Collaborative immersive analytics using immersive virtual reality and non-immersive technologies

Nico Reski (doctoral student)

Guest presentation, University of Oulu

May/June 2019

Nico Reski (M.Sc.)

Linnaeus University, Sweden
Computer and Information Science (Doctoral student)
2017-05-01 -- 2022-05 (planned)

Linnaeus University, Sweden
Social Media and Web Technologies (M.Sc.)
2013 -- 2015

Hochschule für Technik und Wirtschaft Berlin, Germany
International Media and Computing (B.Sc.)
2010 -- 2013

Supervision

Aris Alissandrakis (Ph.D.)
Senior Lecturer in Computer Science and Media Technology
Head of VRxAR Labs research group [vrxar.lnu.se]

Andreas Kerren (Prof.)
Professor in Computer Science and Media Technology
Head of ISOVIS research group [cs.lnu.se/isovis/]

Linnaeus University, Sweden

Doctoral studies at Linnaeus University

- Computer and Information Science (Computer Science, Informatics, Media Technology)

- doctoral thesis = 150 ECTS (ISP)

- additional course activities = 90 ECTS (ASP)

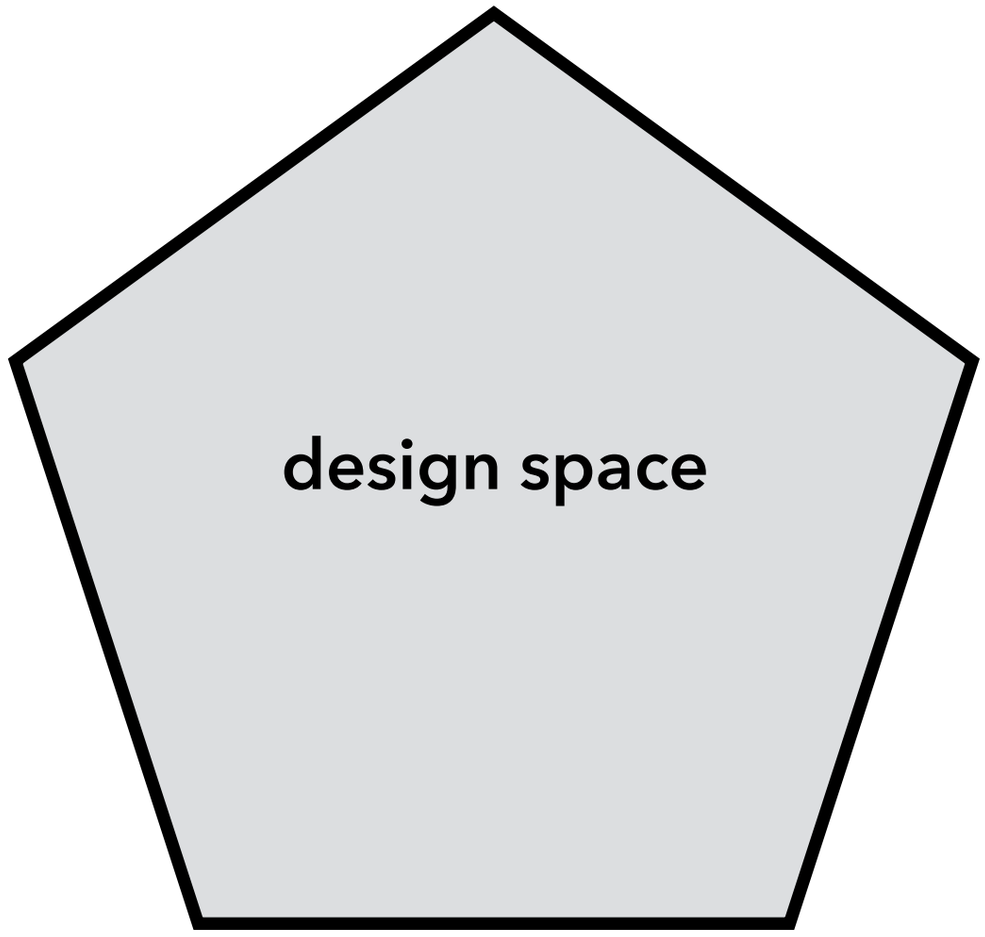
- 100 % (full-time) activity = 80 % PhD work + 20 % work in the department (e.g. admin, teaching assistance, etc)

- third-cycle education = ~ 5 years

- hired at the university (not a project or alike)

virtual reality

immersive analytics



3D user interfaces

computer-supported
cooperative work

[Data / Stakeholders]

