An Empiric Evaluation of the Affordances of Panorama Maps and Planimetric Maps in the Context of Alpine Ski Areas
The Example of SkiWelt Wilder Kaiser - Brixental
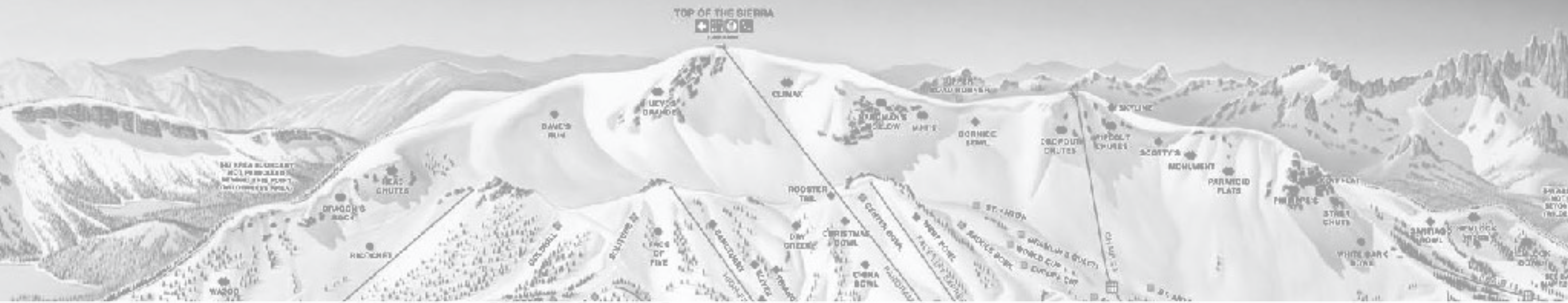
Thesis defense presentation

Cartography M.Sc.

Jenny Janssen | 30th September 2020

Research context

"…**panoramic views dominate ski trail maps** [and] comprise 86% of all maps and 100% of maps for the top 100 resorts."

The Mountain Ski Maps of North America – A Preliminary Survey and Analysis of Style (Tait, 2012)
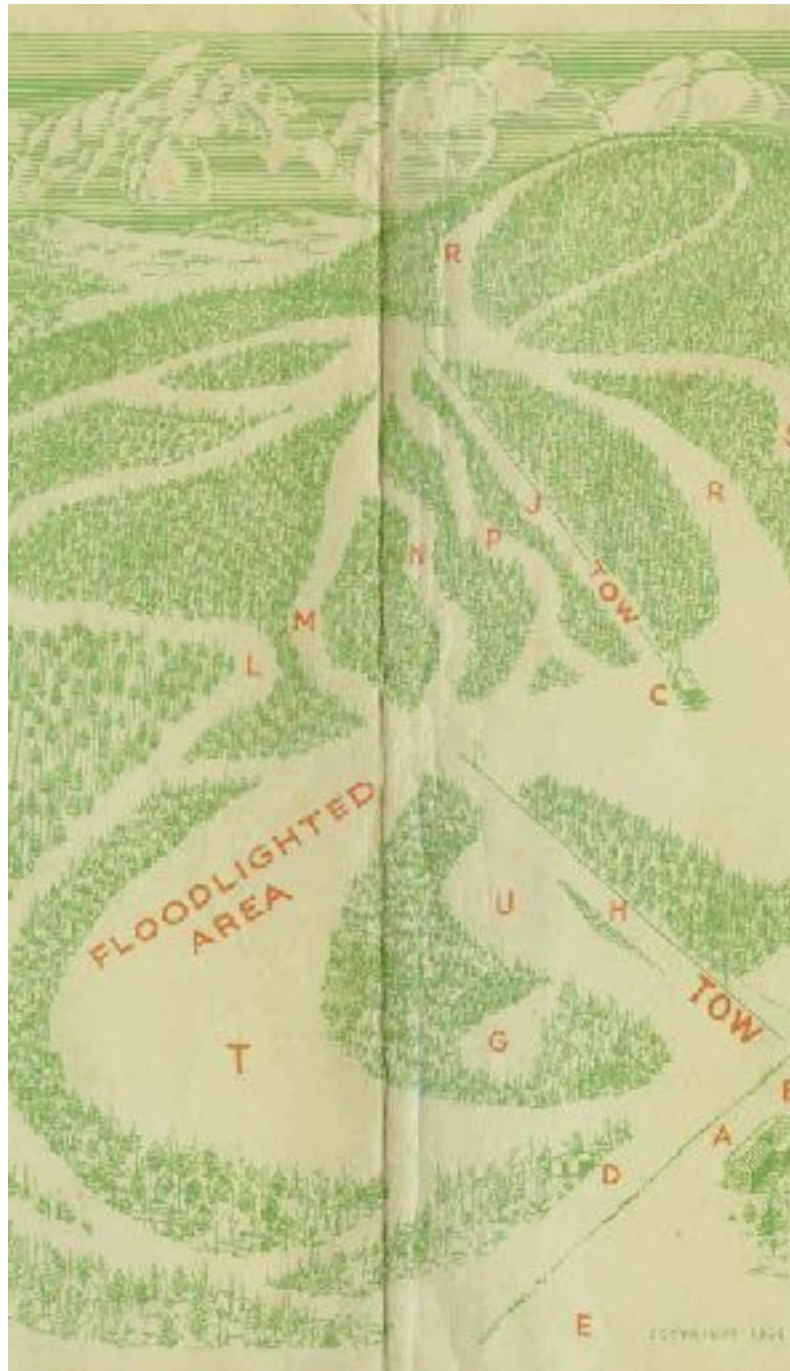
Early ski maps

Bousquet Mountain (1936)

Mt. Baker (1936)

Chamonix (1938)
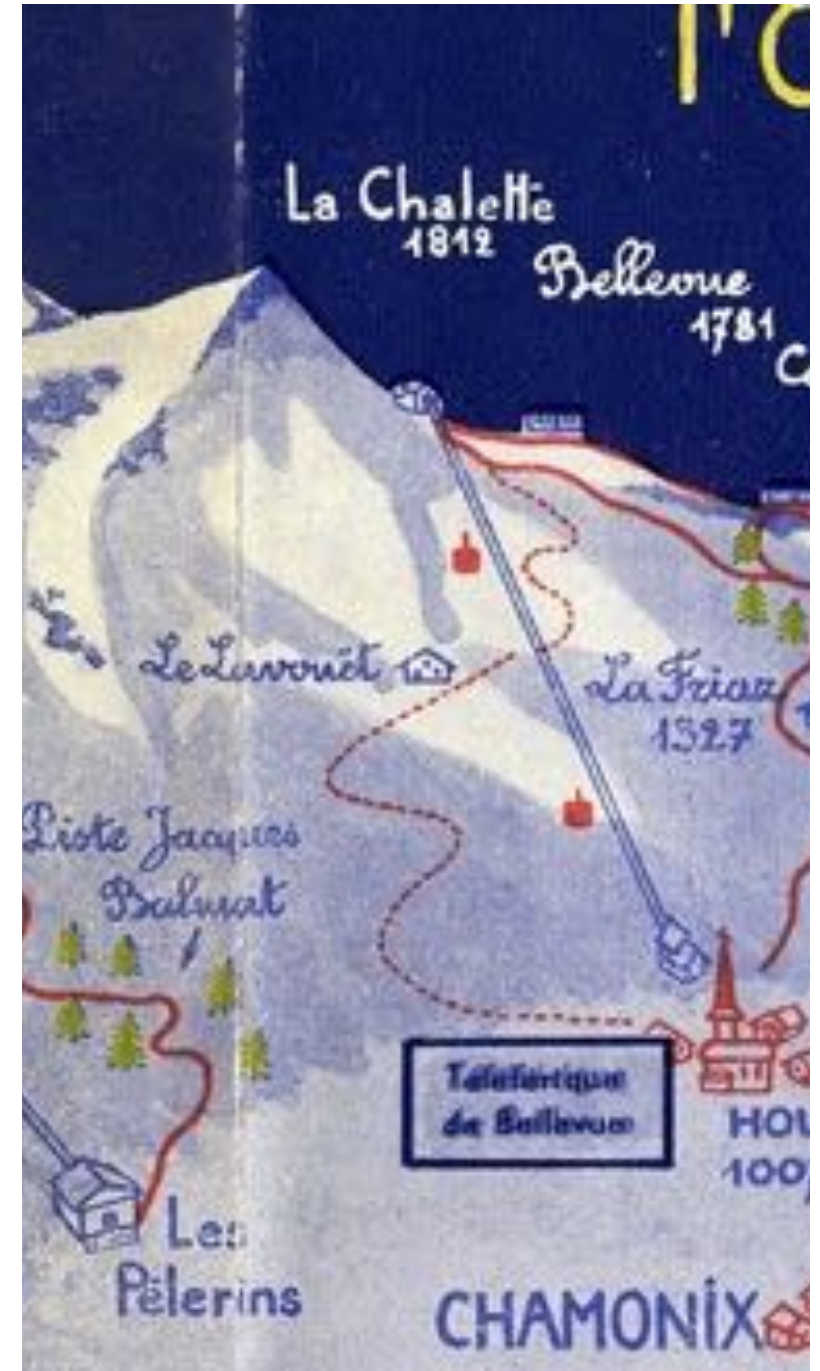
Ski maps around the world

Breckenridge (USA)

