

A COGNITIVE APPROACH FOR INNOVATIVE SKI MAP DESIGN:

THE FRENCH ALPS CASE STUDY



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Ski maps: a user-centred approach

MEMory, COgnition and MOdelling the mountain

The MECOMO Project

Overall issue

In France, for over 40 years **mountains operators** have been providing a representation of GI through artistic creation of panoramas and ski maps.

They are at a turning point : paper ski maps no longer meet the needs of a large part of the **skiers**.

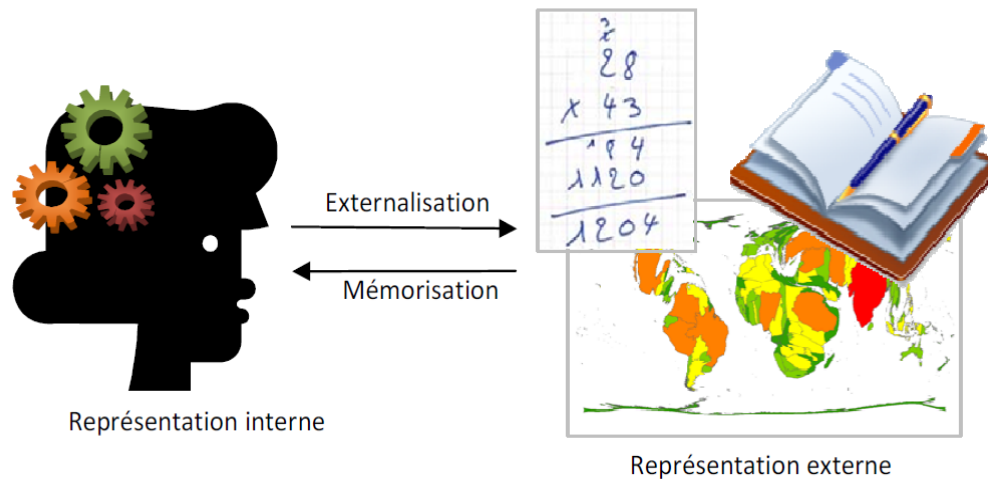
In order to respond more adequately to the new practice in winter sports, they need innovative efficient representation of the geographic information in mountain.



✓ asses the effectiveness of panoramic maps

Research questions of the study

1. What geographic information (and its representation) make ski paper maps effective to perform a user-skier's task?
2. What is the impact of (the paper representation of) mountain local distortion on user-skier's comprehension?



Chabris et Kosslyn, 2005

Mental representations refer to the natural and anthropogenic elements (objects) depicted in the ski map.

An **object** describes the temporary grouping of a collection of visual features together with other links to verbal-propositional information (Ware, 2008).

Methodology

To answer to the research questions, an **empirical experiment** was set up:

A. To study the *expert knowledge* and practices → « **messy data** » to understand how knowledge is represented, organized and structured (Chi, 2006).

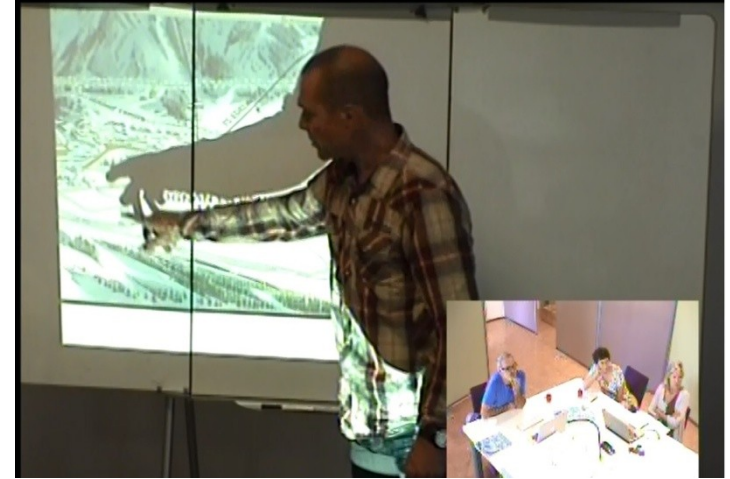
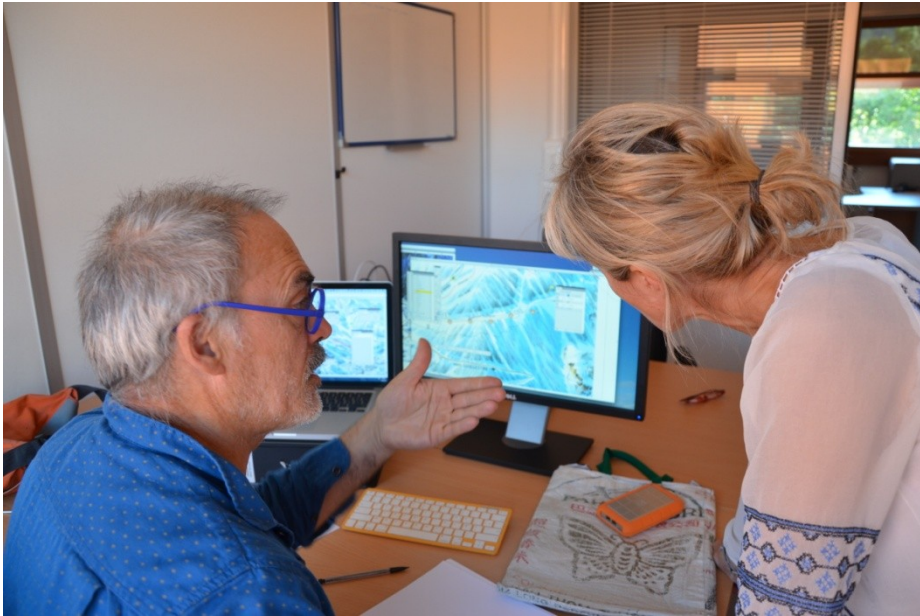
B. 1. To study of *user-skier's knowledge and heuristics* → **verbal data** collection and analysis according techniques (Chi, 1997) and (Ericsson, 2006).