A user in a VR environment. (example)

Collaborative immersive analytics using
immersive VR and non-immersive technologies

tracking sensors

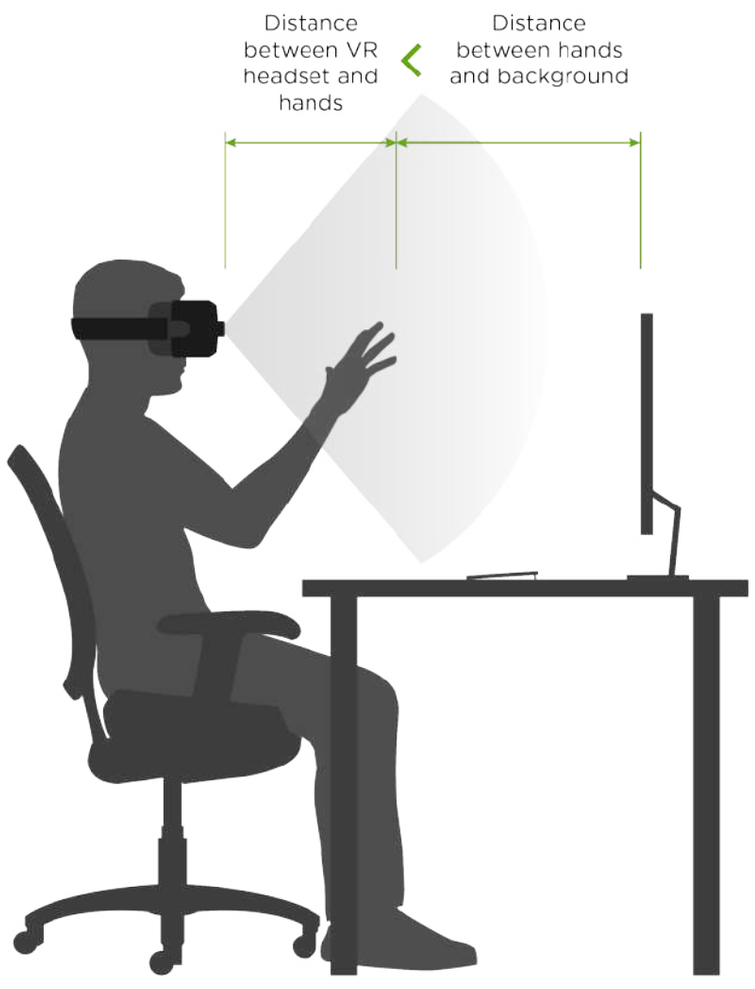
head-mounted display
(HMD; “VR headset”)

