“Oh, that’s were you are!” - Towards a Hybrid Asymmetric Collaborative Immersive Analytics System

Nico Reski, Aris Alissandrakis, Jukka Tyrkkö, and Andreas Kerren

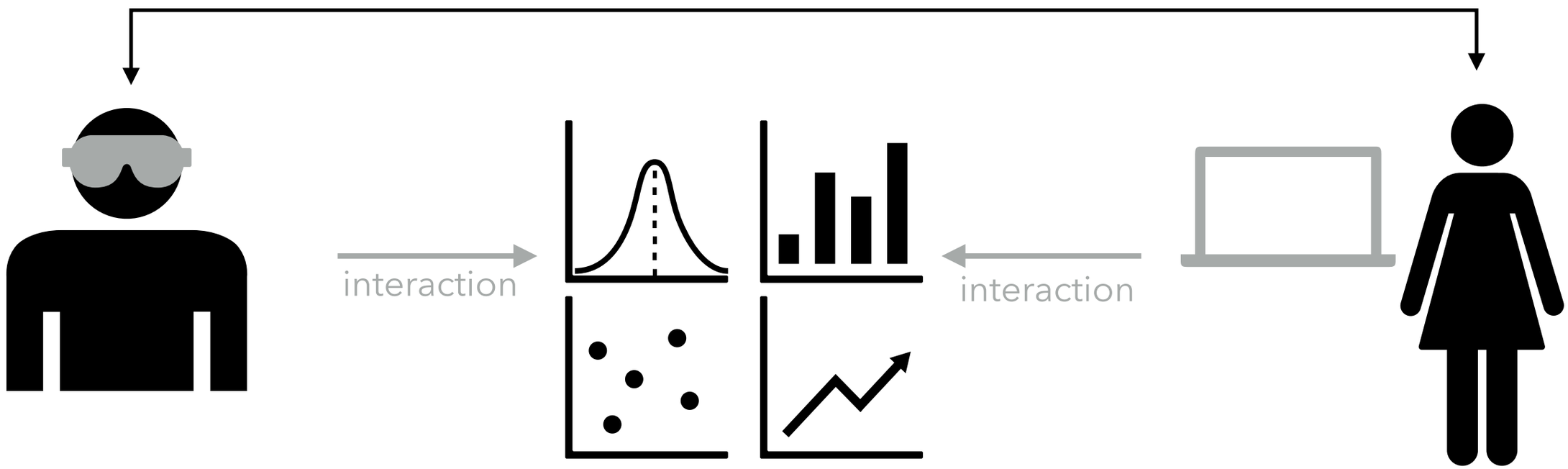
11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society (NordiCHI ’20)

Tuesday, October 27, 2020

Linnéuniversitetet

[vrxar.lnu.se]
[cs.lnu.se/isovis/]

1. Common Ground / Awareness
2. (Spatial) Reference / Deixis



immersive display and interaction technologies

synchronous interaction and collaboration

non-immersive display and interaction technologies

Immersive Analytics

Immersive display and interaction technology

Virtual Reality
Augmented Reality
Augmented Virtuality
3D User Interfaces
...

Data exploration, interaction, and interpretation

Analytical meaning- and decision-making

interdisciplinarity

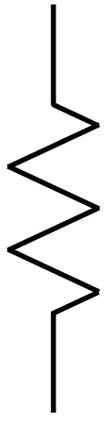
Human-Computer Interaction
Computer-Supported Cooperative Work
Virtual Reality
3D User Interfaces

Information Visualization
Visual Analytics

synergy / complementation

Human-centered Challenges

VR by default rather single user-centered
- visual isolation from real-world surroundings
- collaborative information cues not available

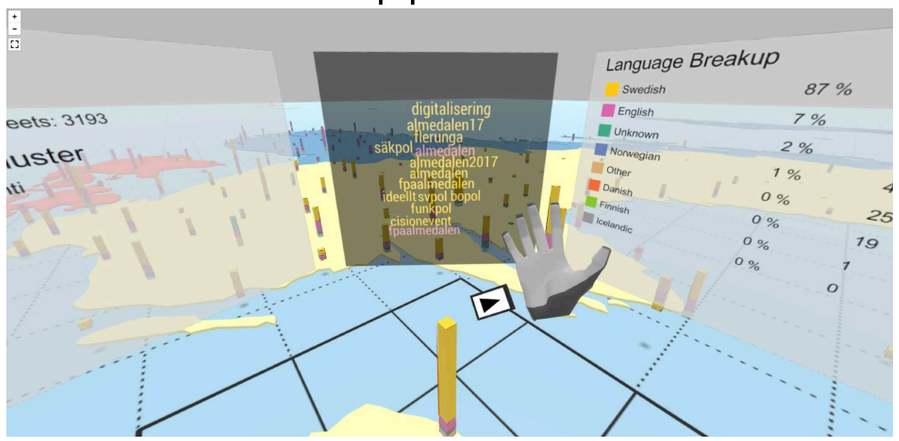


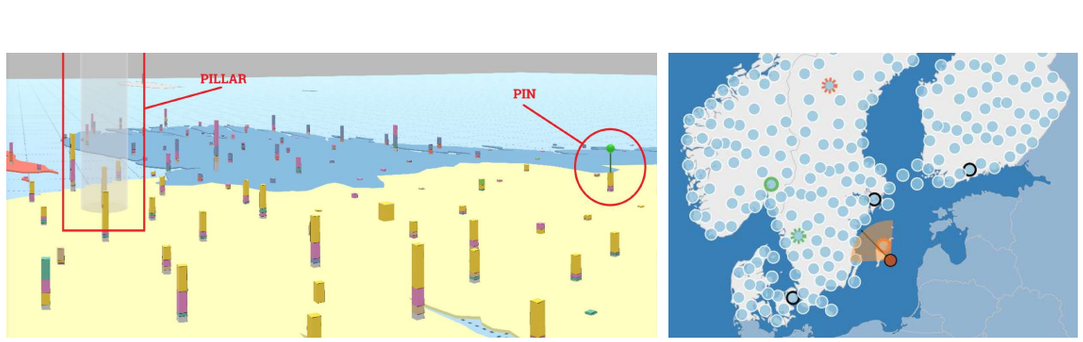
Desire for Collaborative Data Exploration