2. To study of *user-skier's visual attention* → **gaze data** with eye-tracking techniques which consist in recording human eye movements (Ware, 2008).

3. To identify *common trend* in a range of similar settings and populations (Libarkin et Kurdziel, 2002) → Large scale audience, through an **on line survey**.

C. To compare provided and handled information

A. The study of expert-artist activity: messy data analysis



Source : MECOMO project, 2015

Participant: Arthur Novat, CEO of the company Atelier Novat

Modalities: AN was interviewed in "ecological conditions" according to thinking-aloud and explanation techniques during 3 hours and 20 minutes.

Material: AN could use color pencils, paper, ski plans archives from "Atelier Novat" and a PC.

Data: A set of "messy data" (sketches, diagrams, videos and audio recordings) was collected (Chi, 2006). Video-audio recording of the interview was transcribed.

B. The study of user-skier activity

1. Verbal data analysis



Villard ski trails maps, made by Atelier Novat



Alpes d'Huez ski trails maps, made by Atelier Novat

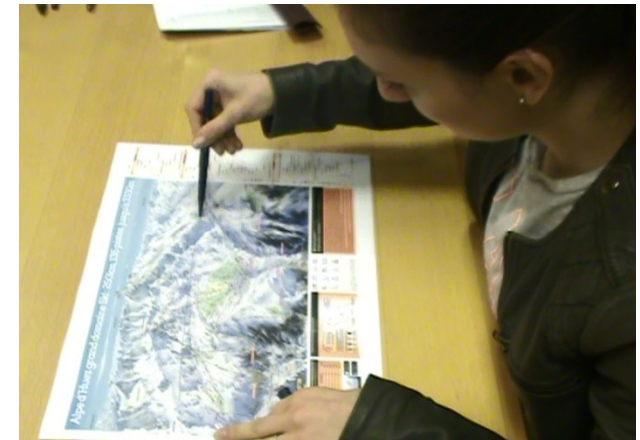
Participants: 20 subjects, between 18 and 65 years old, 12 women and 8 men.

Modalities: “controlled conditions”.

Semi-structured interviews to perform tasks (location, way-finding, decision-making), according to thinking-aloud and explanation techniques.

Material: paper ski maps in real formats and felt pens.

Data: about 15 hours of video-audio recording were transcribed, sketches, drawings.



Subject during the interview

Preliminary results

Analysis from verbal data and from sketches led to qualitative results.

1. the identification of rules in expertise procedure and user practice
2. graphic objects organized in taxonomy of conceptual categories
3. information arising from the graphics

Pierre Novat main procedure rules for making ex-novo ski plans

Code	Task	Code	Action
T0	Demands	T00	analyse marketing demands
		T01	create an overall view of the area
		T02	<i>devise : mental deformation</i>
T1	Design	T10	read and interpret the general staff maps or IGN maps
		T11	<i>built mental deformation</i>
		T12	take aerial and ground photographs
T2	Penciled production	T20	draw: copy the mountain features from photos
		T21	define focal point
		T22	structuring the plan
		T23	<i>deform : spin, stretch, reduce</i>
		T24	validate with the sponsor
		T25	add ski lifts trails
T3	Graphic production	T30	draw : set up colors
		T31	validate with the sponsor
		T32	make photos output
T4	Slopes and trails overlay	T40	trails drawings
		T41	overlay films trails

Generic rules in practice of ski maps

Basic rules for ski map using procedure

Code	Task	Code	Action
E1	Get start	E11	define a departure point
		E12	define a point of arrival
E2	Define itineraries	E21	assess the landscape and pleasant places
		E22	assess the difficulty of the ski runs, length and capacity of ski lifts
		E23	find networks connections
		E24	find break places
		E25	find panorama places
E3	Decide of the return pathway	E31	find easy ways to get to the starting point

Mainly rules for making ski plans from Pierre & Arhur Novat activity

Arthur Novat main procedure rules for modify ski plans

Code	Task	Code	Action
T0	Demands	T00	analyse marketing demands
		T01	enlarge an area or a zone
T1	Design	T10	read and interpret the general staff maps or IGN maps
		T11	<i>devise</i>
		T12	analyze Google Earth
T2	Make changes	T20	draw: make a sketch
		T23	<i>deform : spin, stretch, reduce</i>
		T24	validate with the sponsor
T3	CAD drawing	T30	draw : duplicating some parts of terrain
T4	Slopes and trails overlay	T40	trails drawings

Preliminary results

Analysis from verbal data and from sketches led to qualitative results.