3D gestural input

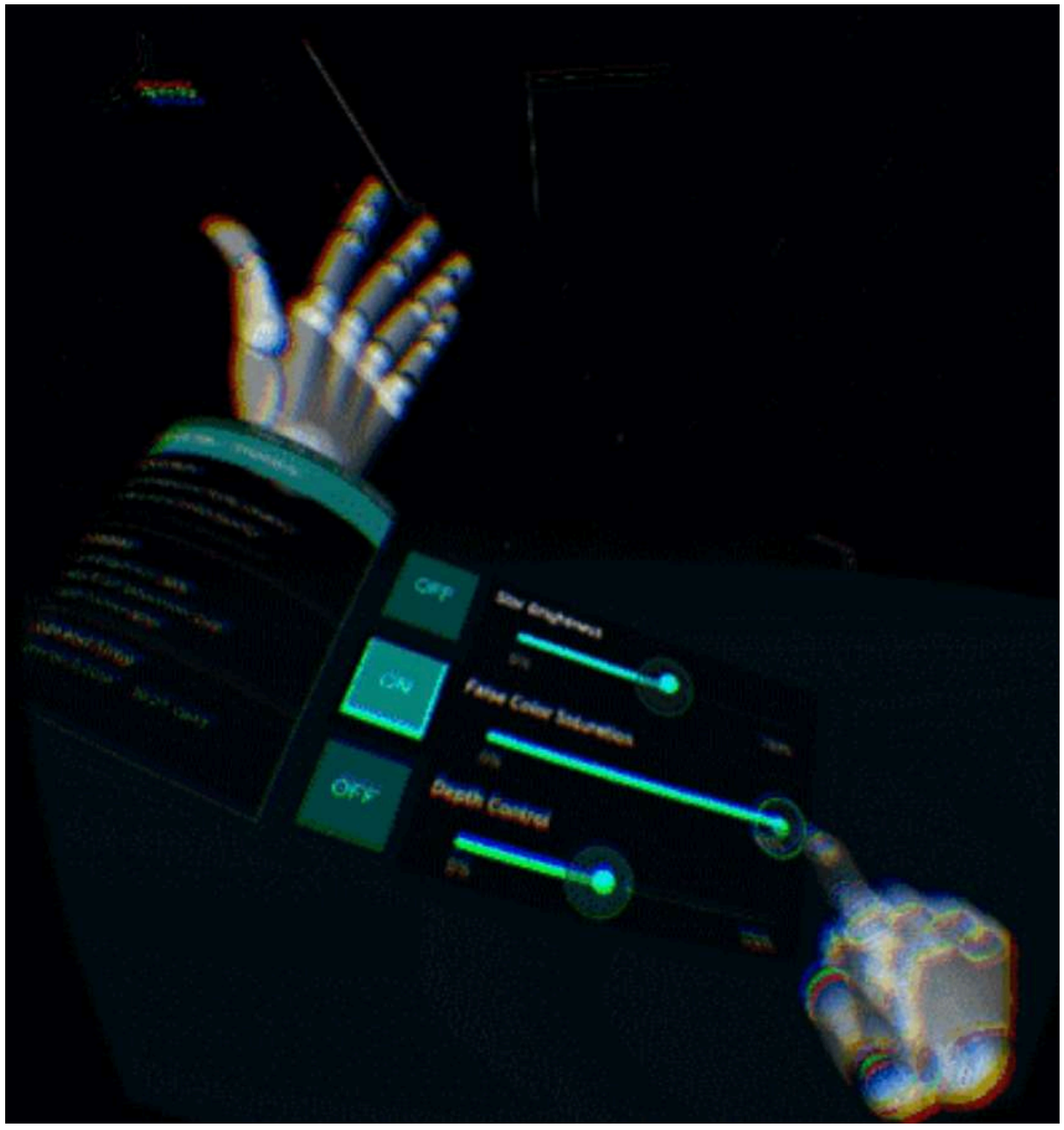
physical real-world space

computer-generated, virtual
three-dimensional (3D) environment

VR Interaction: Vision-based motion controls or 3D gestural input



Collaborative immersive analytics using immersive VR and non-immersive technologies