Silvretta Arena (Austria)
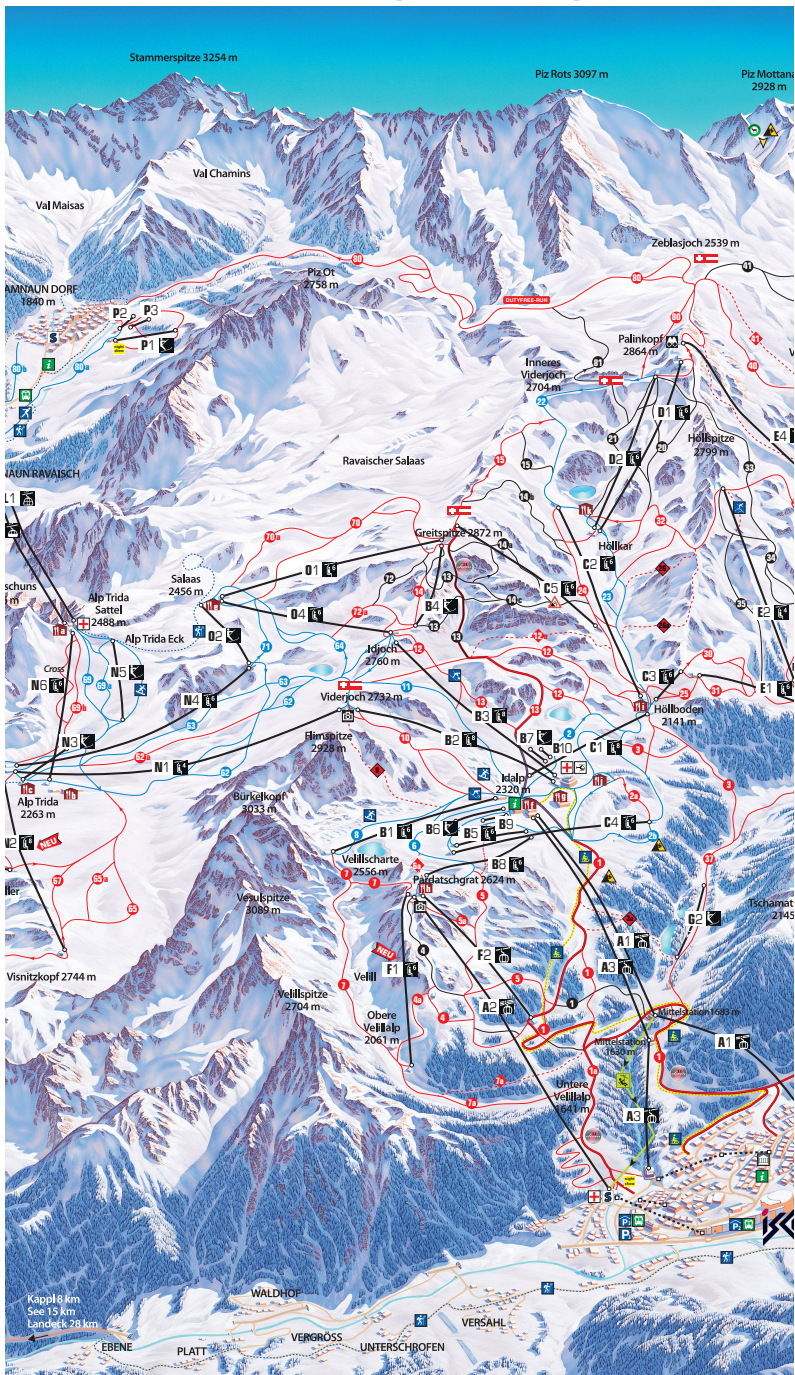
Niseko United (Japan)

Ski maps of Tyrol's largest ski areas

Ski area wayfinding

Image source: Jenny Janssen

Image source: Jenny Janssen

Using a ski map

Image source: Jenny Janssen

In conclusion

The panorama map is the dominant map style to depict ski areas.

It functions as a marketing tool as much as a navigation tool.

It is often the only map type available to visitors and is the main tool used to orient and navigate through the ski area.

But is this type of map best suited to accomplish wayfinding and navigation tasks?

Image source: Jenny Janssen

Research objectives

Research objectives

RO1   Comparing panoramic and planimetric ski maps in terms of their wayfinding, spatial cognition and emotional affordances.

RO2   Identifying the affordances required of a map depicting a ski area from the perspective of the user.

RO3   Making suggestions for further research based on the findings of this study on how panoramic and planimetric maps could be improved and potentially synthesised.

Research questions

Research questions

RO1 Comparing panoramic and planimetric ski maps in terms of their wayfinding, spatial cognition and emotional affordances.

RQ1.1 How do the affordances of panoramic and planimetric maps of alpine ski areas differ in terms of their ability to help carry out wayfinding tasks?

RQ1.2 How do the affordances of panoramic and planimetric maps of alpine ski areas differ in terms of helping the user gain a geographic understanding?

RQ1.3 How do emotional responses to panoramic and planimetric maps of alpine ski areas differ?

Research questions

RO2 Identifying the affordances required of a map depicting a ski area from the perspective of the user.

RQ2.1 Which aspects and qualities of a map are important to users in order to carry out wayfinding tasks in an alpine ski area?

RQ2.2 Which aspects and qualities of a map are important to readers in order to understand the geography of an alpine ski area?

Related work

Usability of ski maps

_ studies conducted by Balzarini et al. (2015) and Balzarini and Murat (2016)

_ testing the effectiveness of panorama ski maps in enabling the map reader to perform tasks including wayfinding and orientation

_ understanding "expert-artist activity" and "user-skier activity"

_ use of eye-tracking technology and observation

_ impact of panorama's mountain distortion on skier's comprehension
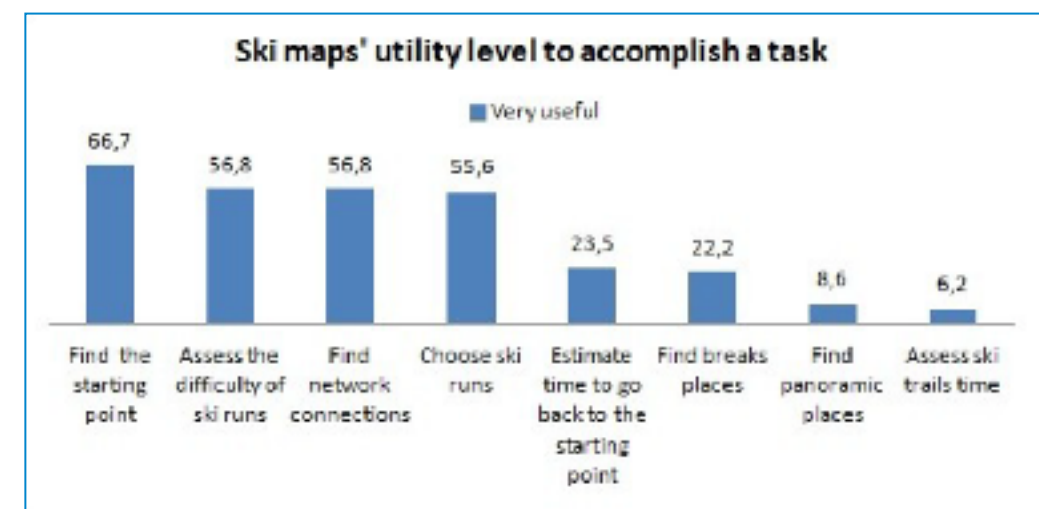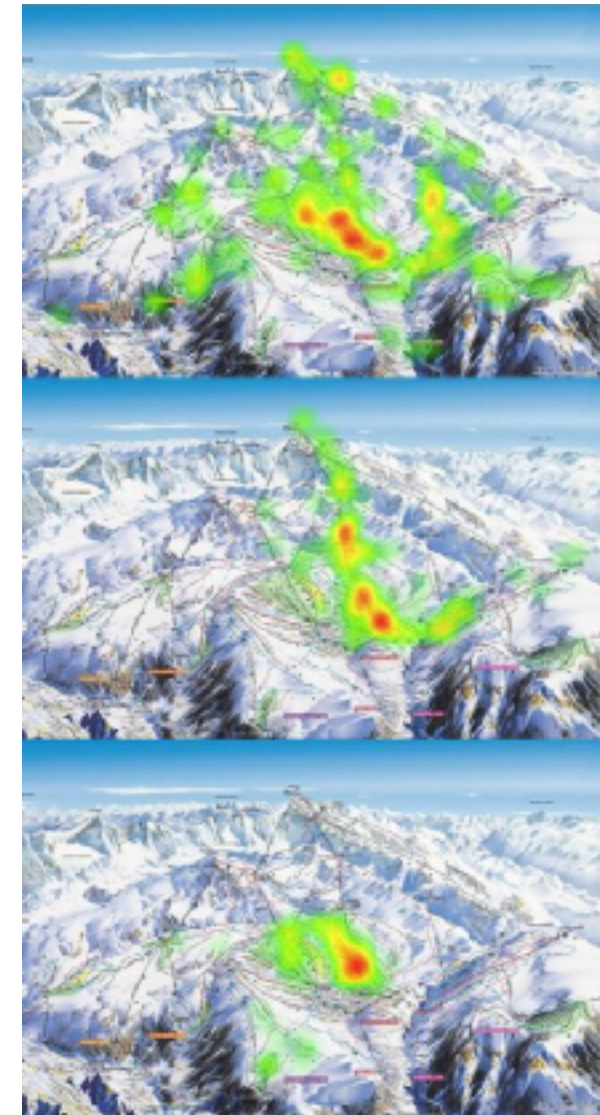
_ skill levels as a factor

