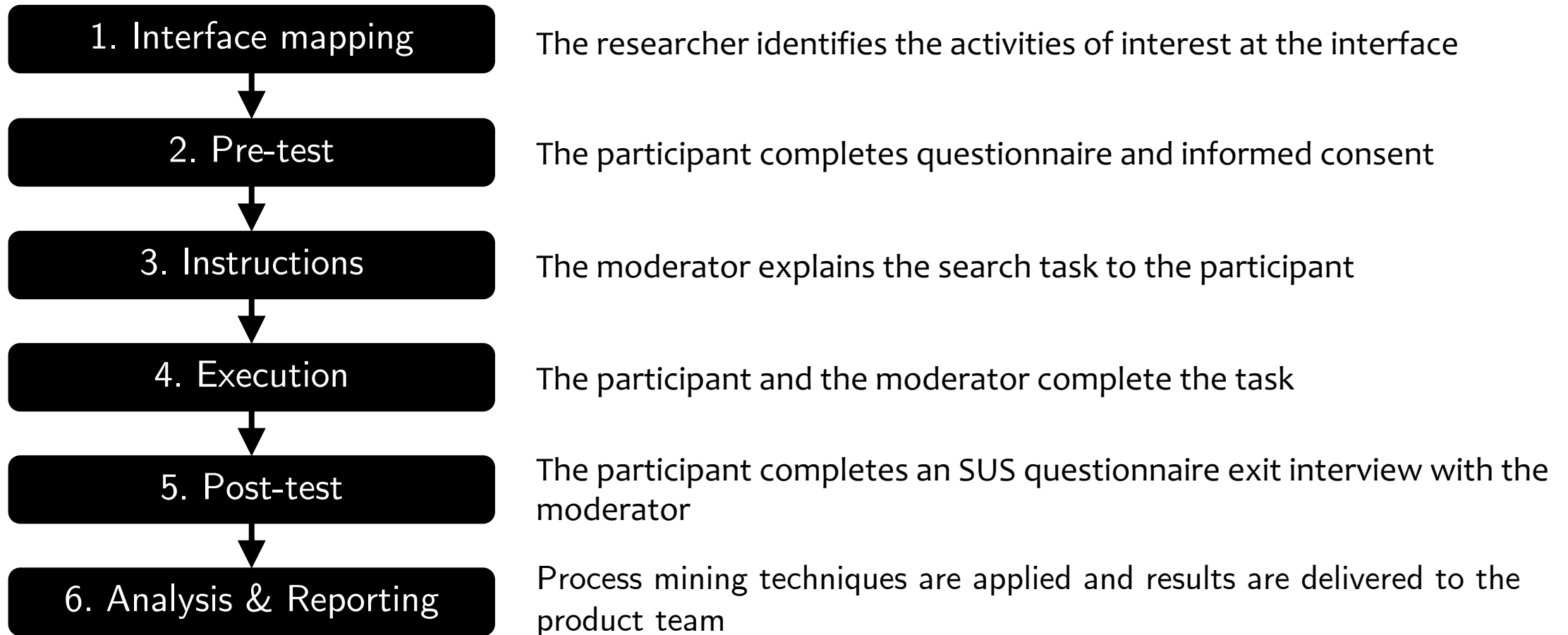


The new geospatial search engine developed by the Spanish National Geographic Institute