via blog.leapmotion.com

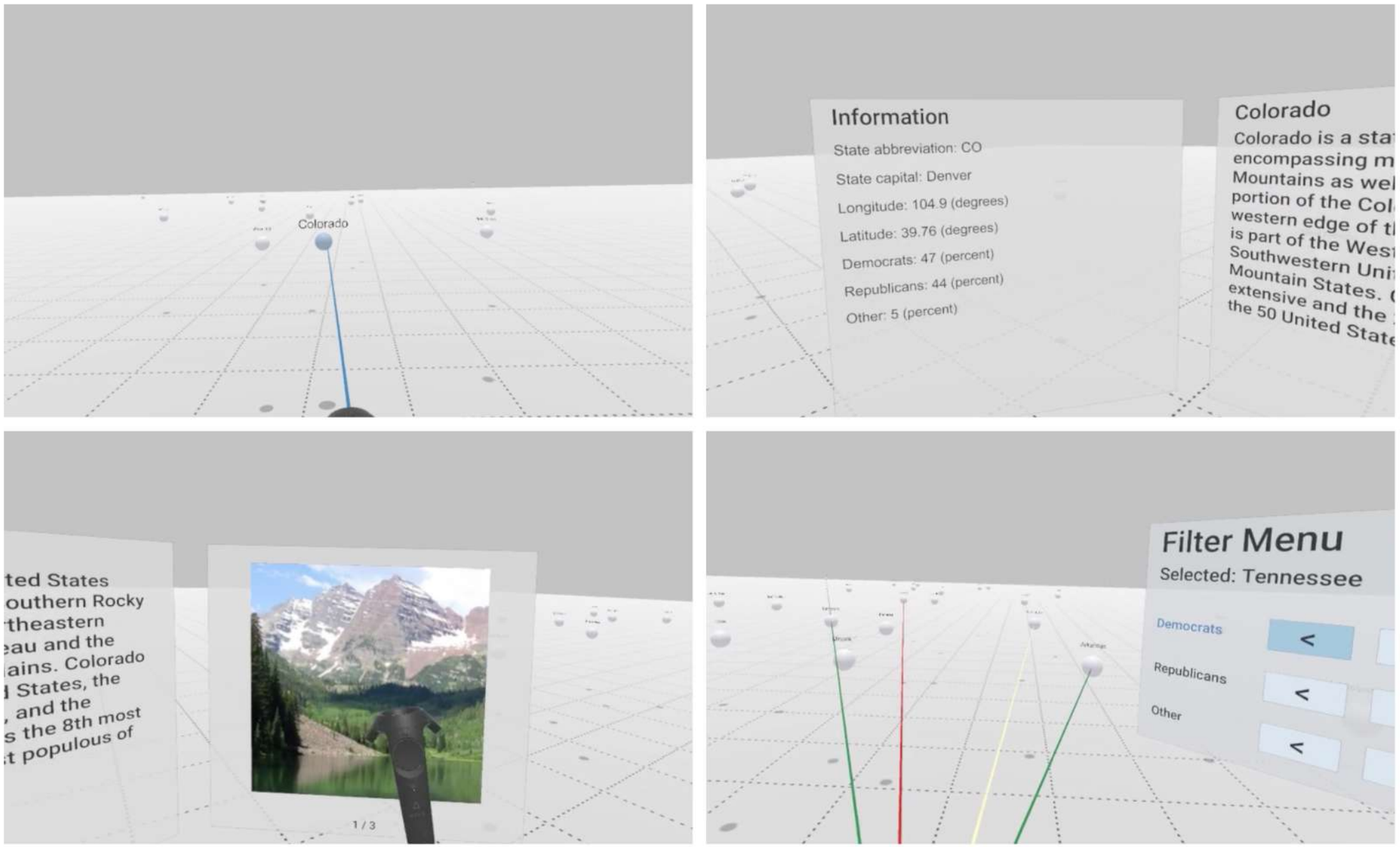
via tomshardware.com

via vive.com

ODXVR:
Open Data Exploration in Virtual Reality

Collaborative immersive analytics using
immersive VR and non-immersive technologies

Development of a system that allows a user to interact with data within an immersive VR environment. Visual user interface design and data visualization are intentionally minimalistic. Data from multiple sources (Wikipedia, Wolfram Alpha, The NY Times).