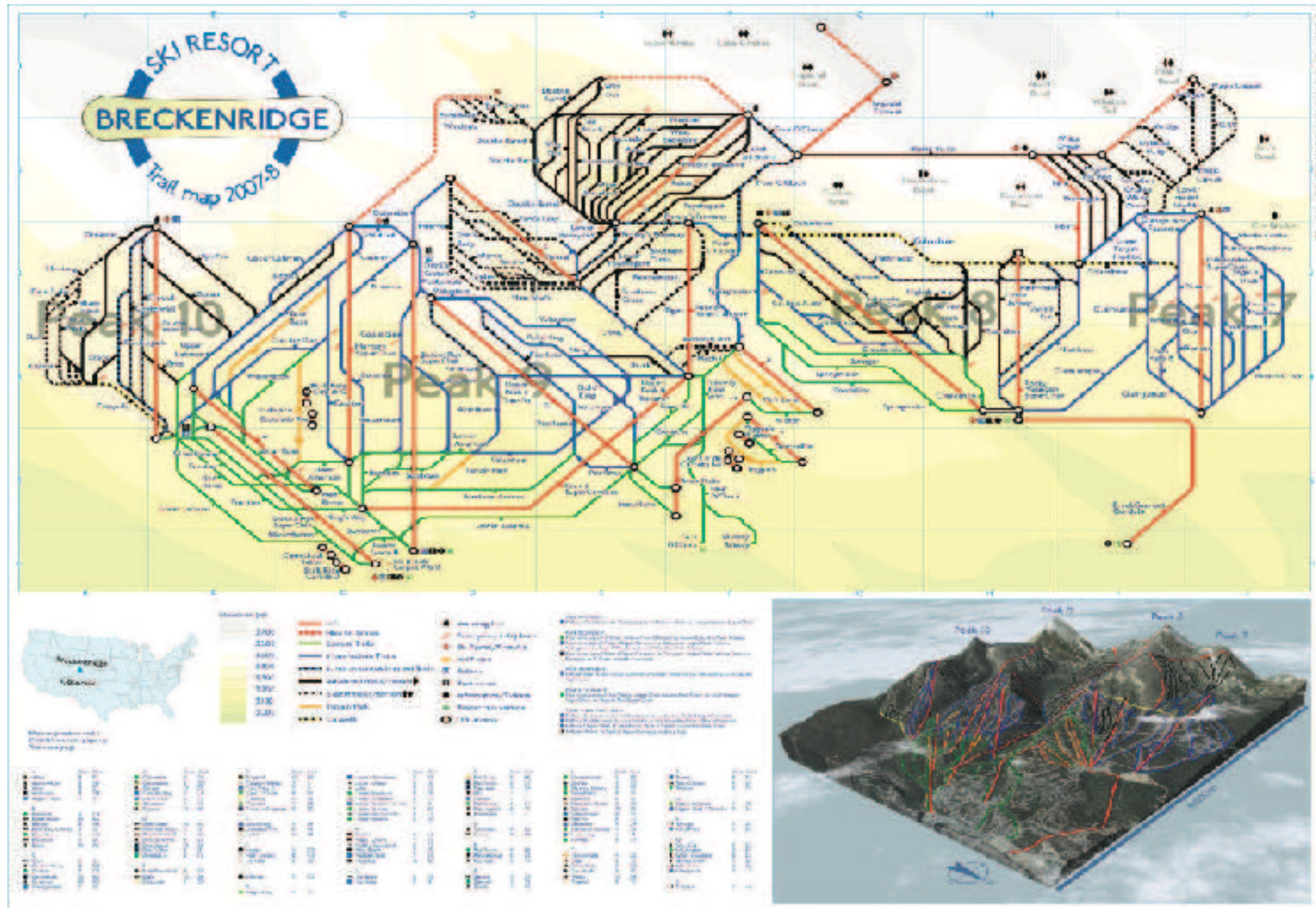Image source: Balzarini and Murat (2016)

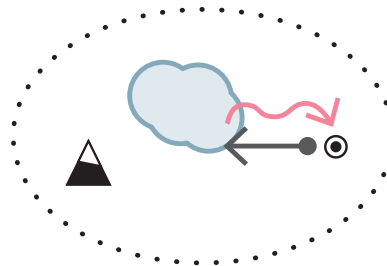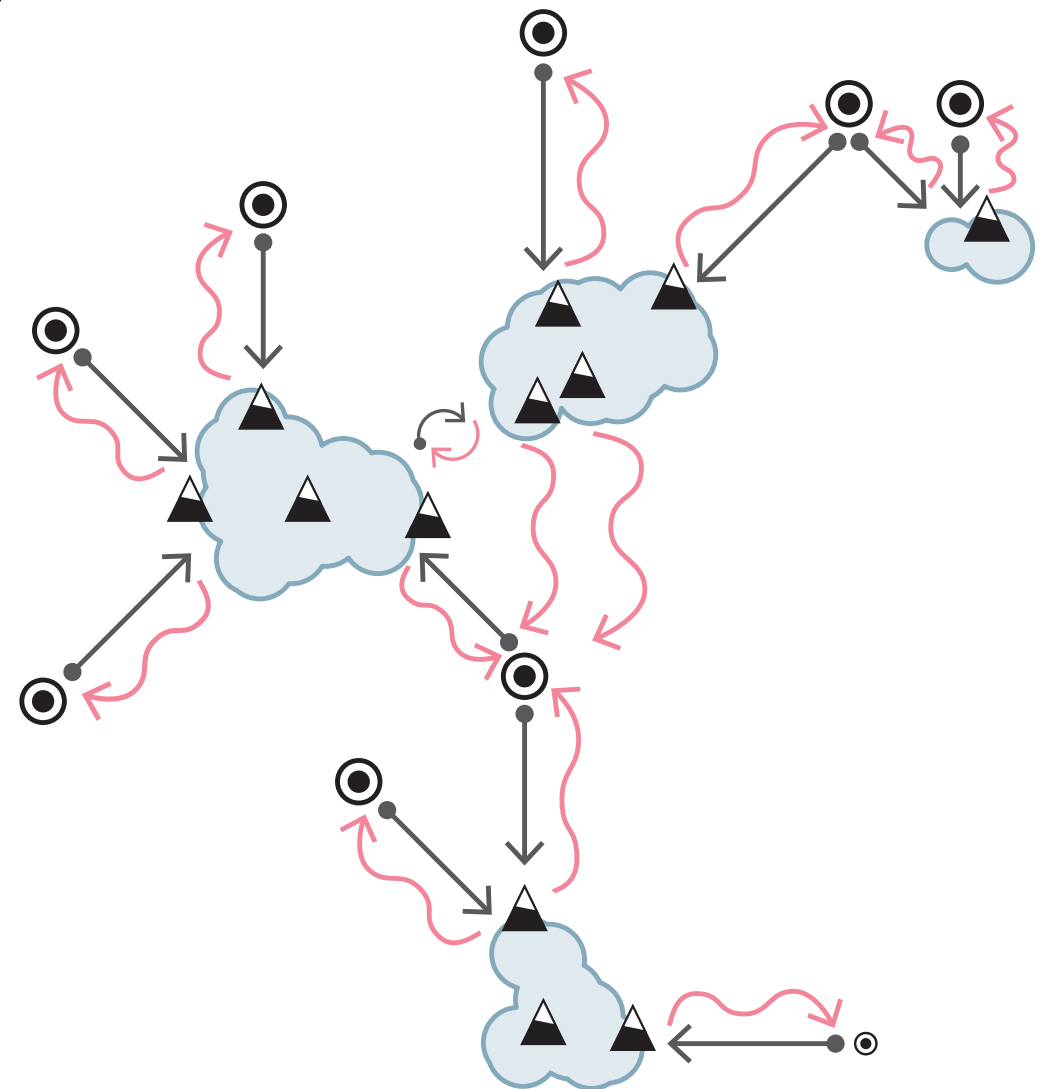# Schematic ski map design
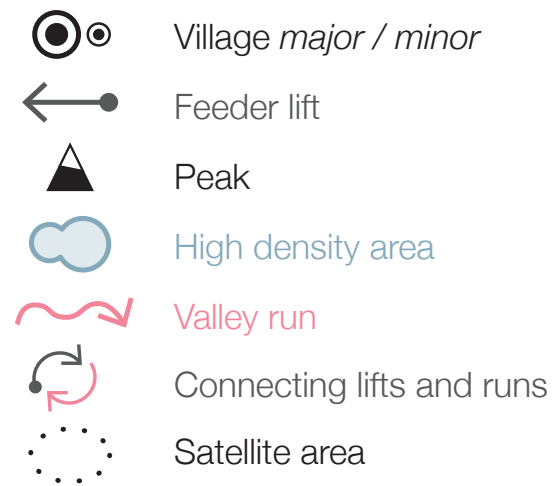

Image source: Field (2010)

Methodology

Methods used

_ **inspection** of maps

_ **expert questionnaire** completed by a representative if the same ski area

_ **user-based evaluation** of a panorama map and planimetric map of one ski area in Austria

Case study area

_ SkiWelt Wilder Kaiser - Brixental, North Tirol, Austria

_ 2nd largest ski area in Austria

_ stretches across multiples peaks and valleys, anchored by 8 villages

_ dense and complex networks of lifts and slopes

Legend:

- Village *major / minor*
- Feeder lift
- Peak
- High density area
- Valley run
- Connecting lifts and runs
- Satellite area

Panorama map (Map A)