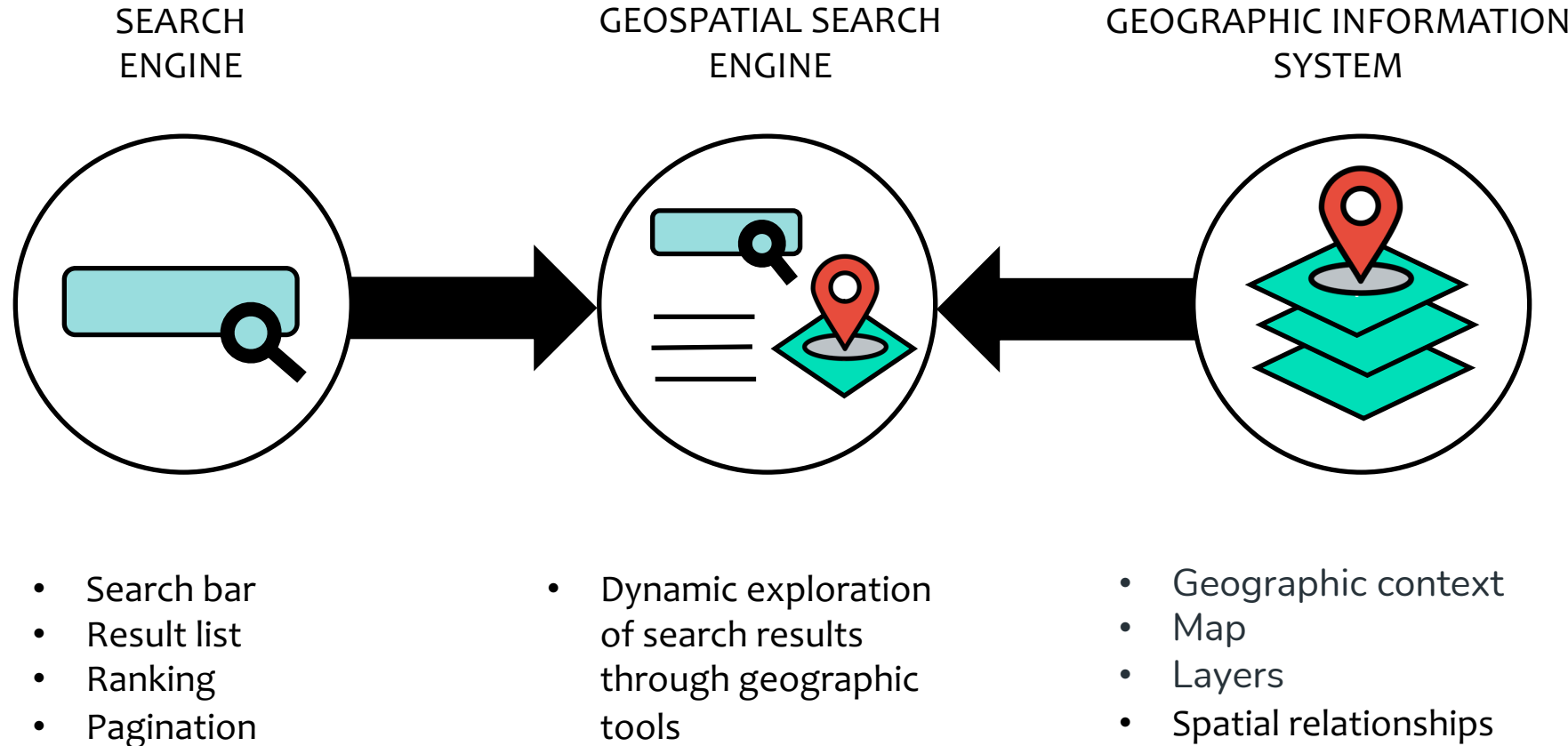
# 2. Methodology



# Workflow

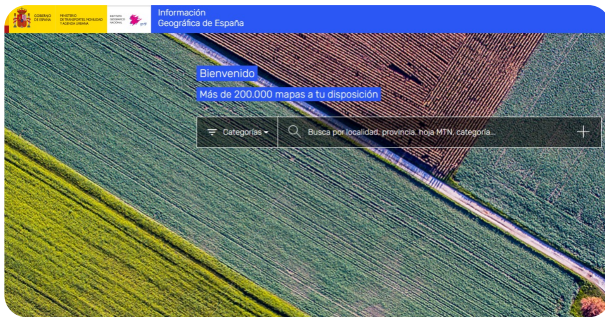


# Conceptual model of the geospatial search engine

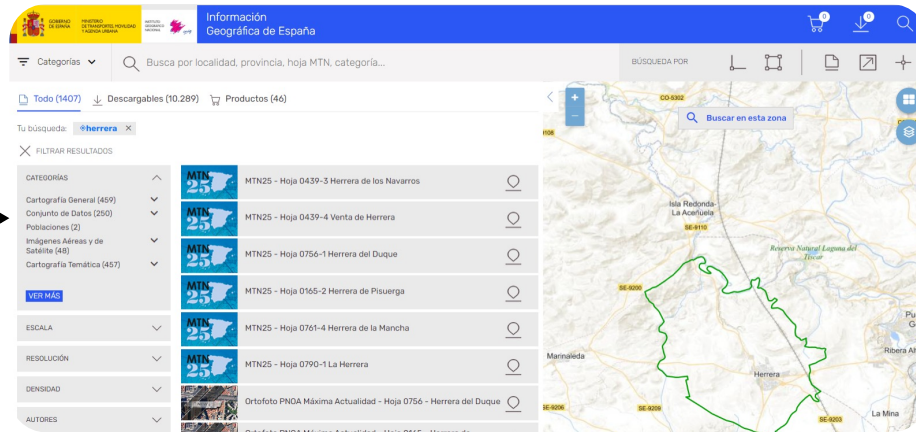


# Mapping activities through the geospatial search engine

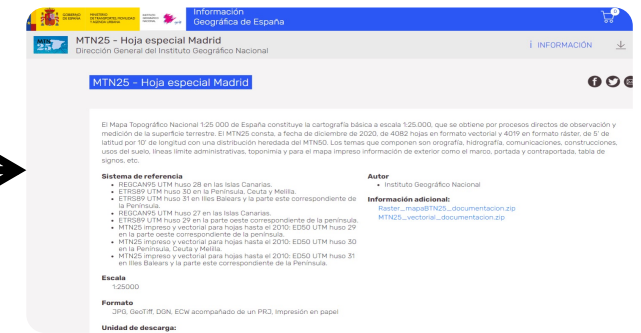
## QUICK SEARCH



## ADVANCED SEARCH & RESULTS



## METADATA



Filter  
Text search

View  
Filter  
Download  
Text search  
Locate  
Map exploration

Buy  
Geometry search  
Point search  
File search  
Cadastral search  
Coordinate search