- 1. the identification of rules in expertise procedure and user practice
- 2. graphic objects organized in taxonomy of conceptual categories
- 3. information arising from the graphics

- 1.1 Domain boundaries
- 1.2 Sunlight exposure, orientation (shadows contrast)
- 1.3 Focal point

1. Geography

- 3.1 Colored ski runs
- 3.2 Ski runs geometry
- 3.3 « Green » areas
- 3.4 Ski lift

3. Tracing

- 2.1 Terrain profile
- 2.2 Peaks and ridges
- 2.3 Slopes (stiff, craggy ...)
- 2.4 Corridors
- 2.5 Hollows, combes
- 2.6 Rocks, cliffs
- 2.7 Fir trees
- 2.8 Snow and ice (hues variance)

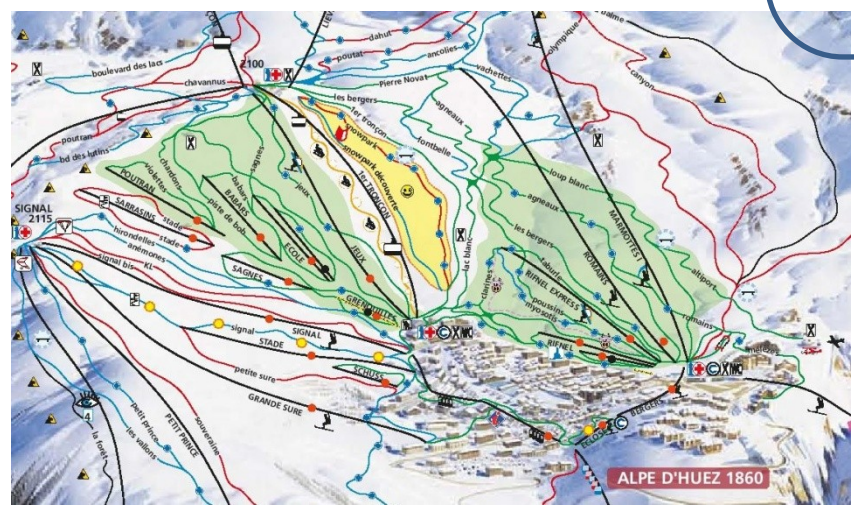
2. Geomorphology

- 4.1 Pictograms
- 4.2 Buildings
- 4.3 Roads

4. Structures

- 5.1 Names of the ski runs
- 5.2 Names of the ski lift
- 5.3 Elevation values
- 5.4 Toponyms

5. Nomenclature



Preliminary results

Analysis from verbal data and from sketches led to qualitative results.

1. the identification of rules in expertise procedure and user practice
2. graphic objects organized in taxonomy of conceptual categories
3. information arising from the graphics

1. GEOGRAPHY				
Graphics	Expert	Skiers by ski level		
		C1	C2	C3
1.1 Domain boundaries	Overview, scope	Overview, scope	Overview, scope	Overview, scope
1.2 Orientation and sunlight exposure, (shadow contrast)	Give sham exposure (east-west)		Look for real orientation	Look for real orientation
			Estimate snow quality	Estimate snow quality
1.3 Focal point	Center of the picture	Center of the ski resort	Center of the ski resort	Center of the ski resort

3. TRACING				
Graphics	Expert	C1	C2	C3
3.1 Colored ski runs	Indicate difficulty level	Indicate difficulty level	Indicate difficulty level	Indicate difficulty level
3.2 Ski runs geometry	Show curving traces		Understand network organisation	Understand network organisation
			Estimate dimensions	Estimate dimensions
3.3 « Green » areas		Indicate quality level	Indicate quality level	
3.4 Ski lift	Give realistic proportions and distances	Look for directions and connections	Look for directions and connections	Look for directions and connections

Comparing
the information the artist-expert intends to convey
and
the information that is interpreted by a skier.

Preliminary results

Decision making in a discovery approach of a ski area,
is not without hesitancy among skiers.

Difficulties may be manifested by misunderstanding, uncertainty, inconsistency and illegibility about representations.

1. GEOGRAPHY		
Graphics	Intermediate/C2 Verbatim	Advanced/C3 Verbatim
1.2 Orientation and sunlight exposure (shadow contrast)	<i>"This is something that is not always easy to see on these maps. I do not know if the North is up, but on a ski map I have no idea"</i>	<i>"What is the majority of the exposure? I do not know how it is exposed ... "</i>
	<i>"Here I concretely do not know where I am"</i>	<i>"Depending on the orientation of the sun to enjoy the morning, I deduce it a little with the slopes, I will say that the North is there ... But I have no indication"</i>

Preliminary results

Decision making in a discovery approach of a ski area,
is not without hesitancy among skiers.

Difficulties may be manifested by misunderstanding, uncertainty, inconsistency and illegibility about representations.

From a total of 55 expressions of difficulties	
geomorphology	30.9%
tracing	27.3%
structure	18.2%
geography	16.4%
nomenclature	7.3%

B. The study of user-skier activity 2. Gaze Data Analysis

Participants: 10 subjects, between 25 and 55 years old, 5 women and 5 men.

Modalities: “controlled conditions”.

Semi-structured interviews to perform 2 tasks (exploration, way-finding), according to thinking-aloud techniques.

Gaze data collection and analysis according to mobile eye-tracking techniques (Kiefer, 2014).

Material: paper ski maps in real panel formats. Tobii Pro Glasses 2 Eye Tracker.

Data: total recording of 3036 video frames for T1 and 2120 for T2. 60 minutes of total video-audio recordings.