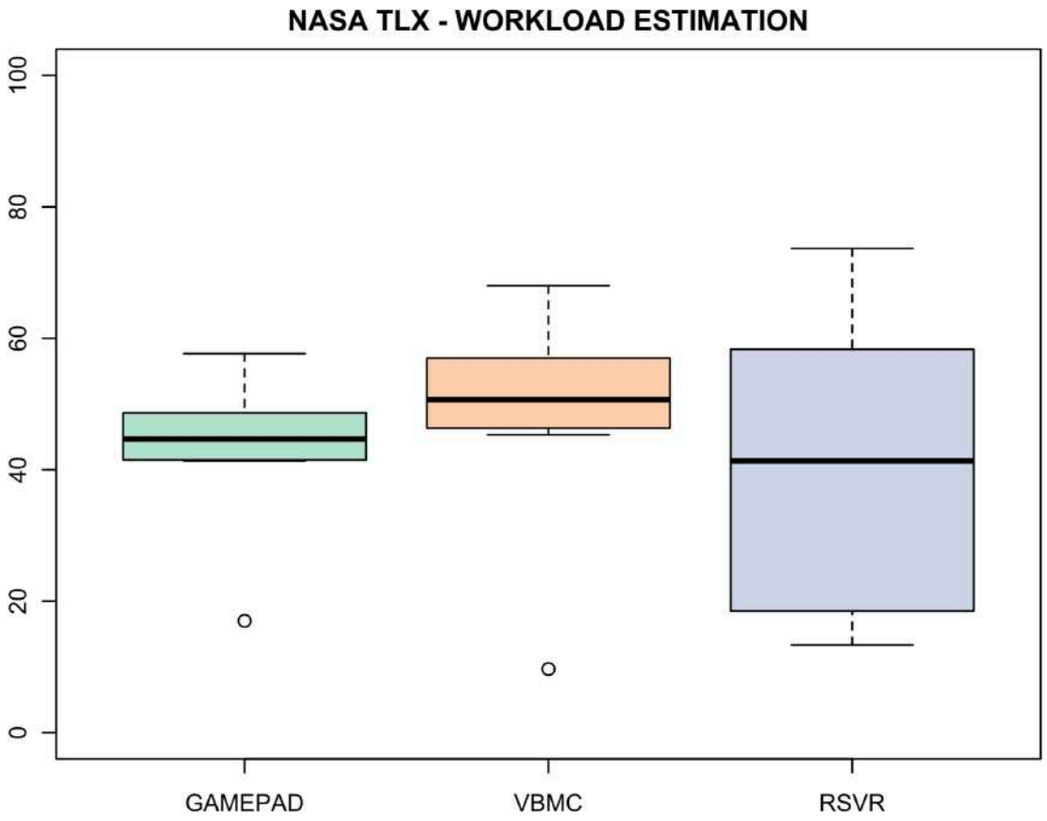


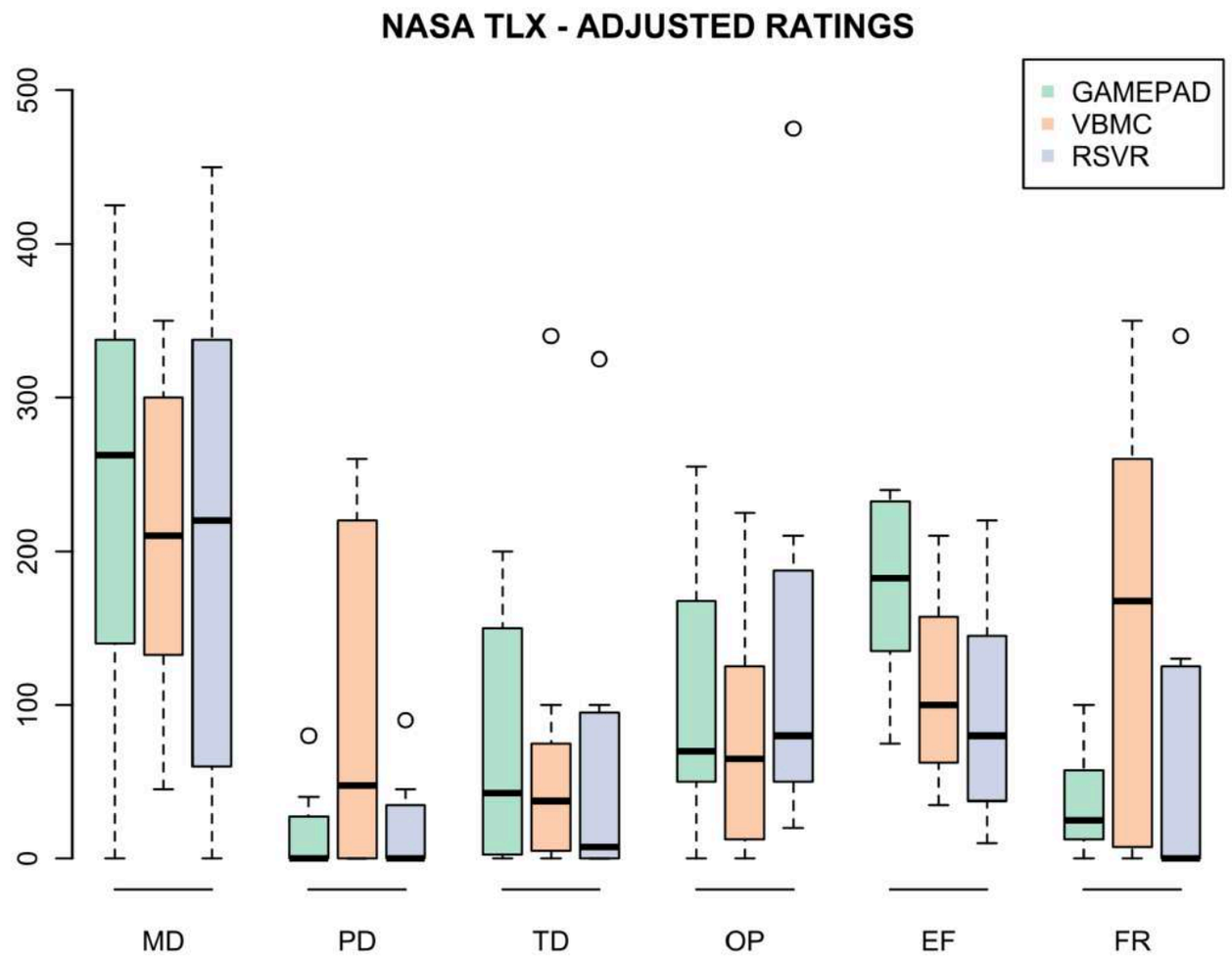
Reski and Alissandrakis. 2019.
[vimeo.com/vrxar/odxvr-demo]

Comparison of using different types of input technologies in order to interact within an immersive VR environment in the context of data exploration.