Planimetric map (Map B)
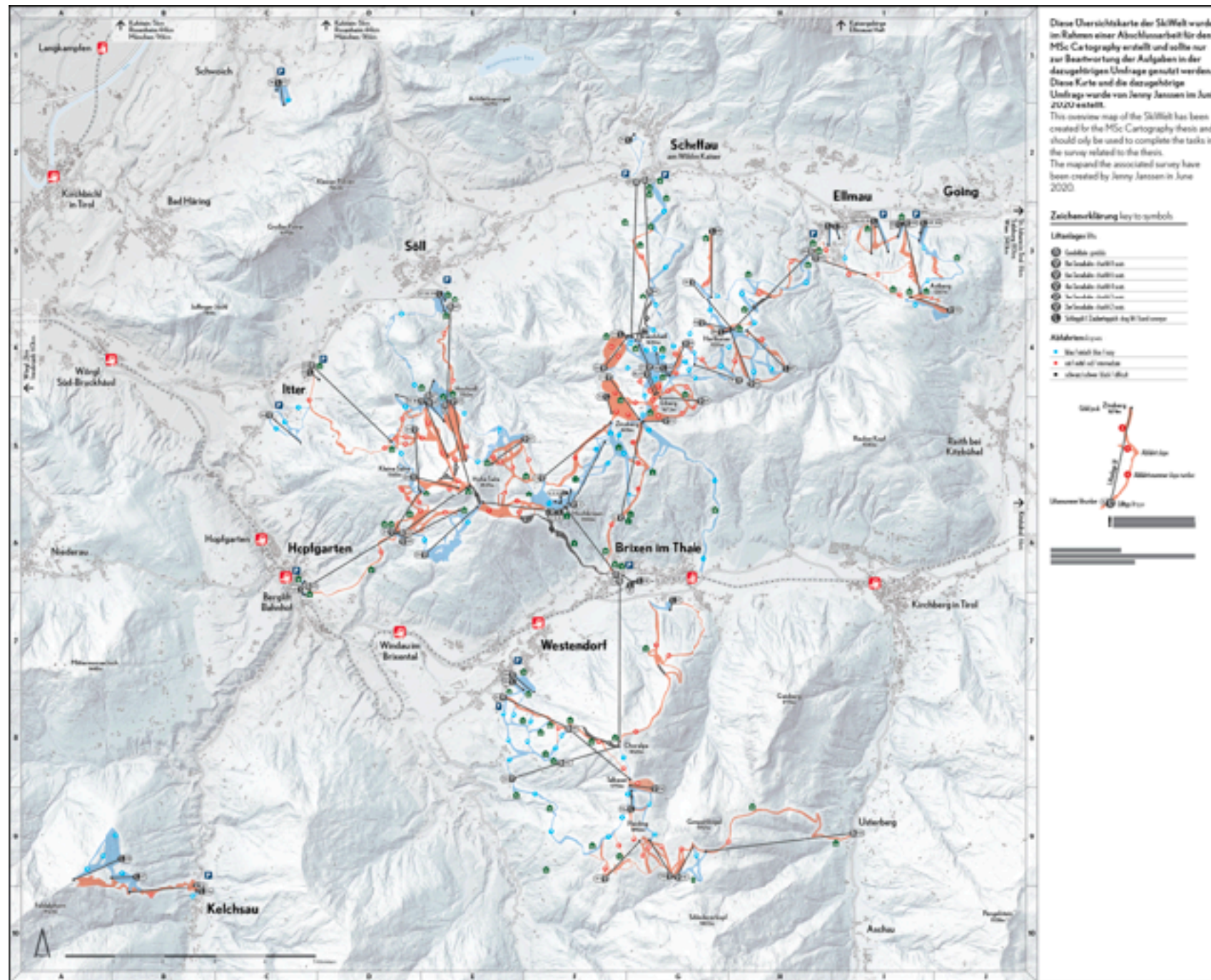
Comparing map contents

Geographic objects	Map A (unedited)	Map B (unedited)
Ski area boundary	Not explicitly shown. Map boundary implies ski area extent.	Not explicitly shown. Map boundary implies ski area extent.
Sunlight exposure / shadows	"sham exposure (east/west)" *	Hillshading, lighting from north west
Focal point of the map	"centre of the picture" *	Not given due to parallel perspective
Perspective	Bird-eye view	Orthogonal
Geomorphological objects	**Map A (unedited)**	**Map B (unedited)**
Terrain	Painted	Presented through DEM hillshade layer
Peaks and ridges	Painted	Presented through DEM hillshade layer
Slopes	Painted	Presented through DEM hillshade layer
Corridors	Painted	Presented through DEM hillshade layer
Hollows, combes	Painted	Implied by the hillside layerPresented through DEM hillshade layer
Rocks, cliffs	Painted	Not shown
Trees	Individually painted	Not shown
Areas of snow and ice	Painted	Not explicitly shown, but the hypsometric tints aims to imply more snow as elevation increases
Paths	**Map A (unedited)**	**Map B (unedited)**
Slopes	Shown as curved lines, colour to indicate difficulty level	Shown as areas, colour coded to indicate difficulty level, based on OSM data
Lifts	Shown as lines, aim to "give realistic proportions and distances" *	Shown as lines, based on OSM data
Roads	Smaller roads painted, main arteries through the SkiWelt overlaid as generalised lines	Shown as lines, based on Open Data Österreich data
Waterways	Painted	Shown as lines, based on Open Data Österreich data
Train lines	Overlaid on to the panorama painting as generalised lines	Shown as lines, based on Open Data Österreich data
Structures	**Map A (unedited)**	**Map B (unedited)**
Settlements	Individually painted	Shown as individual buildings, based on Open Data

Comparing visual styles

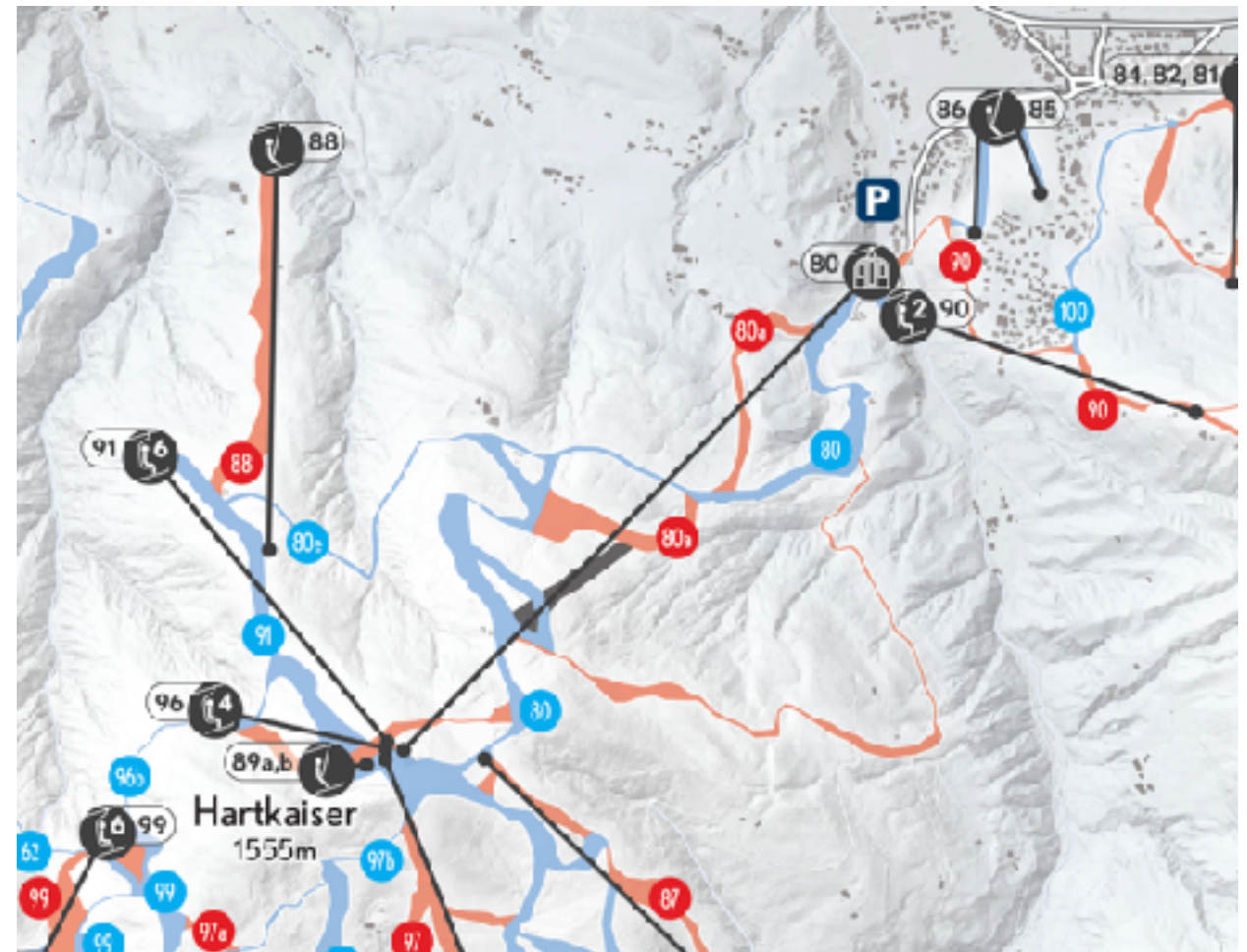Image source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

Image source: Jenny Janssen

Expert-questionnaire

_ completed by Stefan Grafl of SkiWelt Wilder Kaiser - Brixental Marketing GmbH

Expert-questionnaire

_ insights into the map creating process

_ the selection of map contents based on their importance to users, the ability to provide orientation and overview of the ski area, and visualisation pf infrastructure

_ it addresses a broad range of user types - not just skiers!