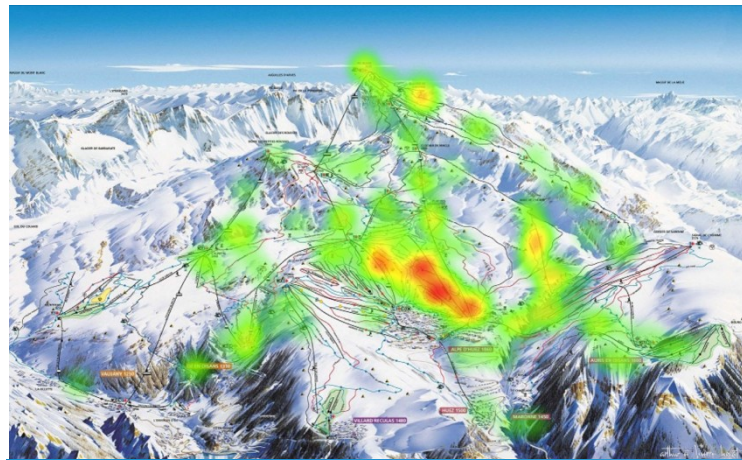
Subject during the eye-tracking experience

Preliminary results

Analysis from gaze data led to **qualitative results**

HEAT MAPS

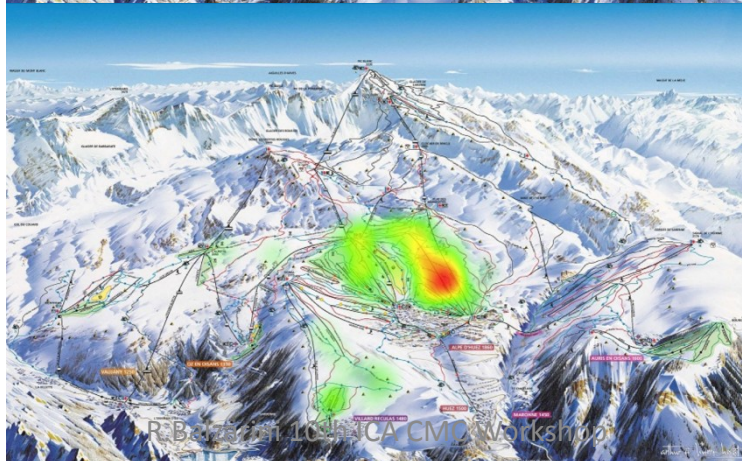
Task 1 : exploration



advanced



intermediate



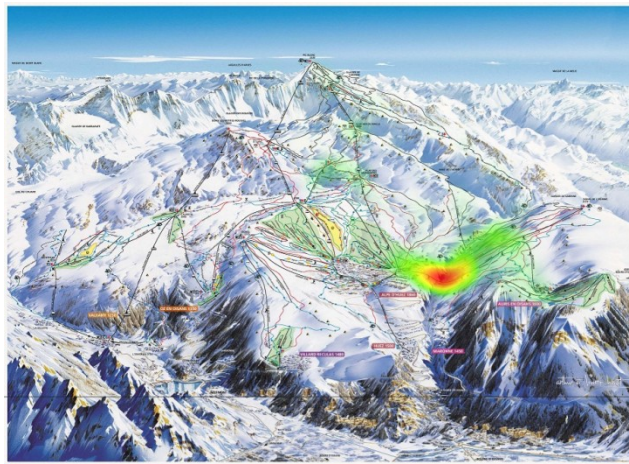
novice

Preliminary results

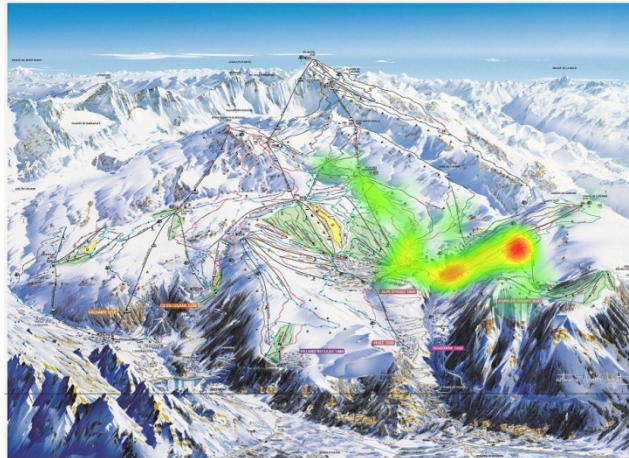
Analysis from gaze data led to **qualitative results**