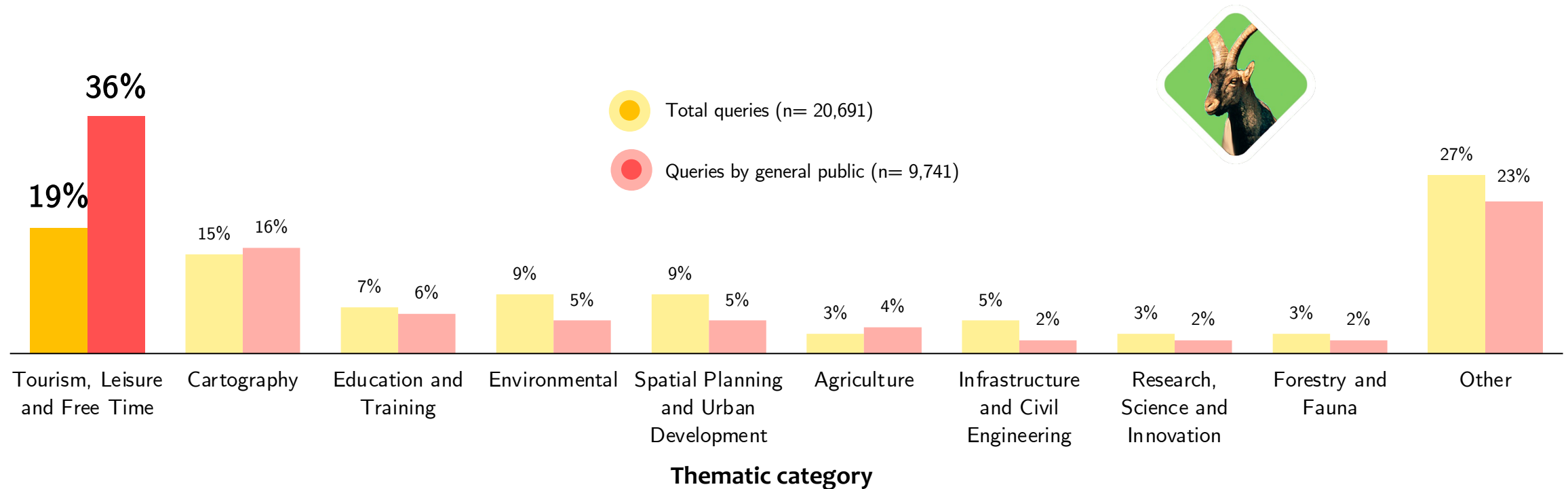
Download  
Locate  
Buy

# Participant demographics, n (%)

	Novice users	Expert unfamiliar users	Expert familiar users	All
<b>Gender</b>				
Male	4 (57%)	3 (43%)	4 (57%)	11 (48%)
Female	3 (43%)	4 (57%)	3 (43%)	10 (52%)
<b>Age</b>				
18-24	1 (14%)	- (0%)	- (0%)	1 (5%)
25-34	1 (14%)	2 (29%)	2 (29%)	5 (24%)
35-44	- (0%)	1 (14%)	2 (29%)	3 (14%)
45-54	3 (43%)	4 (57%)	3 (43%)	10 (48%)
54-65	2 (29%)	- (0%)	- (0%)	2 (10%)
<b>Education</b>				
High School	1 (14%)	- (0%)	- (0%)	1 (5%)
Graduate	5 (71%)	3 (43%)	7 (100%)	15 (71%)
Postgraduate	1 (14%)	4 (57%)	- (0%)	5 (24%)
<b>Total</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>21</b>

# Search task representative of intended use

"This Christmas, you are planning to visit the **Sierra Nevada National Park** and you require information about the area. Your objective is to use the search engine to find resources that will enhance your understanding of the region. Find information about the park, download files, or add products to your cart that you consider valuable for your trip".