_ receiving generally positive feedback about the panorama map

_ some areas of the map that are "behind" the mountains are sometimes not clear to users

_ the basic concept of the overview map (panorama map) will be kept but is subject to continuous further developments

Online survey

Demographic questions
Knowing the gender of participants
Knowing the age of participants

Winter sport and ski map experience
Gaining an understanding about the preferred alpine winter sport activity and skill level of participants
Gaining an understanding about the familiarity with the SkiWelt of participants
Gaining an understanding about the familiarity with panorama and planimetric maps of participants
Gaining an understanding about the awareness of ski map types and frequency of use of participants

User needs (RQ 2.1. and 2.2)
Understanding how important are particular ski map content types to participants
Understanding how important are particular supportive map elements to participants

Navigation and orientation (RQ 1.1)
Participants are asked to complete 3 navigation and orientation tasks of increasing complexity by using either Map A or Map B (the maps are assigned through a random stimuli generator)

Geographic understanding (RQ 1.2)
Participants are asked to complete 3 tasks which test their geographic understanding of the area based on the map they are assigned

Emotional response (RQ 1.3)
Participants are asked to assess emotional statements related to the map that they have been assigned

User needs

Map content	Supportive map layout elements
Slope difficulty level	Legend / key to symbols
Slope downhill direction	Orientation indicator such as a north arrow
Slope width	Scale indicator such as a scale bar
Geographically correct course of slopes	Lines of latitude and longitude (graticule)
Lift type	
Lift capacity	
Lift entrance	
Lift direction	
Ground transportation routes and stops between valley stations (such as a Skibus service that is included in the ski pass)	

Survey structure

the survey's random generator selects either Map A or Map B

Introduction of stimuli

About the participant → User needs → Navigation and orientation → Geographical understanding → Emotional response

Navigation and orientation tasks

_ 3 tasks asking to connect two POIs on the map presented

_ tasks increase in complexity

_ understand how difficult was the completion of each task

_ receive specific feedback about parts of the map that did not work and made it difficult to complete the tasks
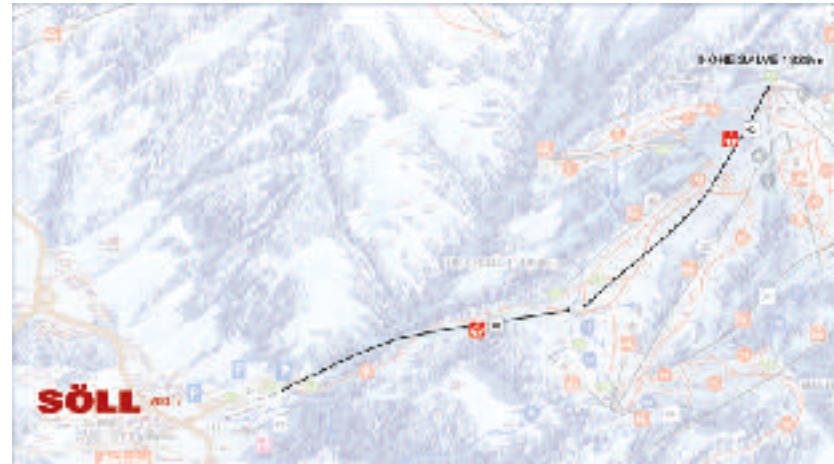
Geographical understanding

_ testing whether the map helps to understand the geography of the SkiWelt with respect to cardinal directions

_ are the following statements true or false?

_ Going is located north of Scheffau.

_ Brixen im Thale is located east of Hopfgarten.

_ Hopfgarten is located east of Itter.

Image source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)
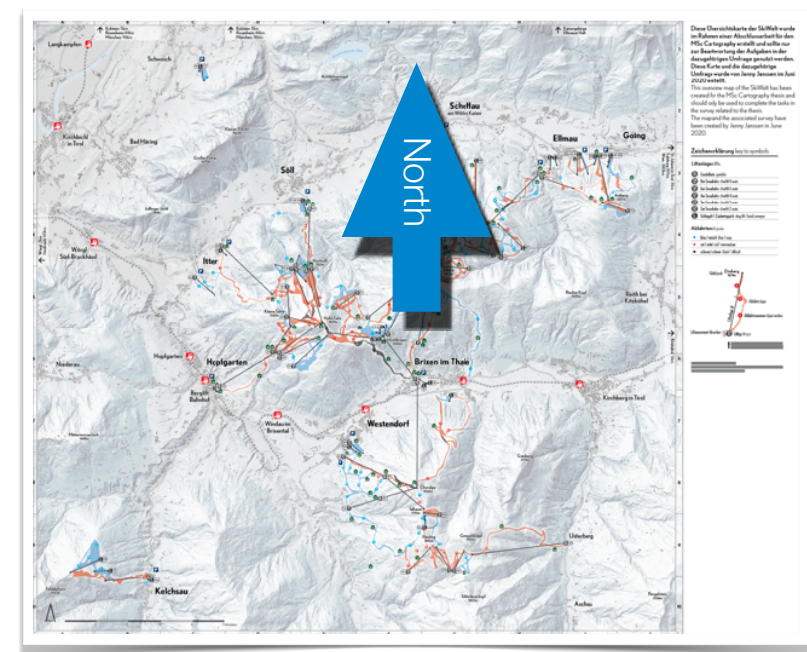
Image source: Jenny Janssen

Geographical understanding

Does the map help you understand the geography of the SkiWelt?

The map gives a good impression of how **steep** the slopes are.

The map gives a good impression of how **wide** the slopes are.

The map gives a good impression of how **long** the slopes are.

This map enables to judge **distances**.

The map enables to judge the **terrain** of the SkiWelt and identify particularly steep and flat areas.

The map provides a good **overall geographical understanding** of the SkiWelt.

Emotional response

How do you feel about this map with regards to the impression it gives about the SkiWelt as a winter sports destination?

Curiosity: This map **makes me curious about the SkiWelt** and what it has to offer for winter sports.

Excitement: This map **gets me excited about the SkiWelt** as a winter sport destination I want to spend time at.The map gives a good impression of how wide the slopes are.

Certainty: This map **enables me to judge the terrain and slope characteristics** and provides me with a sense of certainty when choosing a slope.

Confidence: This ski map **gives me confidence that I can navigate and orient myself** when I am in the SkiWelt.

Results

Sample groups

_ 85 valid cases

_ Group A (48) and Group B (37) established by random generator

_ similar characteristics including age, gender and preferred alpine winter sports

_ largely intermediate skill level

_ majority unfamiliar with the case study area

_ familiarity with panorama and planimetric map types

_ printed ski maps used most often, followed by large static map

Map A 56,5 %

Map B 43,5 %
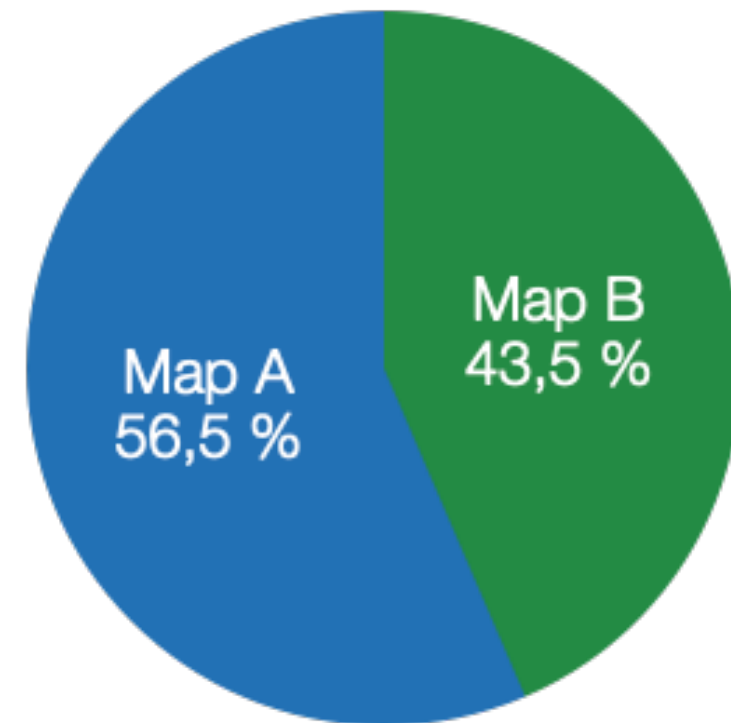
Distribution of stimuli to Group A and Group B

User needs
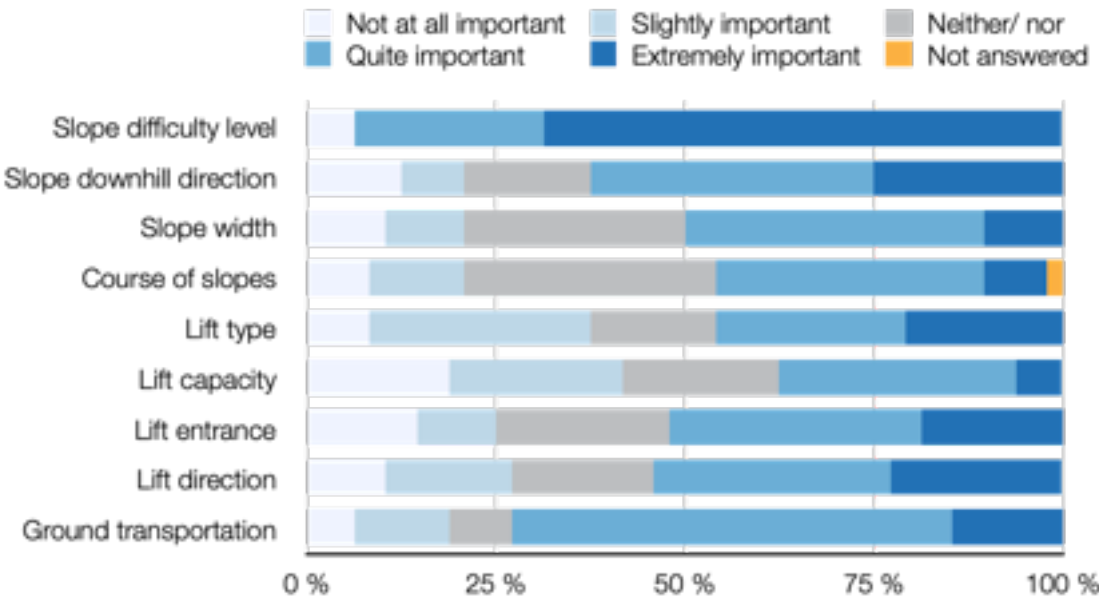
Importance of map contents to Group A