HEAT MAPS

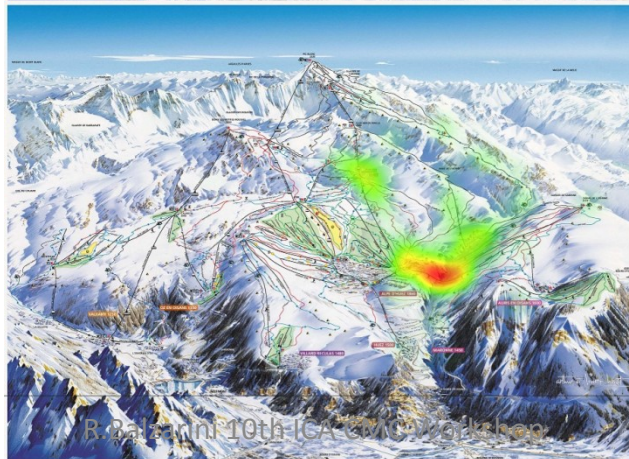
Task 2: way-finding



advanced



intermediate



novice

Preliminary results

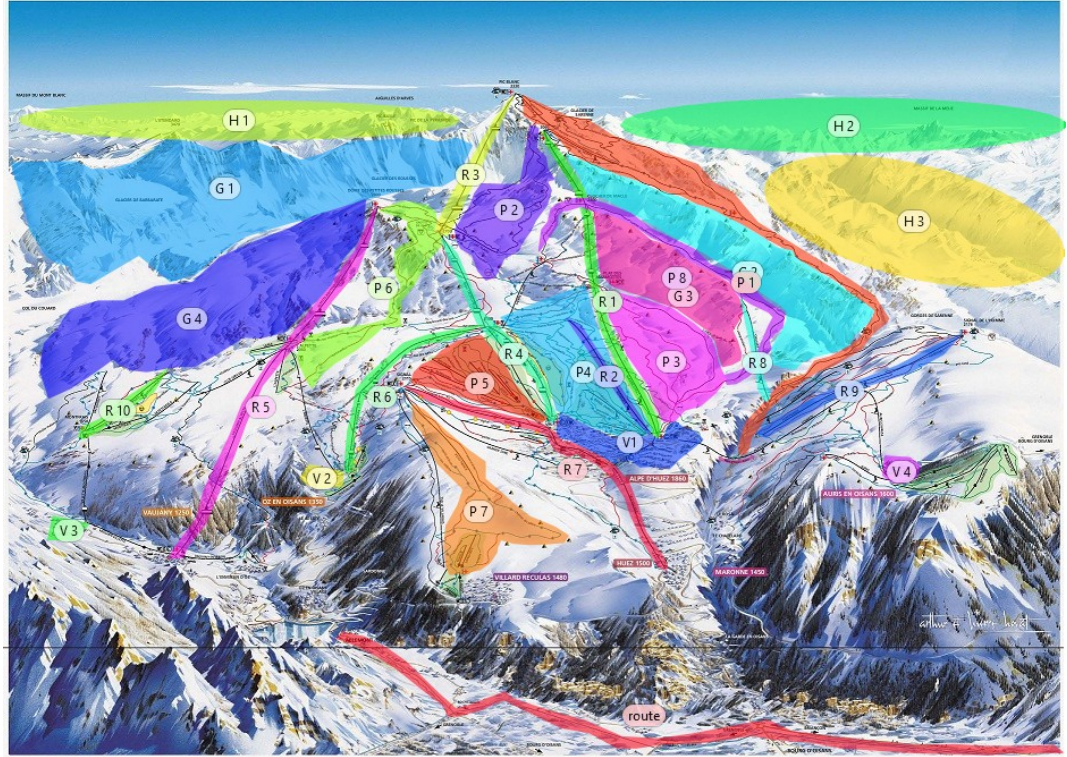
Analysis from gaze data led to descriptive statistics

Task 1 : exploration
Areas Of Interest (AOI)

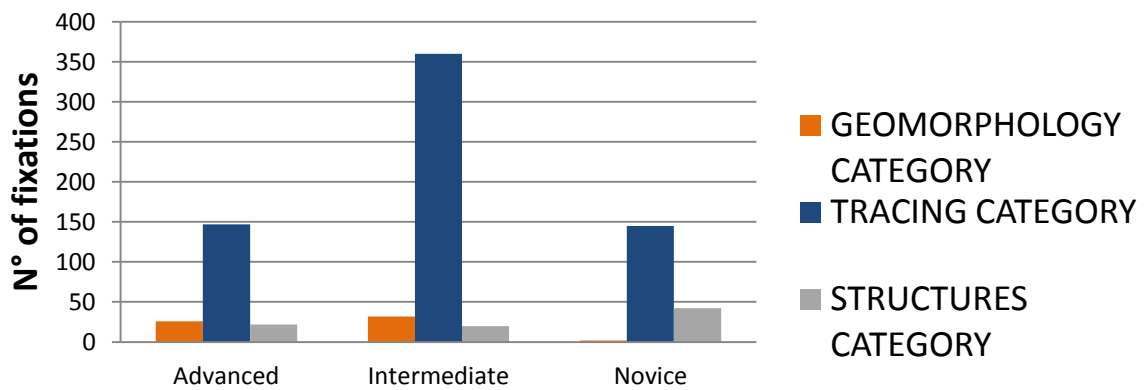
Geomorphology category (G+ H) =
geomorphology and geography (Horizons)