- broader expertise
- more effective than working alone
- debating about interpretation of data
- individual and contextual knowledge

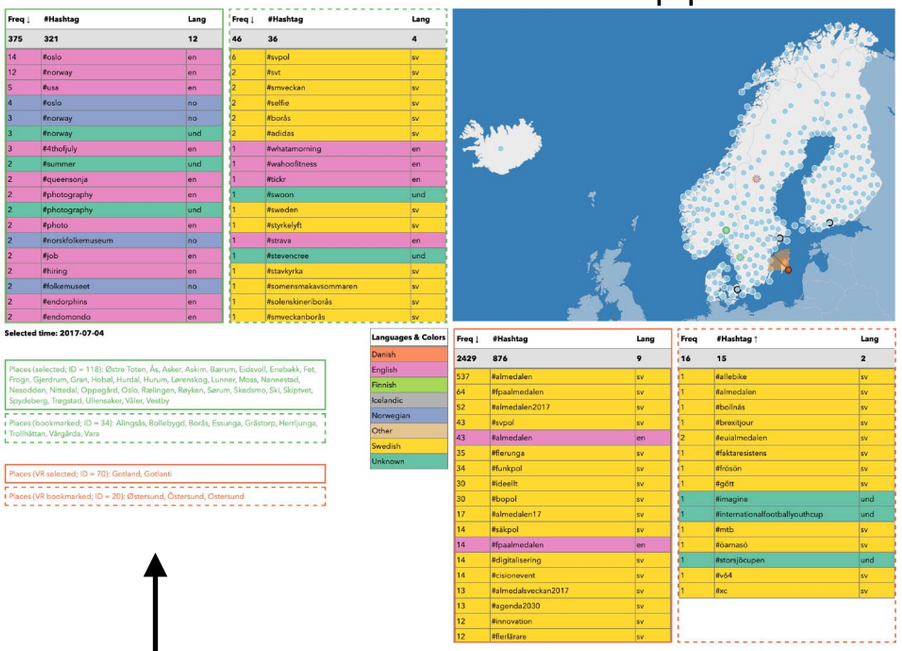
Hybrid Collaborative Immersive Analytics System