Importance of map layout elements to Group A

Importance of map contents to Group B

Importance of map layout elements to Group B

Navigation and orientation tasks
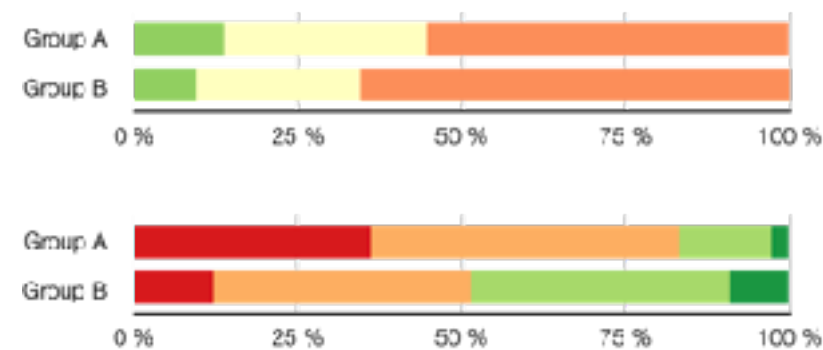
Image source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020); Jenny Janssen

Navigation and orientation tasks

Map A

Map B

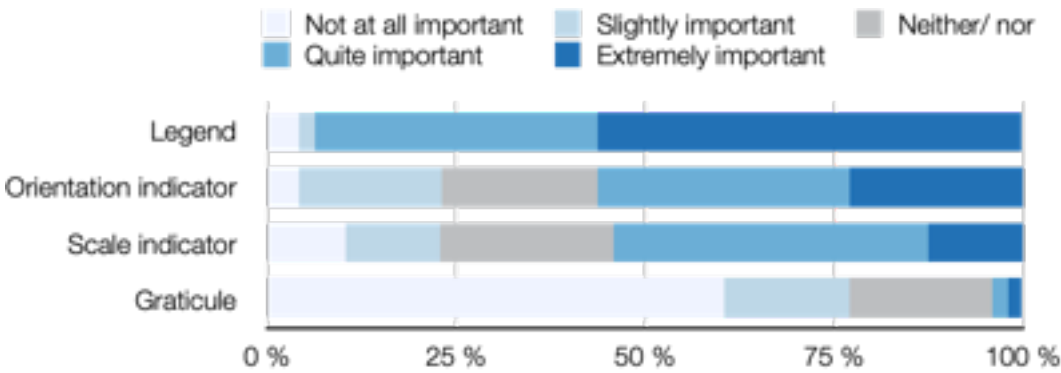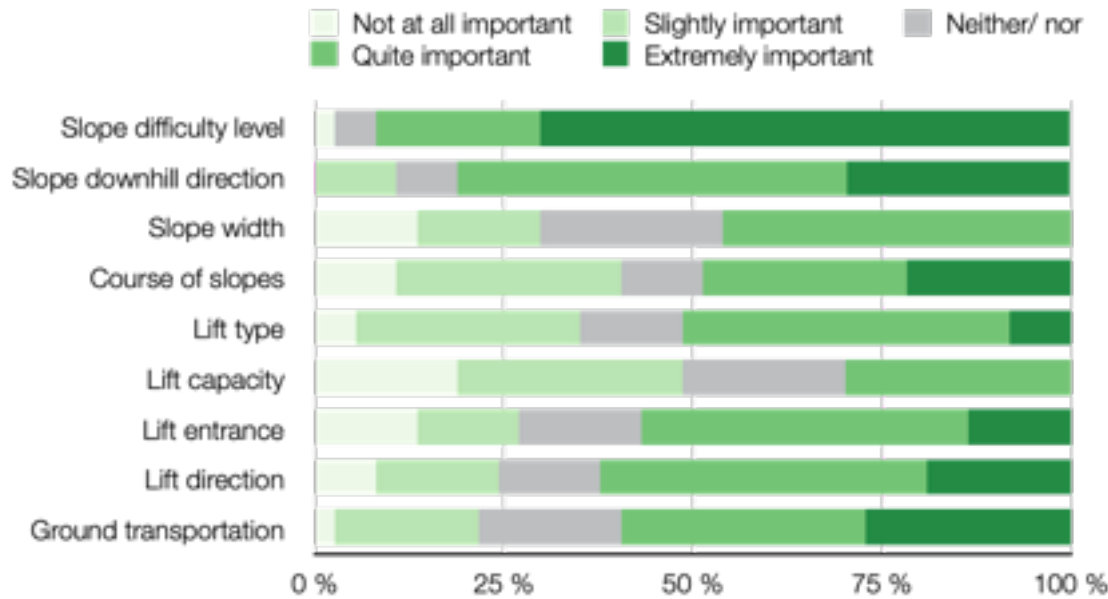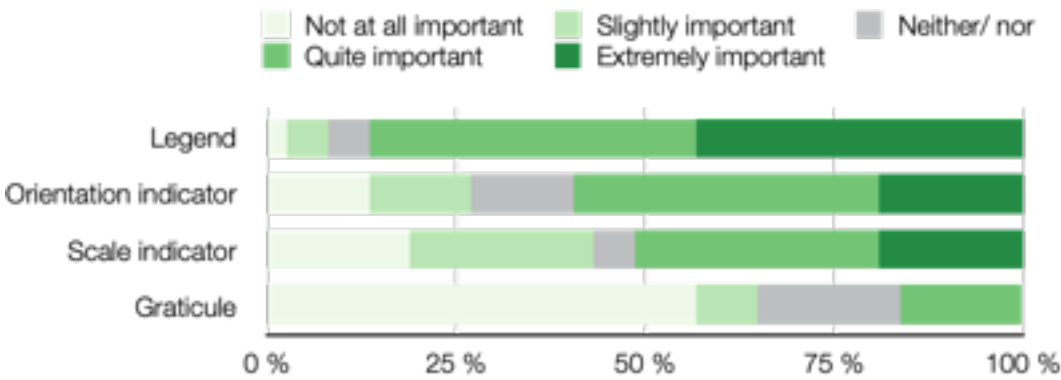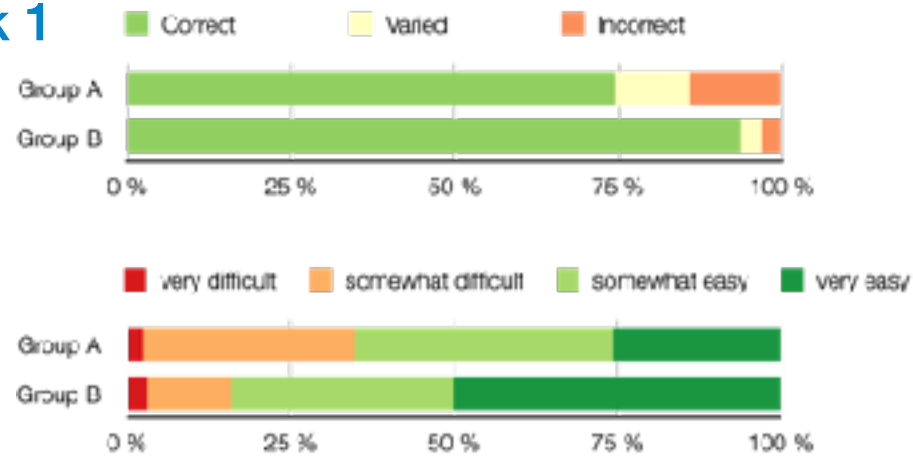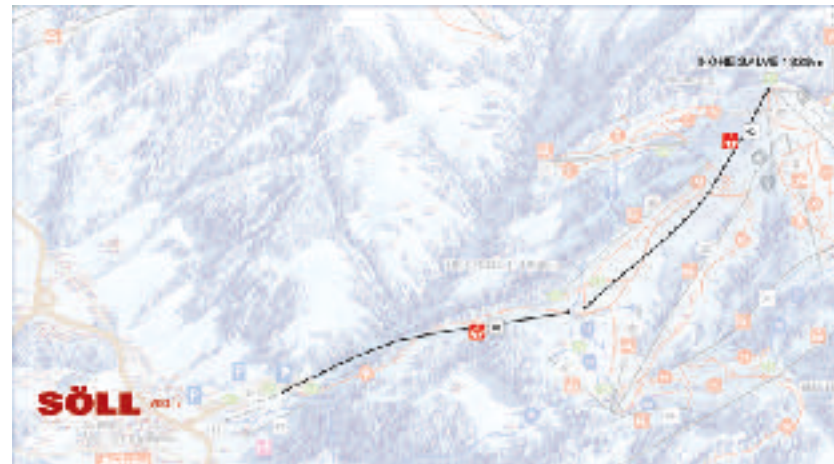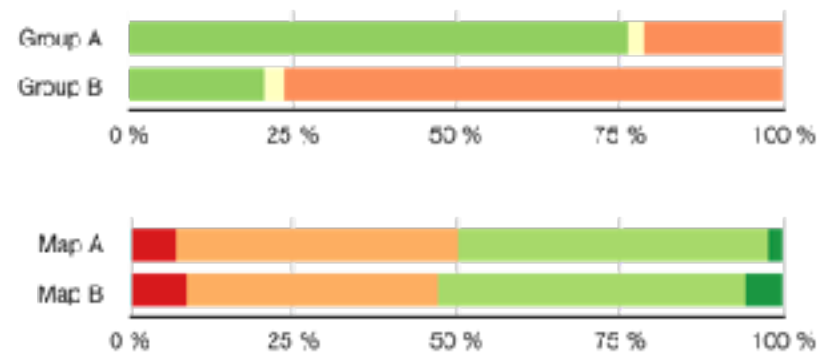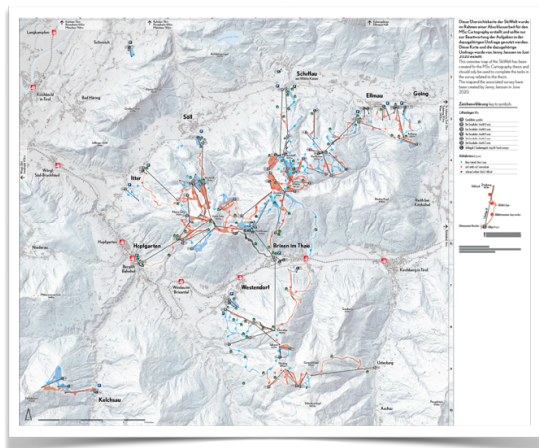| Group A difficulties (ranked from most mentioned to least)	Mentions
Finding the map illegible and too complex	26
Unable to make connections	20
Finding the destination	18
Directions of lift/slope not clear	13
Naming of lifts/ slopes unclear	11
Legend was a problem/ incomplete or not in English	8
Lack of labels	8
Lack of accuracy	5
Lack of experience with skiing	4
Not understanding the terrain	4
Identification of different map objects	3
Poor resolution of the map	3
Symbol / font size too small	3
Label position	1
Logic of naming	1
Choice of slopes according to ability	1