Tracing category (P+R)= ski runs and ski trails

Structures category (V+route) =building and
roads



Task1 's Total Fixation Count



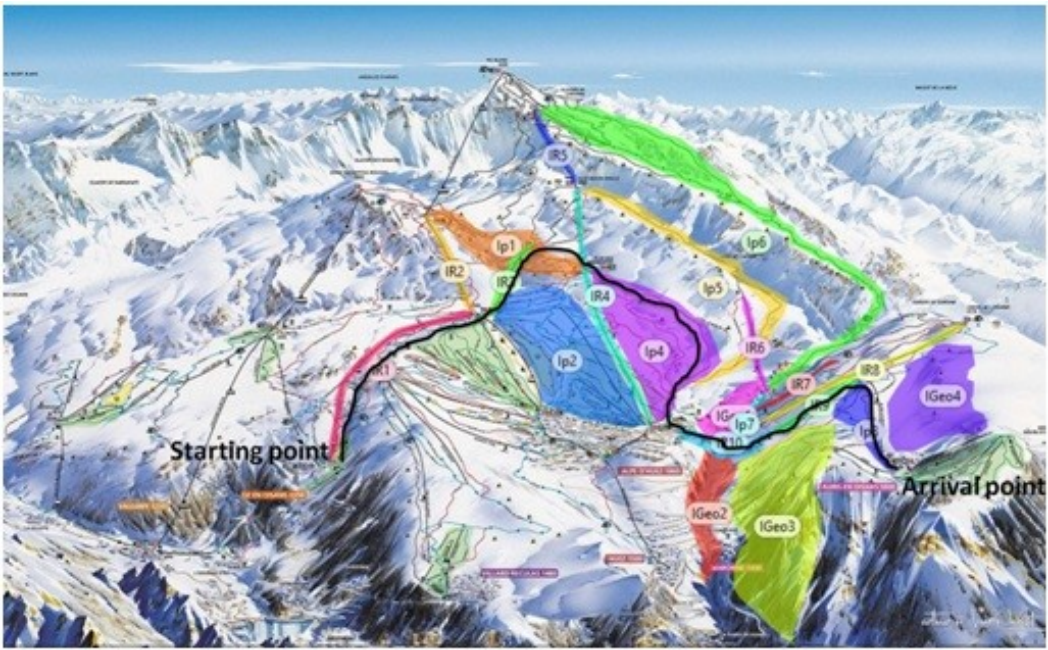
Preliminary results

Analysis from gaze data led to descriptive statistics

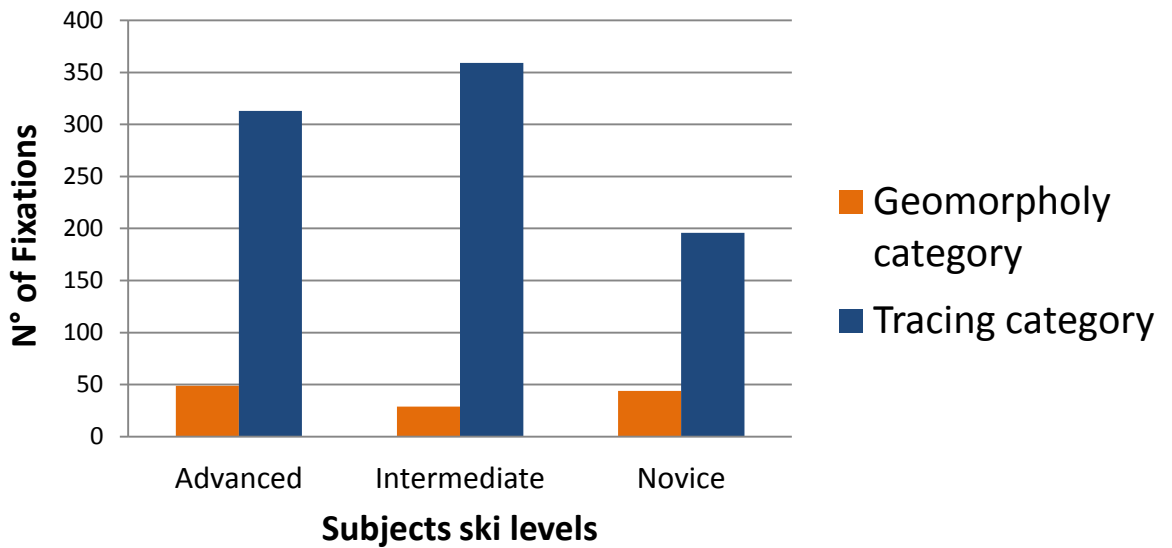
Task 2 : way-finding
Areas Of Interest (AOI)

Geomorphology category (**IGeo**) =
geomorphology

Tracing category (**Ip+Ir**)= ski runs and ski trails



T2's Total Fixations count



B. The study of user-skier activity

3. Large-scale survey

[Web-quest](#) during 15 days :

13 questions

92 answers gathered

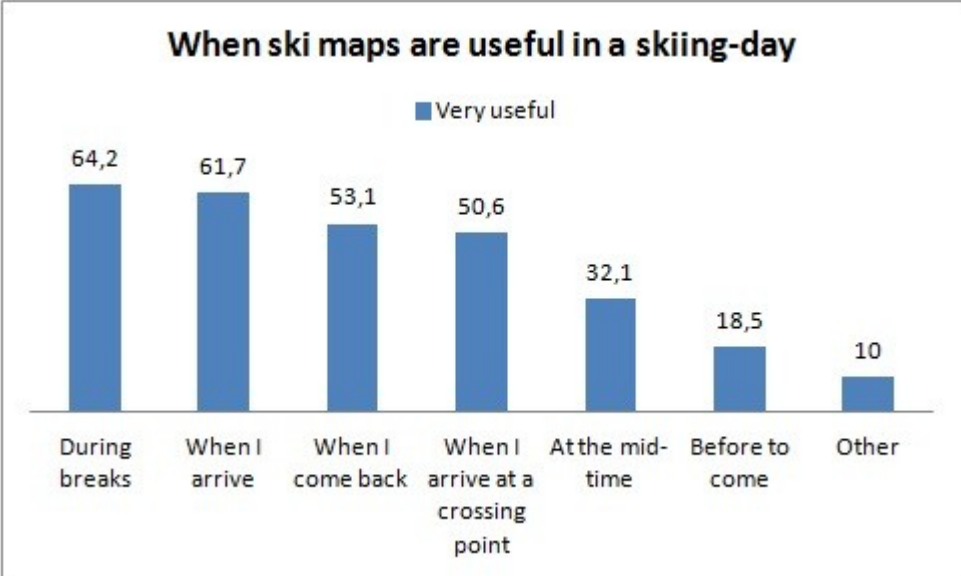
To control sample of survey:

- 1) knowledge about the ski resort Alpes d'Huez
- 2) level of skiing practices
- 3) knowledge about cartography and
- 4) socio-demographics features

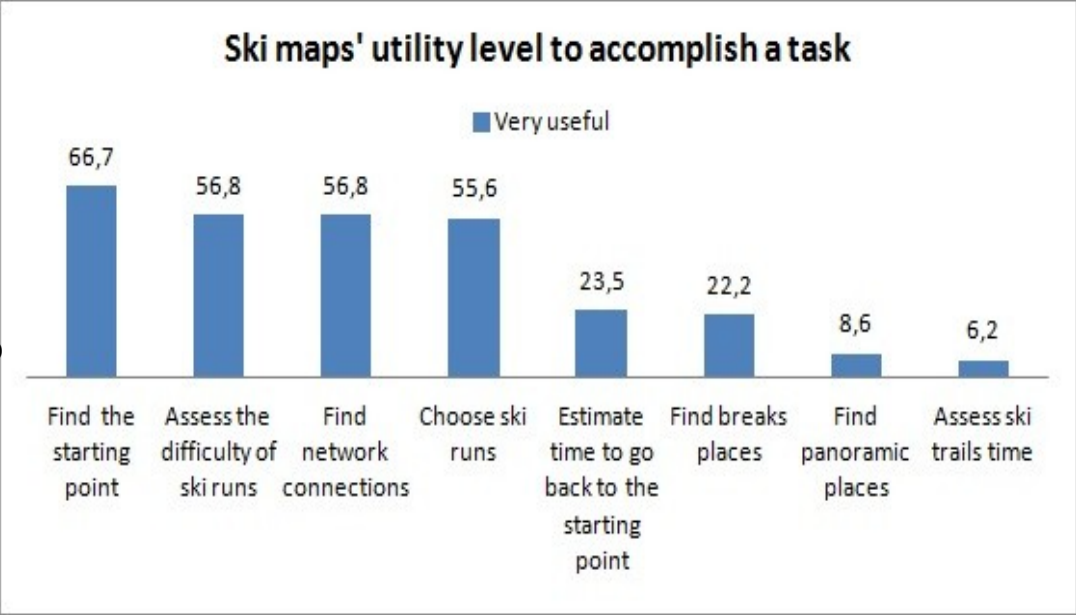
The survey investigates 3 main topics:

- 1) during a skiing-day, in which tasks the ski map is (most) used
- 2) in which moments of day ski maps are (most) used,
- 3) what depicted information is (more) useful on a map

Main results from large-scale survey

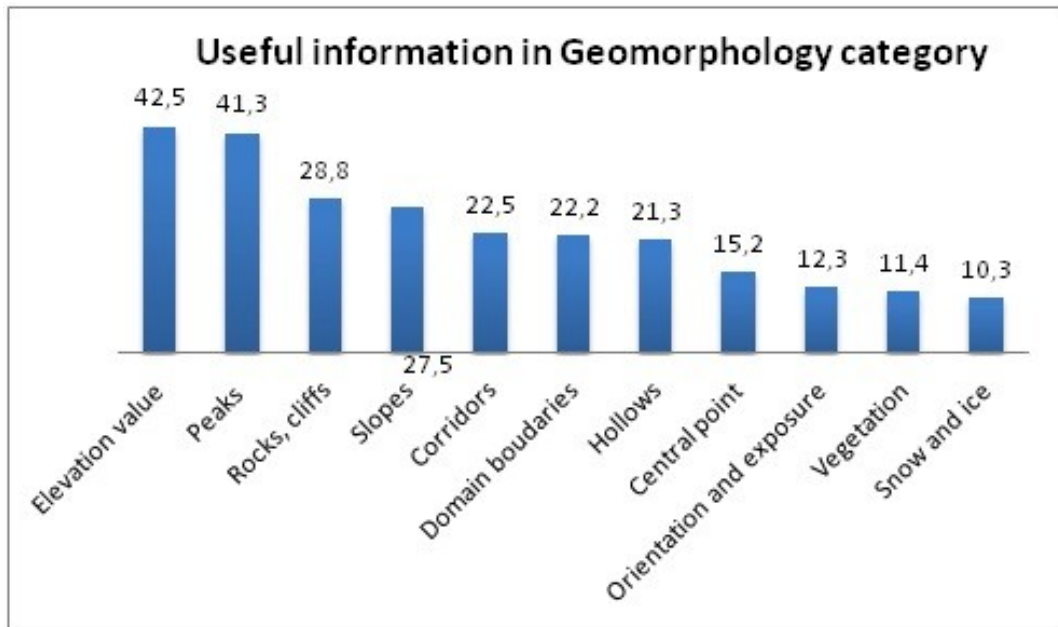


Percent of response "very useful" ski map in different moments of a skiing-day.