Immersive VR Application





Non-immersive Web Application

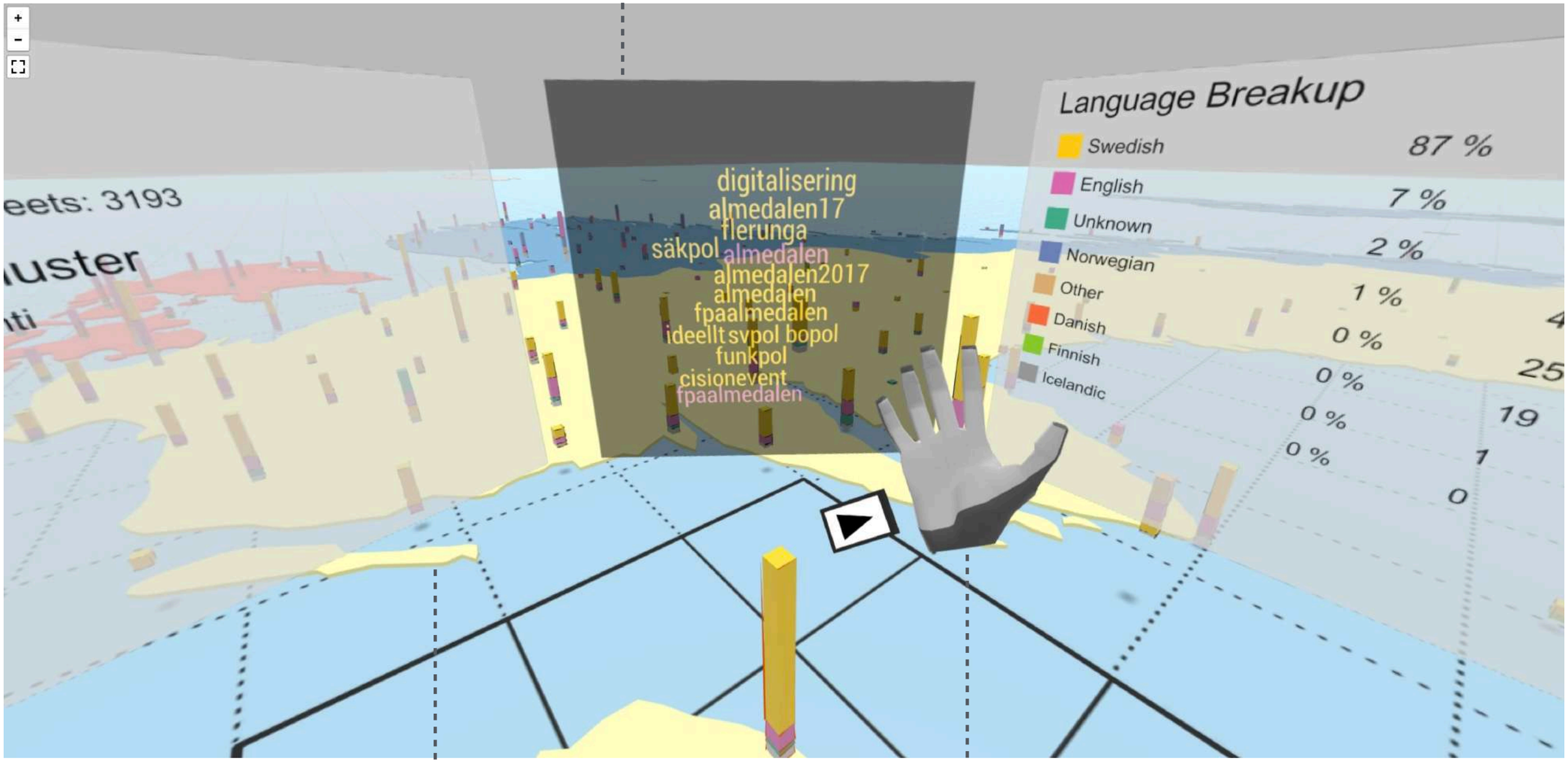


Connectivity and Collaborative Features

Data Context: Digital Humanities

- Socio-lingusistic perspective: language variability on social media
- Nordic Tweet Corpus: dynamic corpus of Tweets, rich-meta data
  - geolocation: Nordic region
  - language (according to Twitter API)

three-windowed information panel



Nordic countries

cluster

3D gestural input

Web User Table View

Freq ↓	#Hashtag	Lang
375	321	12
14	#oslo	en
12	#norway	en
5	#usa	en
4	#oslo	no
3	#norway	no
3	#norway	und
3	#4thofjuly	en
2	#summer	und
2	#queensonja	en
2	#photography	en
2	#photography	und
2	#photo	en
2	#norskfolkemuseum	no
2	#job	en
2	#hiring	en
2	#folkemuseet	no
2	#endorphins	en
2	#endomondo	en

Freq ↓	#Hashtag	Lang
46	36	4
6	#svpol	sv
2	#svt	sv
2	#smveckan	sv
2	#selfie	sv
2	#borås	sv
2	#adidas	sv
1	#whatamorning	en
1	#wahoofitness	en
1	#tickr	en
1	#swoon	und
1	#sweden	sv
1	#styrkelyft	sv
1	#strava	en
1	#stevencree	und
1	#stavkyrka	sv
1	#somensmakavsommaren	sv
1	#solenskineriborås	sv
1	#smveckanborås	sv

Map View

Selected time: 2017-07-04

Places (selected; ID = 118): Østre Toten, Ås, Asker, Askim, Bærum, Eidsvoll, Enebakk, Fet, Frogn, Gjerdrum, Gran, Hobøl, Hurdal, Hurum, Lørenskog, Lunner, Moss, Nannestad, Nesodden, Nittedal, Oppegård, Oslo, Rælingen, Røyken, Sørum, Skedsmo, Ski, Skiptvet, Spydeberg, Trøgstad, Ullensaker, Våler, Vestby

Places (bookmarked; ID = 34): Alingsås, Bollebygd, Borås, Essunga, Grästorp, Herrljunga, Trollhättan, Vårgårda, Vara

Places (VR selected; ID = 70): Gotland, Gotlanti

Places (VR bookmarked; ID = 20): Østersund, Östersund, Ostersund

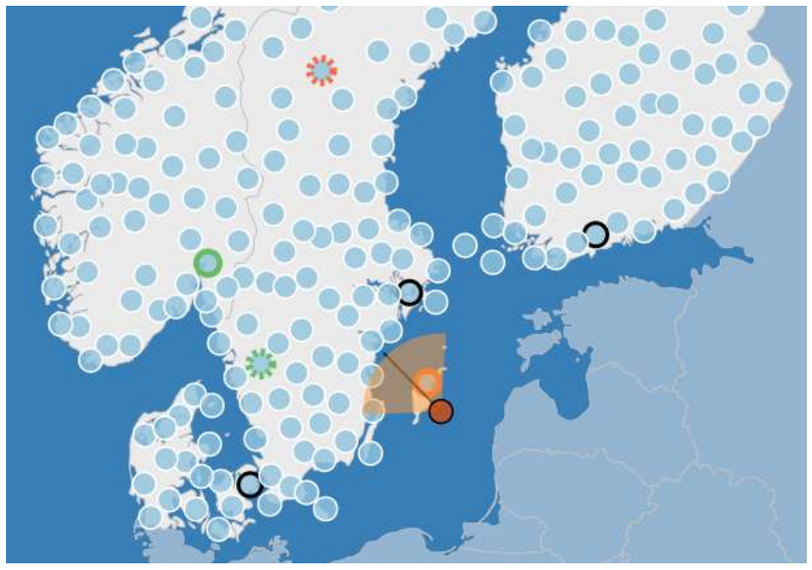
Information View

Languages & Colors
Danish
English
Finnish
Icelandic
Norwegian
Other
Swedish
Unknown