Source: Enquiries received through the CNIG general mailbox Oct 2021- Oct 2022

# Analytical toolkit



PM<sub>TK</sub>

State-of-the-art process mining

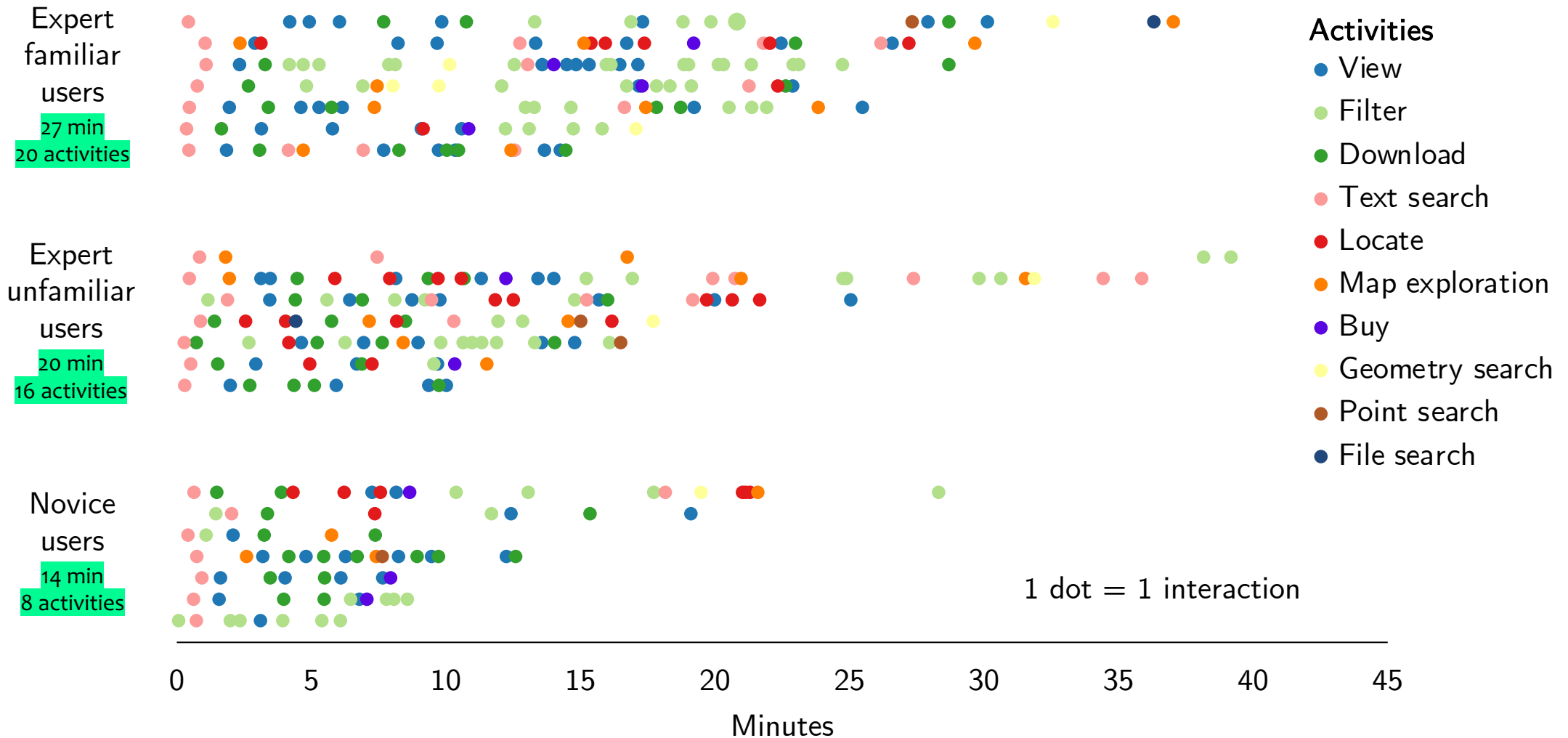
<https://pm4py.fit.fraunhofer.de/>

PM4PY

<https://pmtk.fit.fraunhofer.de/>

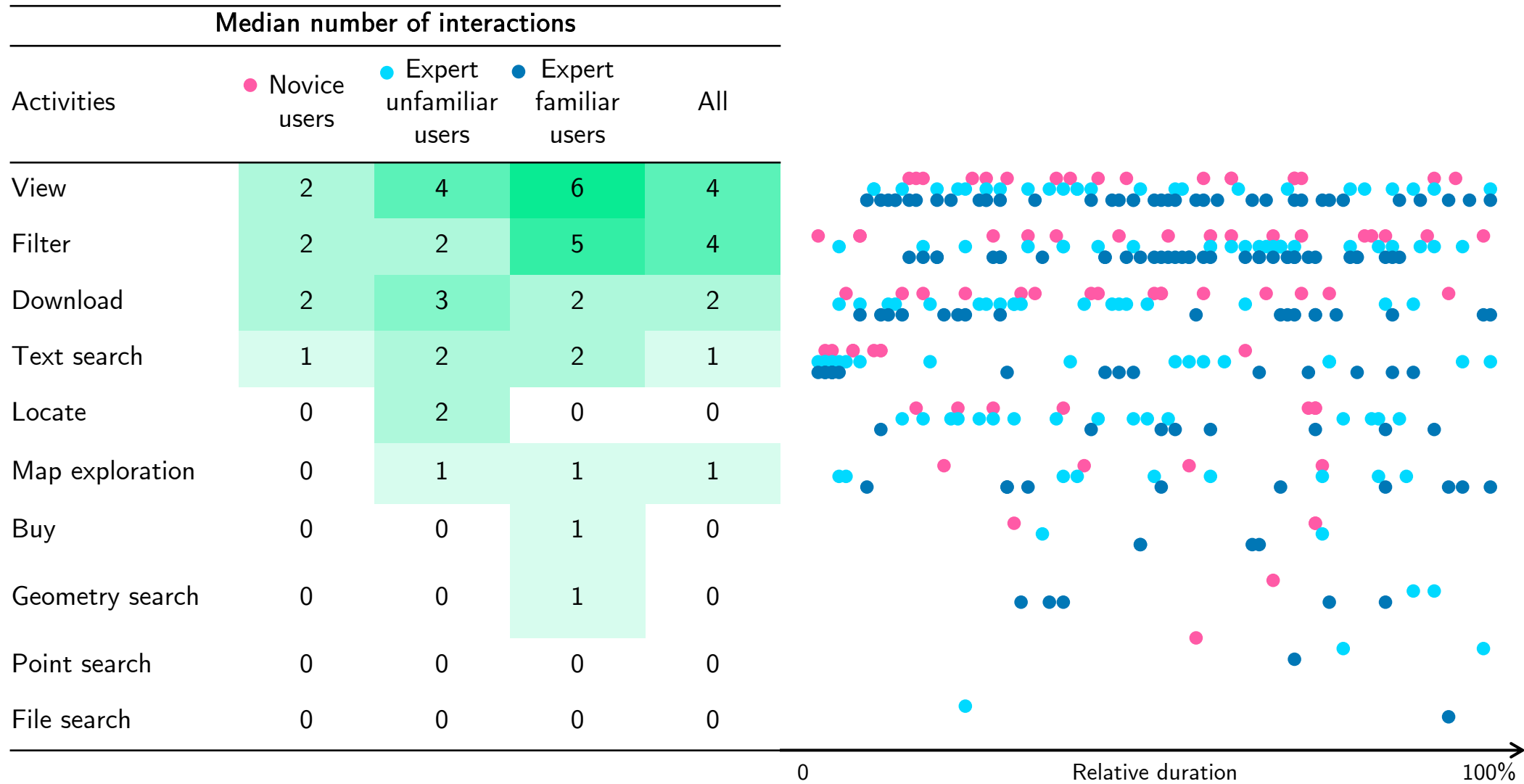