Group B difficulties (ranked from most mentioned to least)	Mentions
Directions of lift/slope not clear	27
Not understanding the terrain	9
Finding the destination	7
Finding the map illegible and too complex	6
Symbol / font size too small	6
Label position	6
Unable to make connections	5
Poor resolution of the map	5
Legend was a problem/ incomplete or not in English	3
Lack of experience with skiing	3
Identification of different map objects	3
Naming of lifts/ slopes unclear	2
Lack of accuracy	1
Lack of labels	0
Logic of naming	0
Choice of slopes according to ability	0

Navigation and orientation tasks

Unable to make connections

Directions of lifts/slopes not clear
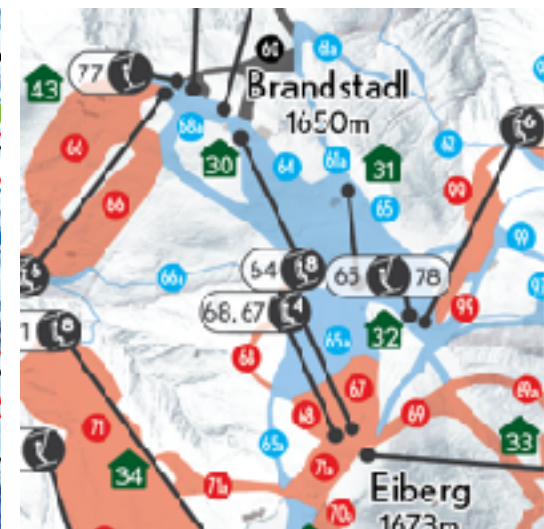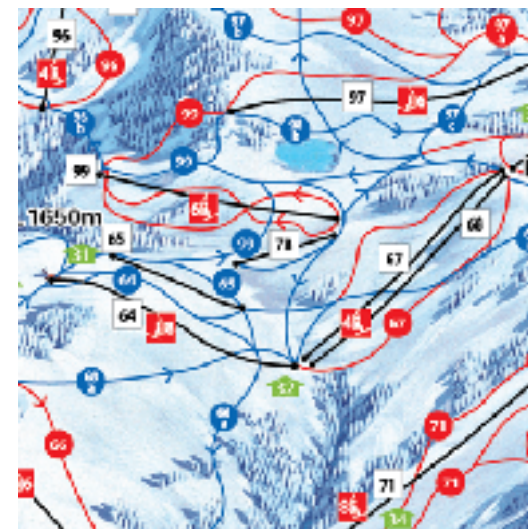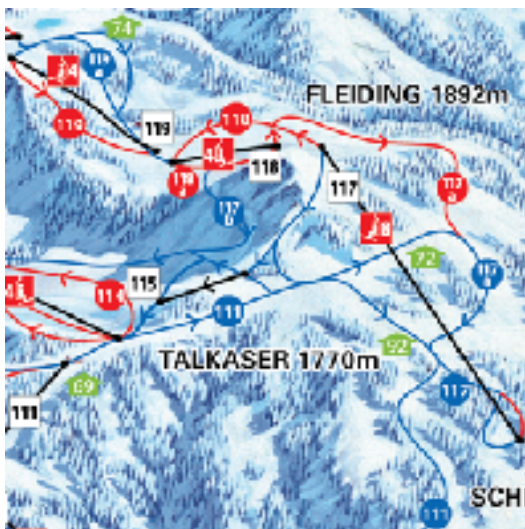
Image source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020); Jenny Janssen

Geographical understanding

Going is located north of Scheffau. ✗
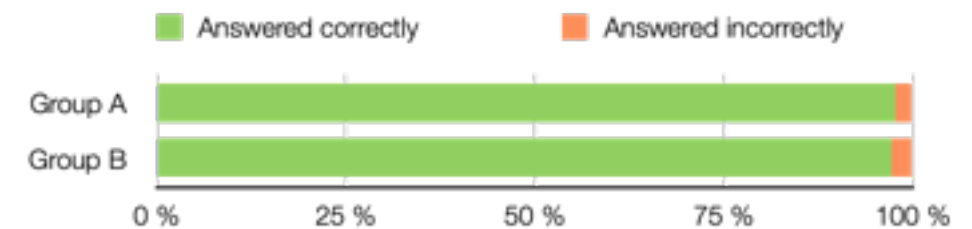
Brixen im Thale is located east of Hopfgarten. ✓
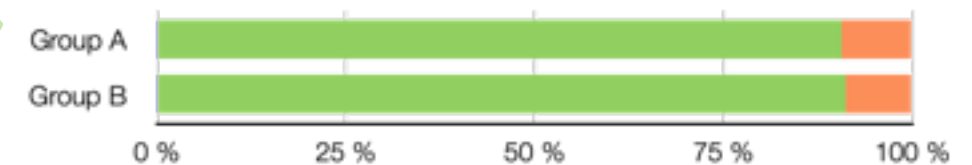
Hopfgarten is located east of Itter. ✗
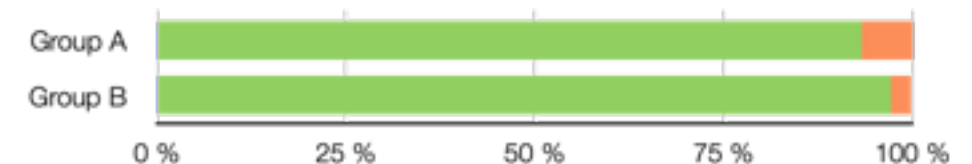
Use of map to complete the tasks:

Legend: Answered correctly (green), Answered incorrectly (orange)

Chart 1: Group A ~100% correct, Group B ~100% correct
Chart 2: Group A ~90% correct, Group B ~90% correct
Chart 3: Group A ~95% correct, Group B ~100% correct

Legend: Yes (green), No (orange)
Chart 4: Group A ~90% Yes, Group B ~100% Yes

Geographical understanding

Group A

Legend: strongly disagree | somewhat disagree | neither agree nor disagree | somewhat agree | strongly agree

Slope steepness, Slope width, Slope length, Distances, Terrain, Overall GU
0 % — 25 % — 50 % — 75 % — 100 %

Group B

Slope steepness, Slope width, Slope length, Distances, Terrain, Overall GU
0 % — 25 % — 50 % — 75 % — 100 %

P-values for T-test

Statement	P-value
The map gives a good impression of how steep the slopes are.	0,22
The map gives a good impression of how wide the slopes are.	0,00
The map gives a good impression of how long the slopes are.	0,00
This map enables to judge distances.	0,00
The map enables to judge the terrain of the SkiWelt and identify particularly	0,70
The map provides a good overall geographical understanding of the SkiWelt.	0,05