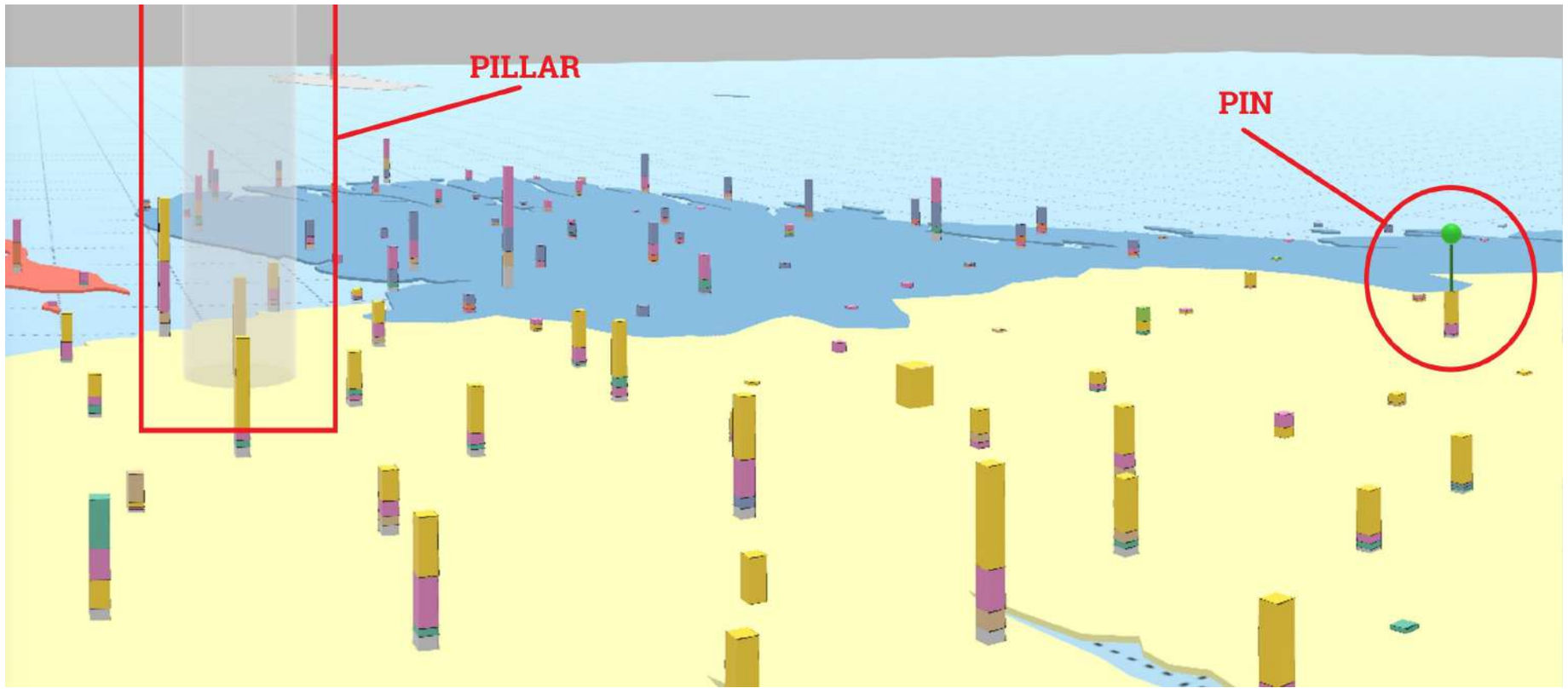
Freq ↓	#Hashtag	Lang
2429	876	9
537	#almedalen	sv
64	#fpaalmedalen	sv
52	#almedalen2017	sv
43	#svpol	sv
43	#almedalen	en
35	#flerunga	sv
34	#funkpol	sv
30	#ideellt	sv
30	#bopol	sv
17	#almedalen17	sv
14	#säkpol	sv
14	#fpaalmedalen	en
14	#digitalisering	sv
14	#cisionevent	sv
13	#almedalsveckan2017	sv
13	#agenda2030	sv
12	#innovation	sv
12	#flerlärare	sv

Freq	#Hashtag ↑	Lang
16	15	2
1	#allebike	sv
1	#almedalen	sv
1	#bollnäs	sv
1	#brexitjour	sv
2	#euialmedalen	sv
1	#faktaresistens	sv
1	#frösön	sv
1	#gött	sv
1	#imagine	und
1	#internationalfootballyouthcup	und
1	#mtb	sv
1	#öarnasö	sv
1	#storsjöcupen	und
1	#v64	sv
1	#xc	sv

VR User Table View



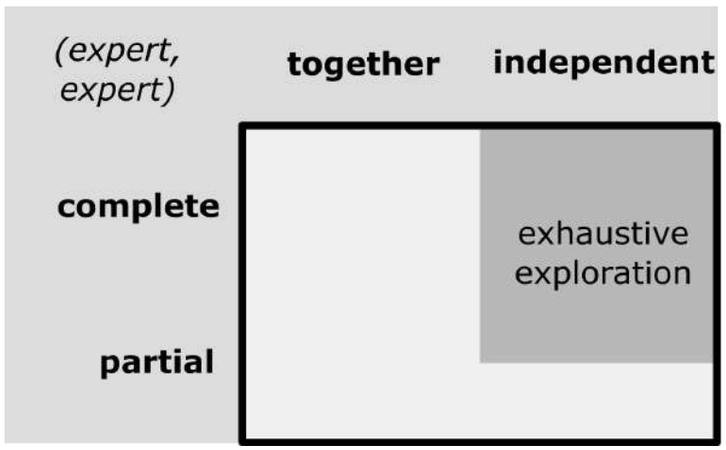
Non-immersive Web Application
VR user's position, orientation,
and FOV in Map View