# 3. Results

# Novice users reported shorter sessions and fewer interactions



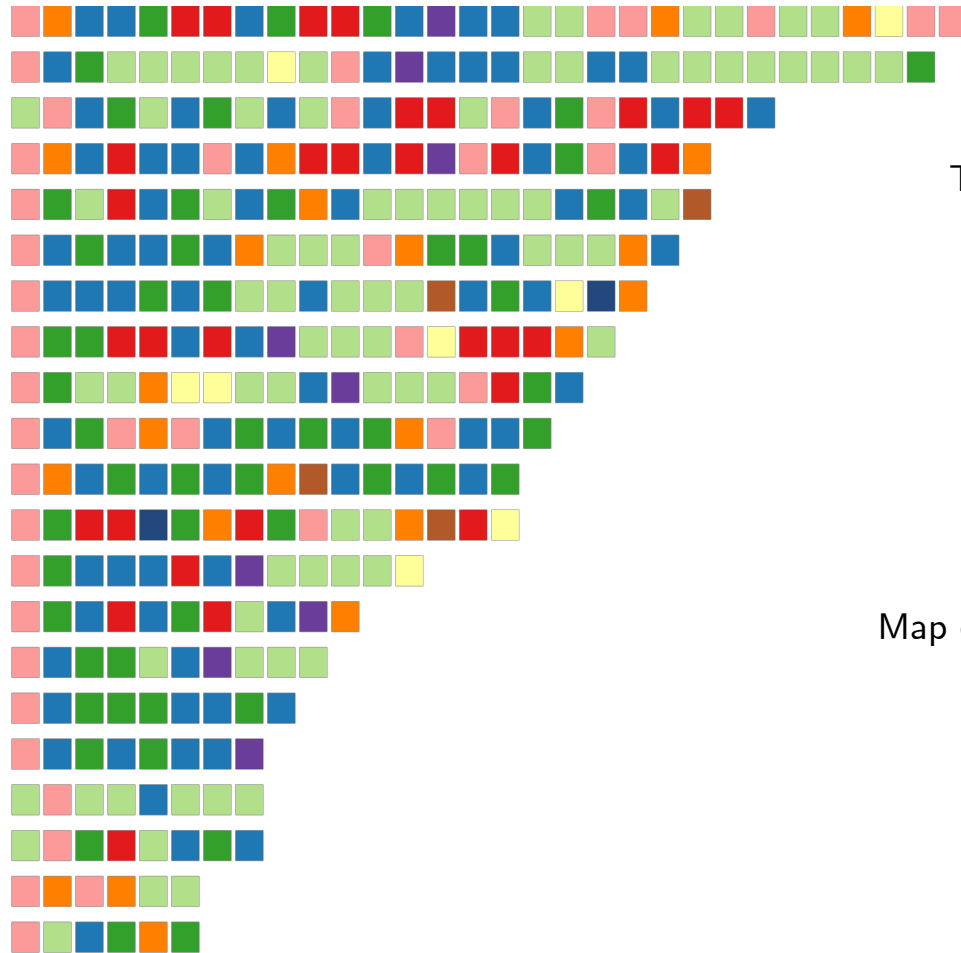


# A standard user "ignores" the engine's geographic tools



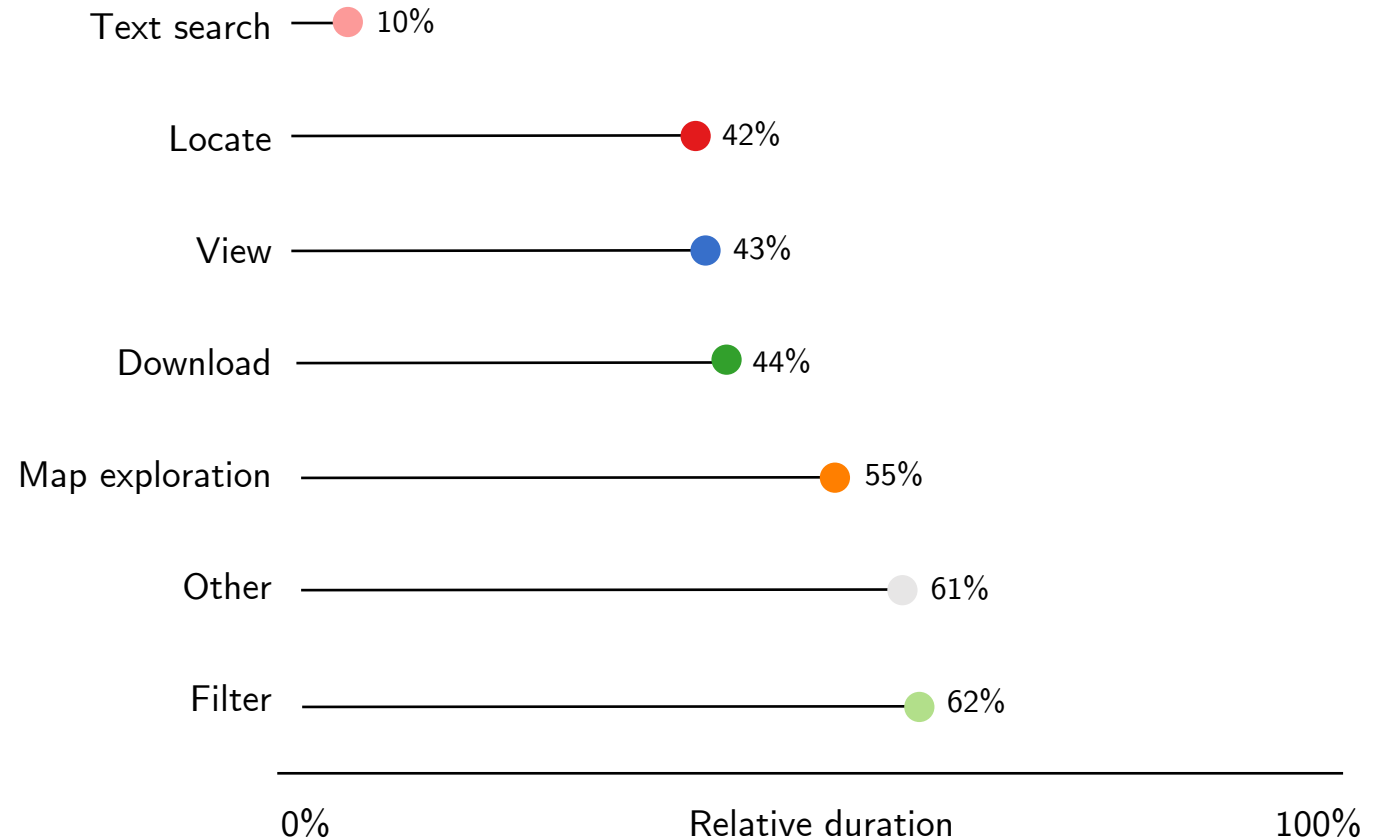
# "Rage clicks" revealed that **filtering** requires adjustments

## Variants



1 frame = 1 interaction

## Median expected time of occurrence



# 4. Final remarks

# Key takeaways

- Opinion surveys are not enough!
- Interaction studies allow us to delve deeper into the **WHYs**
- Process mining tools are useful for analysing user behaviour

## Limitations!

- Small sample size
- Moderator effect
- Search task bias

# Challenges and Future Work

An open discussion on the development of user-intensive methodologies for IU research, design and evaluation.

- Tools for modelling mental models
- Test automation
- Conformance checking
- Personalised interfaces based on usage patterns



# THANK YOU FOR YOUR ATTENTION AND QUESTIONS!

## KEEP IN TOUCH!

ODECO: Towards a sustainable  
Open Data ECOSystem

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