Emotional response

Group A
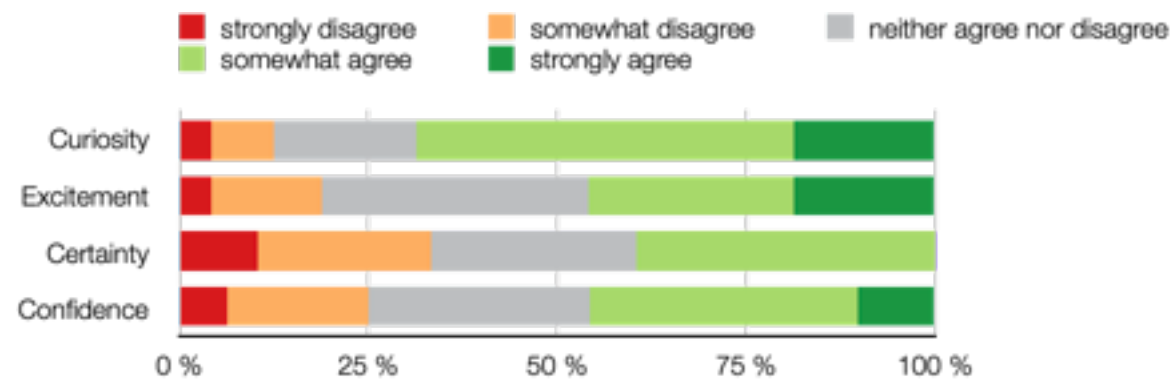
Group B
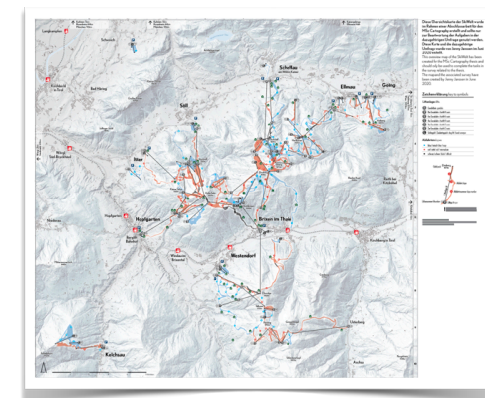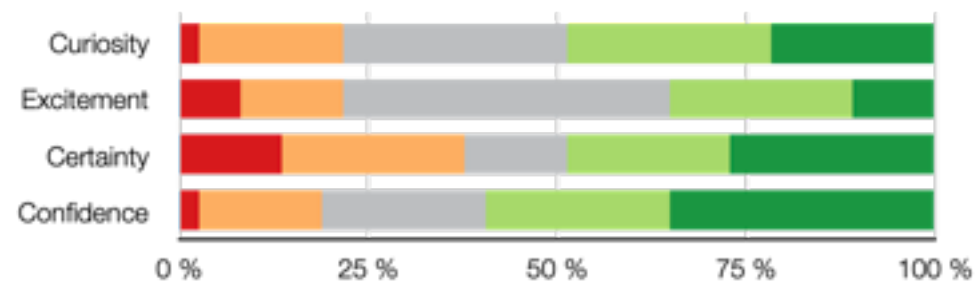
Legend: strongly disagree | somewhat disagree | neither agree nor disagree | somewhat agree | strongly agree

P-values for T-test

Statement	p-value
Curiosity: This map makes me curious about the SkiWelt and what it has to offer for winter sports.	0,29
Excitement: This map gets me excited about the SkiWelt as a winter sport destination I want to spend time at.	0,28
Certainty: This map enables me to judge the terrain and slope characteristics and provides me with a sense of	0,31
Confidence: This ski map gives me confidence that I can navigate and orient myself when I am in the SkiWelt.	0,06

Conclusion and outlook

Headline message

The results from the user evaluation do not suggest that one map is more successful overall than the other.

Instead, the experiment shows that each map type presents the user with unique advantages and challenges when used to assist in completing navigation and orientation tasks, highlighting potential areas for improvement as well as features of one map that perform well and which the other could seek to incorporate.

Conclusions

Make changes to each map type to improve areas that are currently proving difficult to understand in the context of navigation and orientation:

_ **visualise the terrain more clearly** on the planimetric map to enable a better understanding of the direction of lifts and slopes

_ **reduce the complex appearance** of parts of the panorama map to improve finding locations

_ **consider adding more descriptive route information** to lifts and slopes to reduce ambiguity

Create a suite of different map types to support the entire user journey at each information point of the alpine winter sport experience:

_ revisit Field's **schematic ski map**, develop and test it further

_ **avoid dual-use** by not forcing one map type to fulfil several, possibly opposing, roles

_ **identify which map type is best suited** for which activity, which user type and which communication channel

Conclusions

Possible improvements for future research on ski maps:

_ test and evaluate the affordances of ski maps in situ

_ better understand the audience and create sample groups accordingly

_ better understand user journeys and user requirements and design research questions and experiments accordingly

_ seek a close partnership with the local stakeholders, particularly destination marketing and management organisations
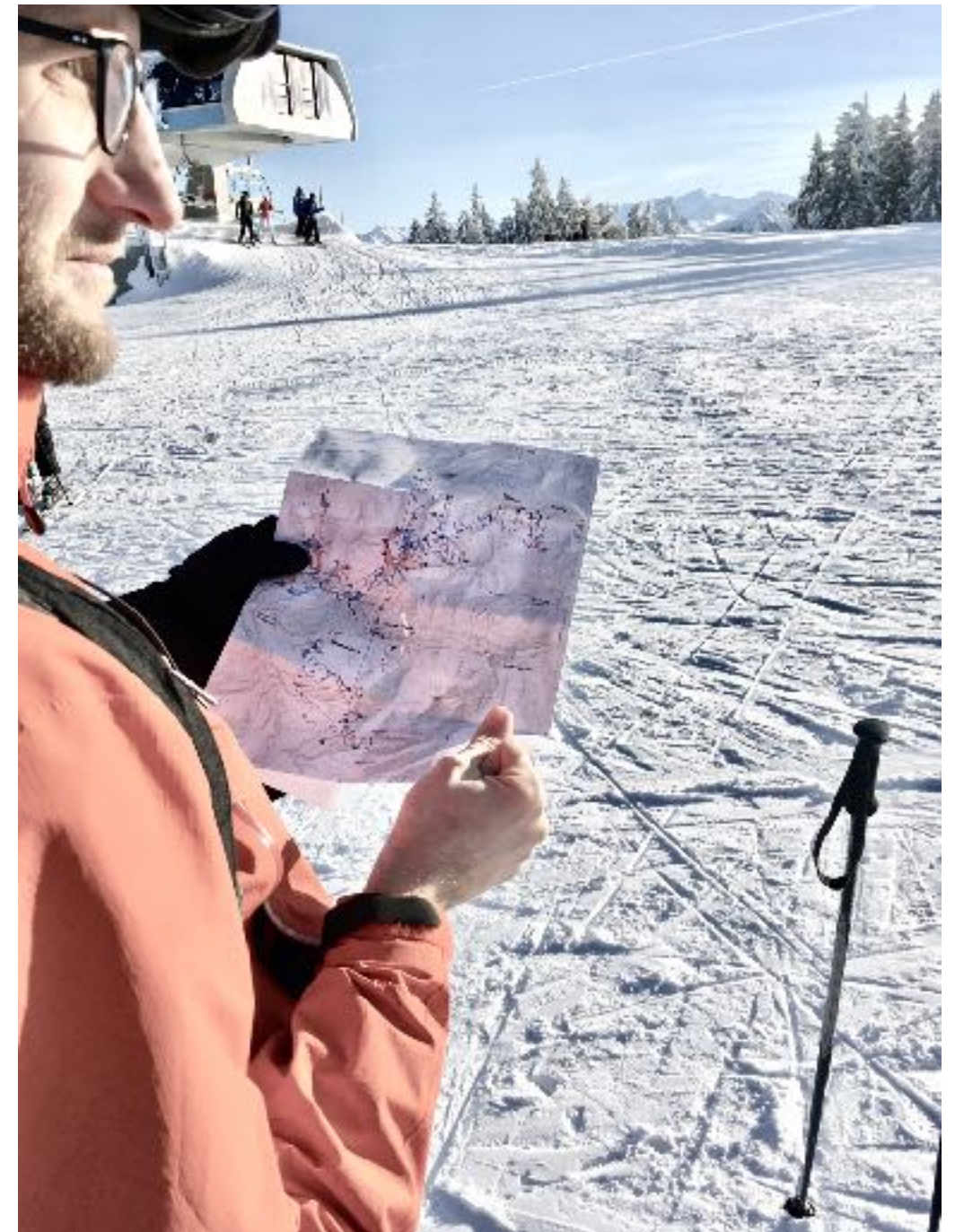
Image source: Jenny Janssen

References

Balzarini, R., & Murat, M. (2016). The Effectiveness Of Panoramic Maps Design: A Preliminary Study Based On Mobile Eye-Tracking. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLI-B2,* 361–368. https://doi.org/10.5194/isprsarchives-XLI-B2-361-2016

Balzarini, R., Dalmasso, A., & Murat, M. (2015). A Study On Mental Representations For Realistic Visualization The Particular Case Of Ski Trail Mapping. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XL-3/W3,* 495–502. https://doi.org/10.5194/isprsarchives-XL-3-W3-495-2015

Field, K. (2010). Gravity is Your Friend but Every Turn is a Leap of Faith: Design and Testing a Schematic Map for Ski Resort Trails. *The Cartographic Journal, 47(3)*, 222–237. https://doi.org/10.1179/000870410X12849977317444

SkiMap.org. (2020). Retrieved 9 September 2020, from https://skimap.org/

SkiWelt Wilder Kaiser- Brixental | Skigebiet Wilder Kaiser Brixental | Skigebiete Tirol Österreich. (2020). *Winter season.* Retrieved 23 April 2020, from https://www.skiwelt.at/de/skiwelt-wilder-kaiser-brixental-skigebiet-kitzbueheler-alpen.html

Tait, A. (2012). Mountain Ski Maps of North America: Preliminary Survey and Analysis of Style. *Cartographic Perspectives, 67,* 5–18. https://doi.org/10.14714/CP67.110

Thank you!