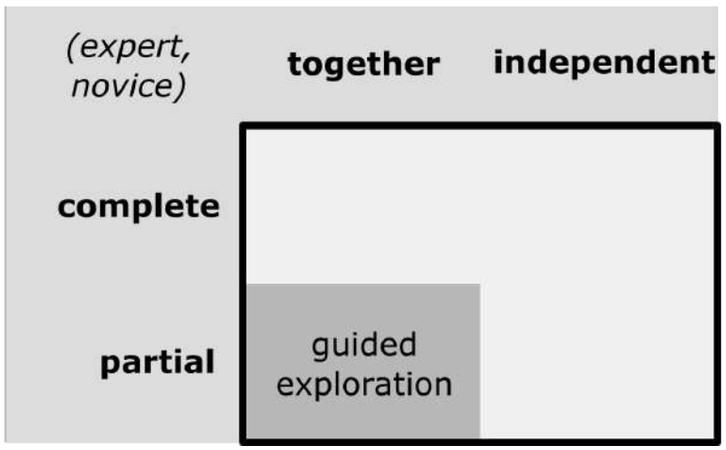


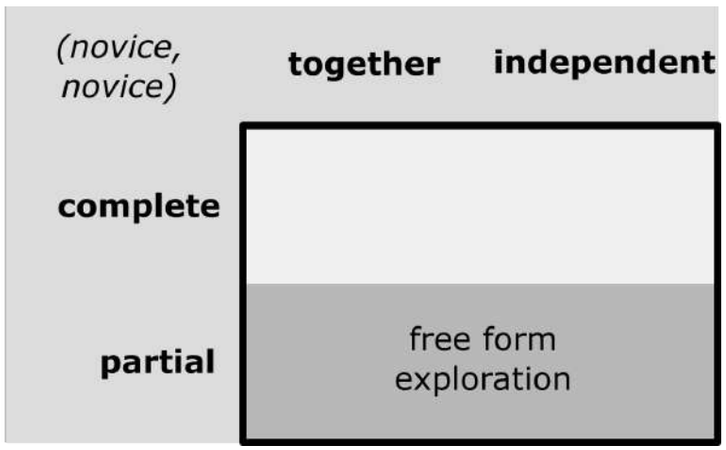
Immersive VR Application
Highlighted clusters
- pillar: web user
- pin: VR user

Anticipated Use-Case Classification

- horizontal dimension: collaboration style
- vertical dimension: dataset exploration