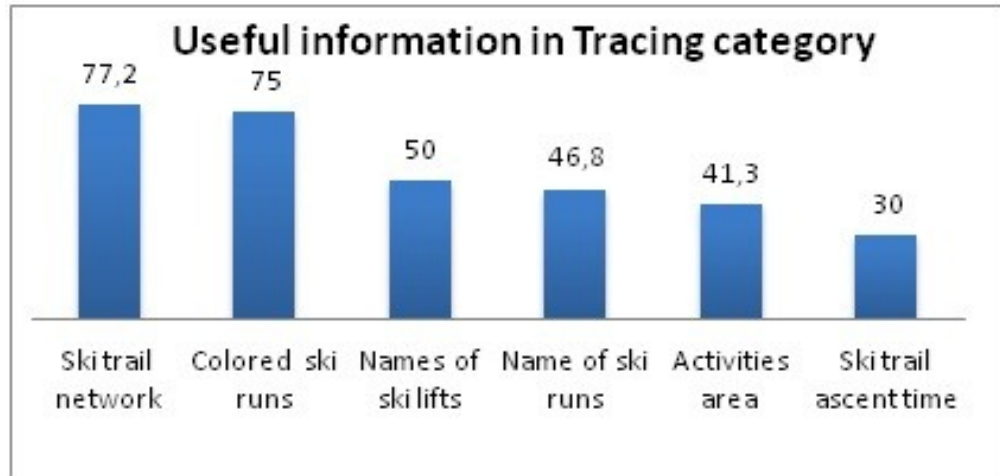


Percent of response "great usefulness" of ski map to perform a task.

Main results from large-scale survey



Percent of responses "very useful" geomorphic information depicted in the ski map.



Percent of responses "very useful" tracing information depicted in the ski map.

Overview from preliminary results

1. What geographic information (and its representation) make ski paper maps effective to perform a user-skier's task?

- ✓ ski trails, ski runs and their connection points (tracing information)
- ✓ ski tracks located in the central area of the resort (focal point)
- ✓ information related to the landscape seems very poorly exploited (geomorphology information)

2. What is the impact of (the paper representation of) mountain local distortion on user-skier's comprehension?

- ✓ panorama seems to be relatively unexplored (horizons)
- ✓ high visual attention rate in highly deformed areas (local distortion)
- ✓ "critical areas" (significant local distortion) of the map generate troubles in interpretation

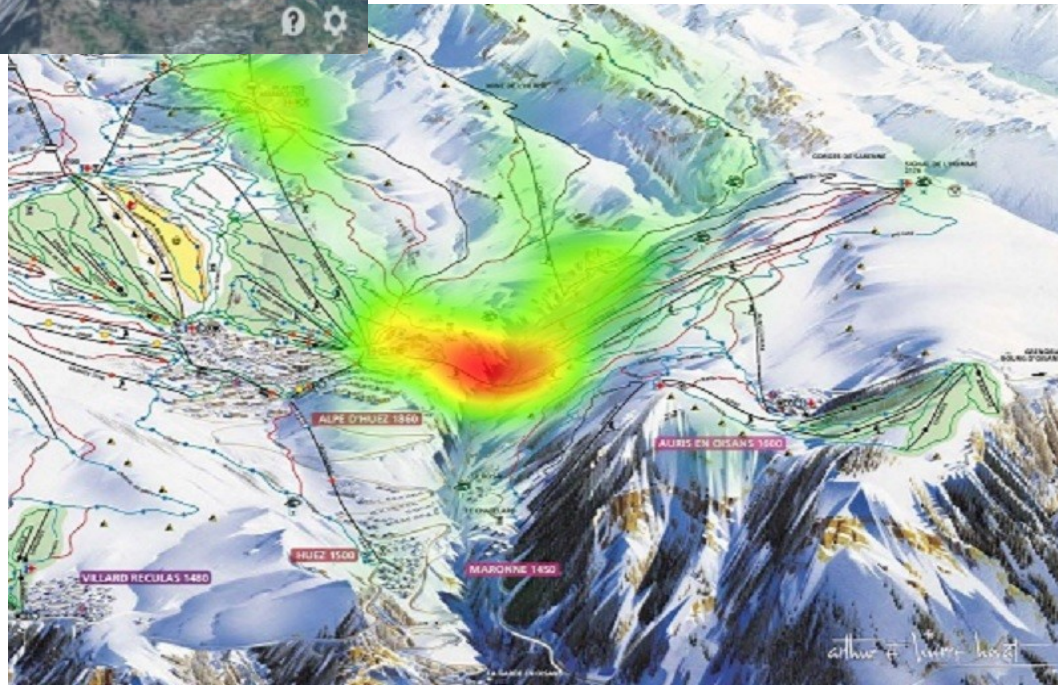
Discussion on users' representations and difficulties



"I prefer not to take care of the real topography but mostly take care of representation as I want to give".

Deformed position of Auris en Oisans and Alpes d'Huez from Atelier Novat.

Real position of Auris en Oisans and Alpes d'Huez from Google maps images©2015



Verbatim
"I can go by here, but it looks a bit confusing, I do not know why, maybe it's closeness to the slopes, the mountain ..."

"This passage troubles me because I do not understand with this shadow, if the only way to cross is that track...I do not know in which direction goes this curve.
I hesitate to venture out there"


Completing the experimental approach

- study visual attention in real world conditions



Source: SMI web site

- study the effectiveness of GI designed with current technological solutions


FATMAP 

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Mobile 3D Ski map

ALL THE SKIING INFORMATION YOU'LL EVER NEED IN ONE SKI (M)APP

FATMAP is for every part of your adventure. From planning at home to navigating on the slopes to sharing your experiences at the bar. Comprehensive coverage of resorts allows you to browse through hundreds of lines, restaurants, viewpoints. Terrain intelligence lets you toggle through overlays for accurate terrain information such as gradient, aspect and avalanche zones. All this with offline access meaning that from the chalet to the lift you'll always be able to make the right decision on where to ski.



Grateful thanks to Arthur Novat for the time and enthusiasm he has devoted to the project.