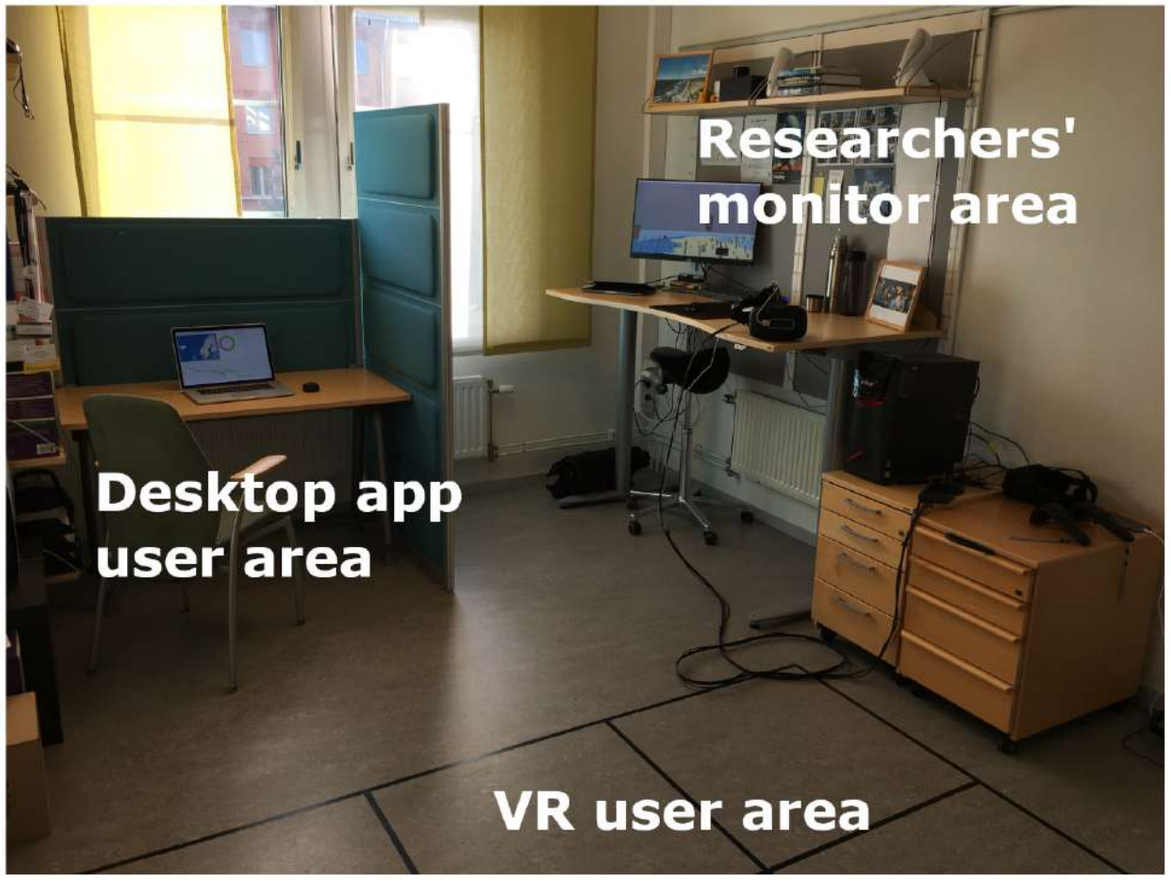


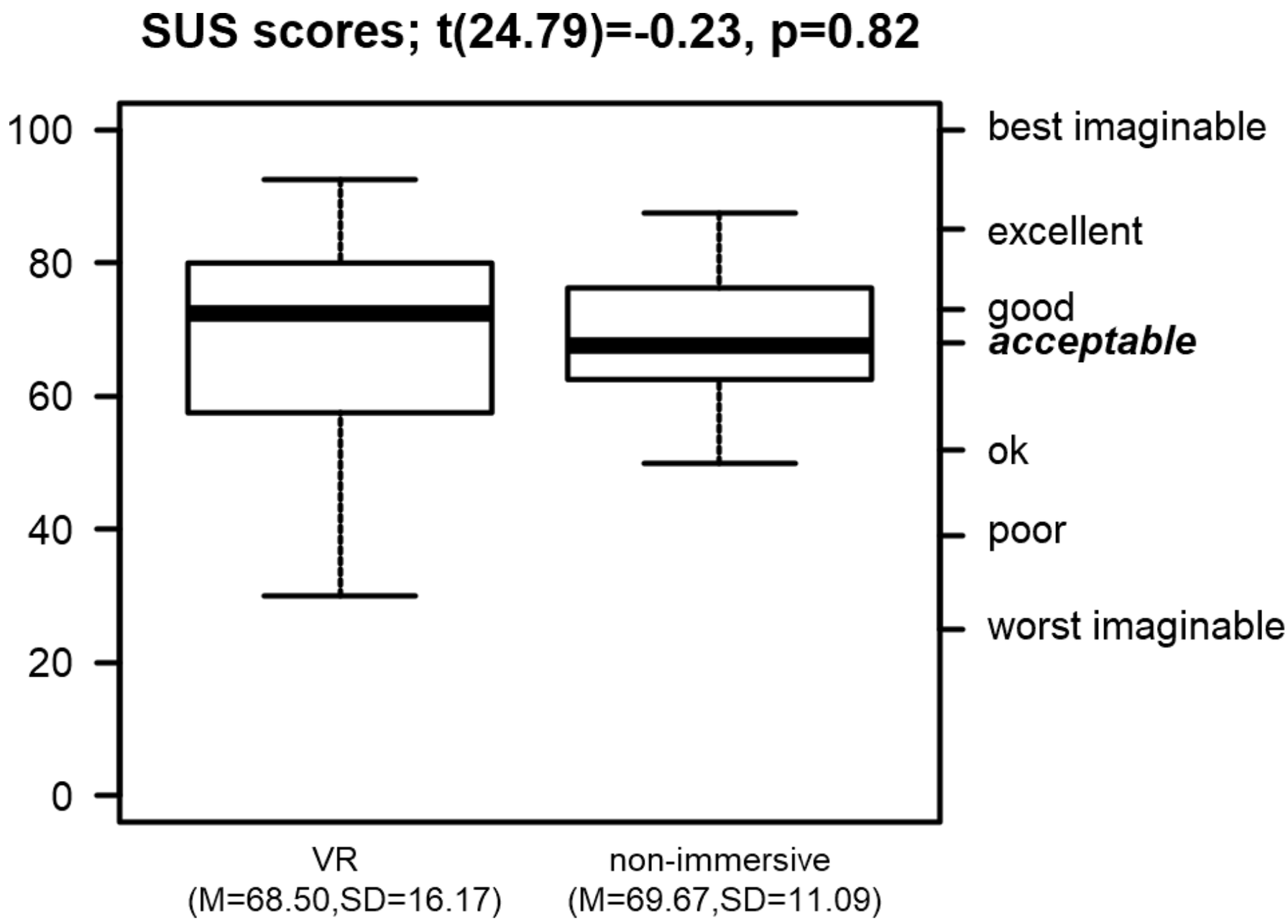


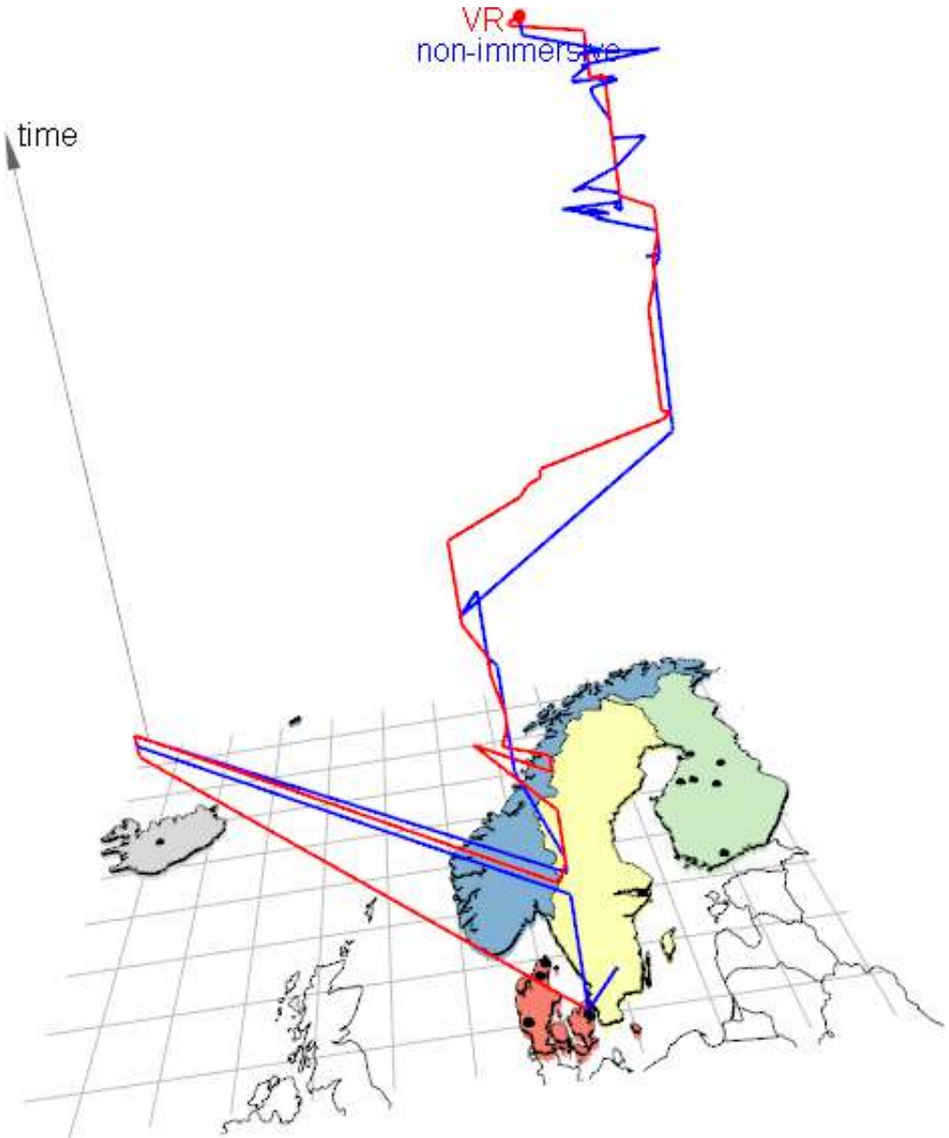


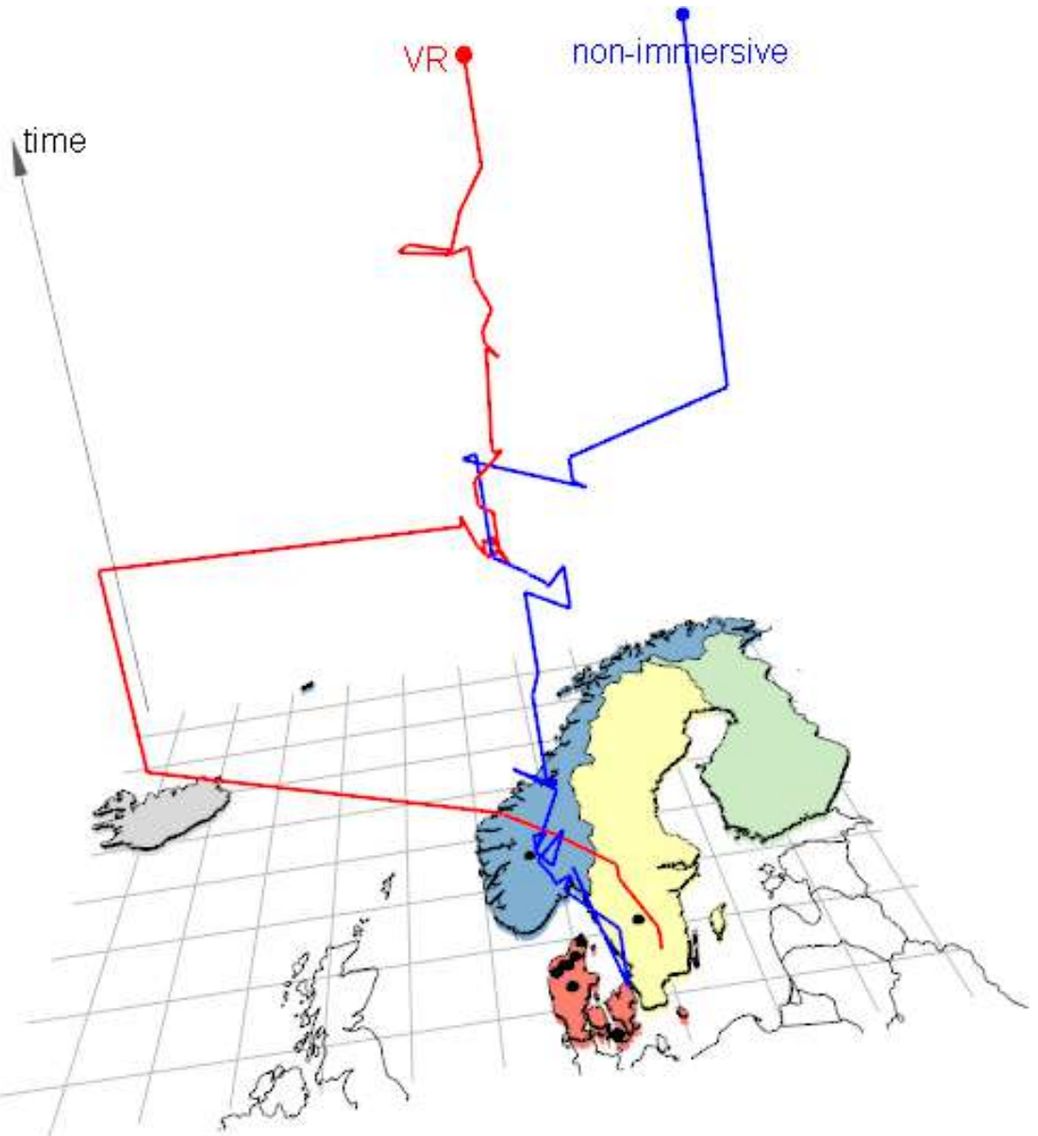
User Interaction Study

- aim: general system validation, insights in collaboration
- participants: 8 pairs of 1st year language students
- two tasks / alternating roles (each student operated each application once)
- explorative analysis: undirected search with no hypothesis given
- task: investigate language variability in relation to hashtags per Nordic region
- data collection: System Usability Scale, system logs, observations, semi-structured interview




SUS scores; t(24.79)=-0.23, p=0.82
100
80
60
40
20
0
best imaginable
excellent
good
acceptable
ok
poor
worst imaginable
VR
(M=68.50,SD=16.17)
non-immersive
(M=69.67,SD=11.09)





“mostly together”

“individual”

Task Assessments

- domain expert was satisfied with assessments from first year language students
- formulated assessments reasonable in regard to complexity and critical thinking
- collaboration encouraged additional assessments based on own contextual knowledge

Collaborative Data Exploration Strategies

- 3 pairs: close collaboration, systematic / structured exploration
- 3 pairs: close collaboration, free form exploration
- 2 pairs: mixed collaboration (close and individual) with ad-hoc “synchronization”

Reference and Deixis

- generally frequent use of deictic references and related terminology across all pairs
- examples: "I am here", "Let's look there", "Do you want to see this or that", "Turn around", "Behind you", "Should I come to you", …
- collaborative pointing features facilitated mutual understanding

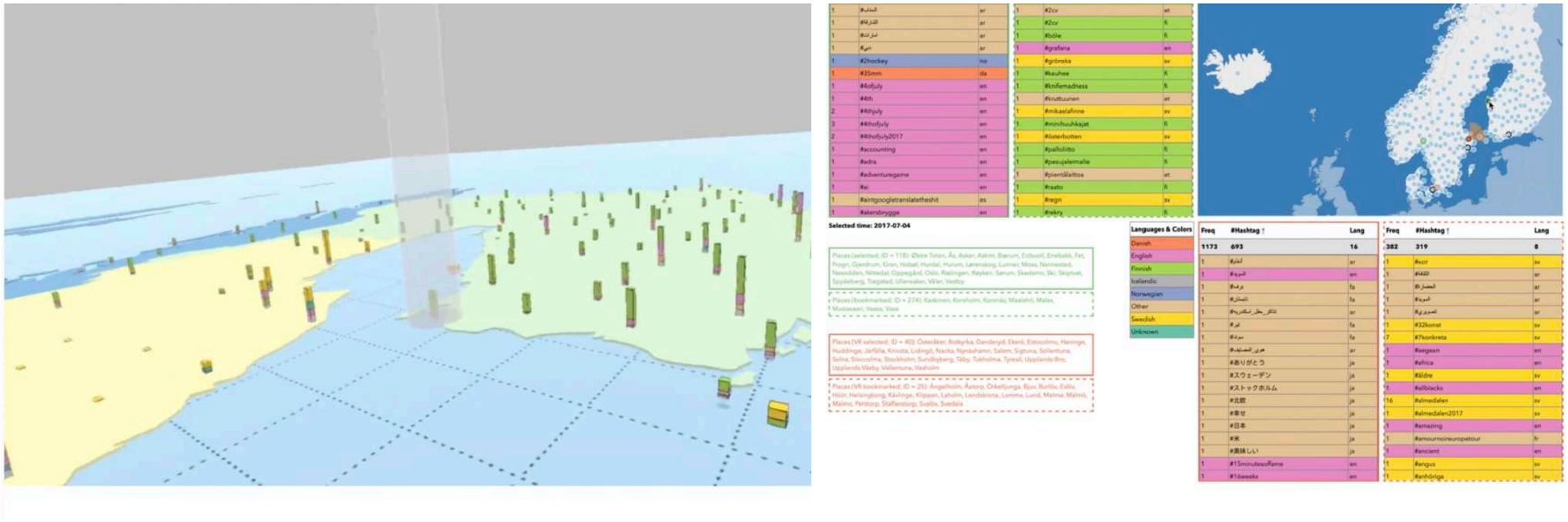
Role Distribution and Preferences (multiple answers per participant possible)

- 4 participants: equal balance between immersive and non-immersive application

- 6 participants: preference towards immersive application
- 1 participant: preference towards non-immersive application
- 4 participants: choice depends on task

- 5 participants: active argumentation for preference of collaborative scenario
- “two-person job”

Virtual Reality application · Web application



Conclusion

- validation of a novel approach towards asymmetrical collaboration (“inside” and “outside” VR) within the context of Immersive Analytics

Vision

- multiple tools, using different display and interaction technologies, to support different purposes within data exploration, framing a greater workflow

Future Work

- additional studies, further investigating other collaboration aspects, e.g., user engagement, attention, empathy