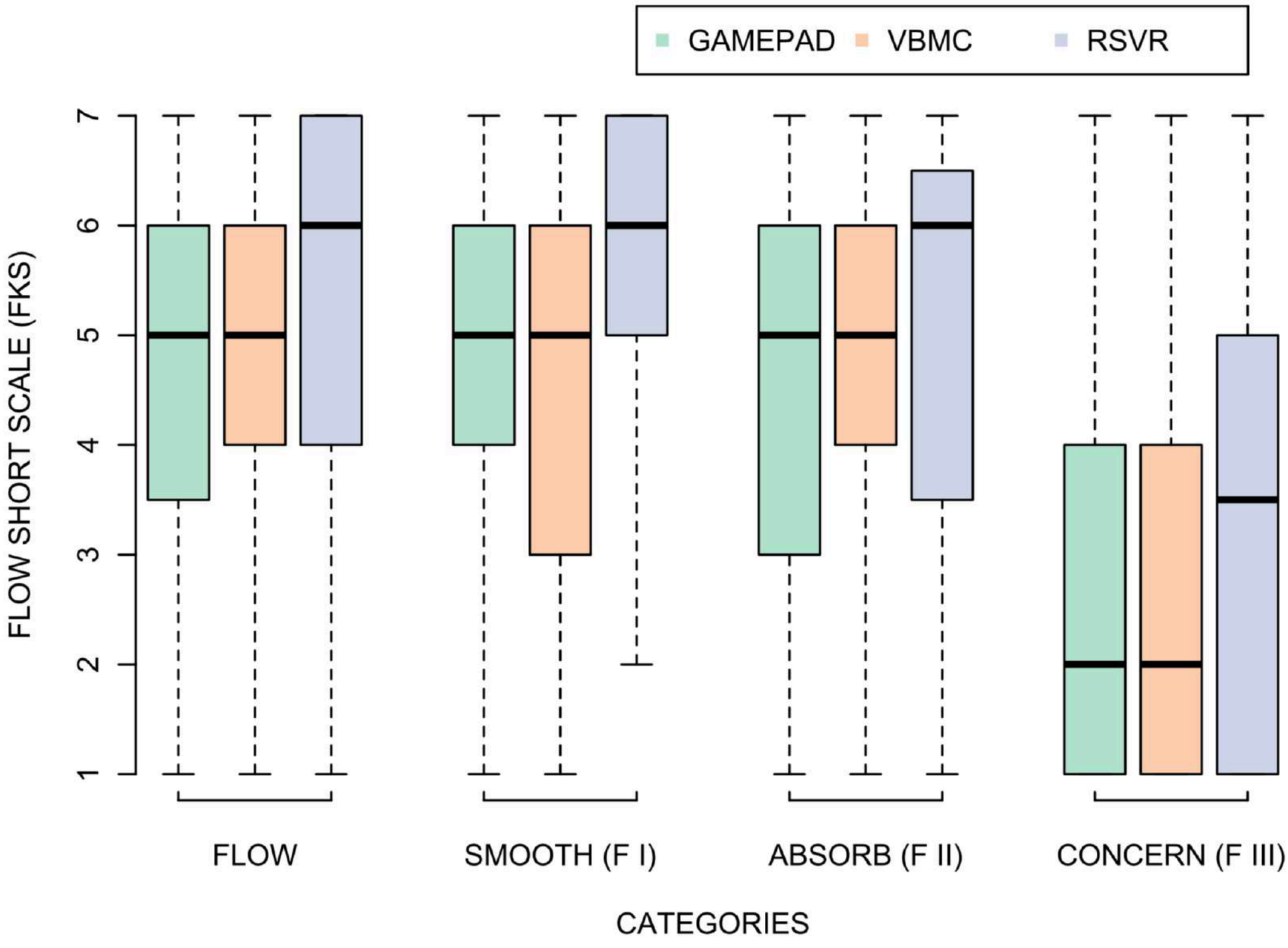
Input device characteristics	GAMEPAD	Vision-based motion controls (VBMC)	Room-scale VR (RSVR)
Visual representation (in VR)	No	Yes	Yes
Physical controller	Yes	No	Yes
Sensor type	Active	Passive	Active and passive
Input device data frequency	Discrete	Continuous	Discrete and continuous
HMD	Oculus Rift CV	Oculus Rift CV	HTC Vive

Reski and Alissandrakis. 2019.





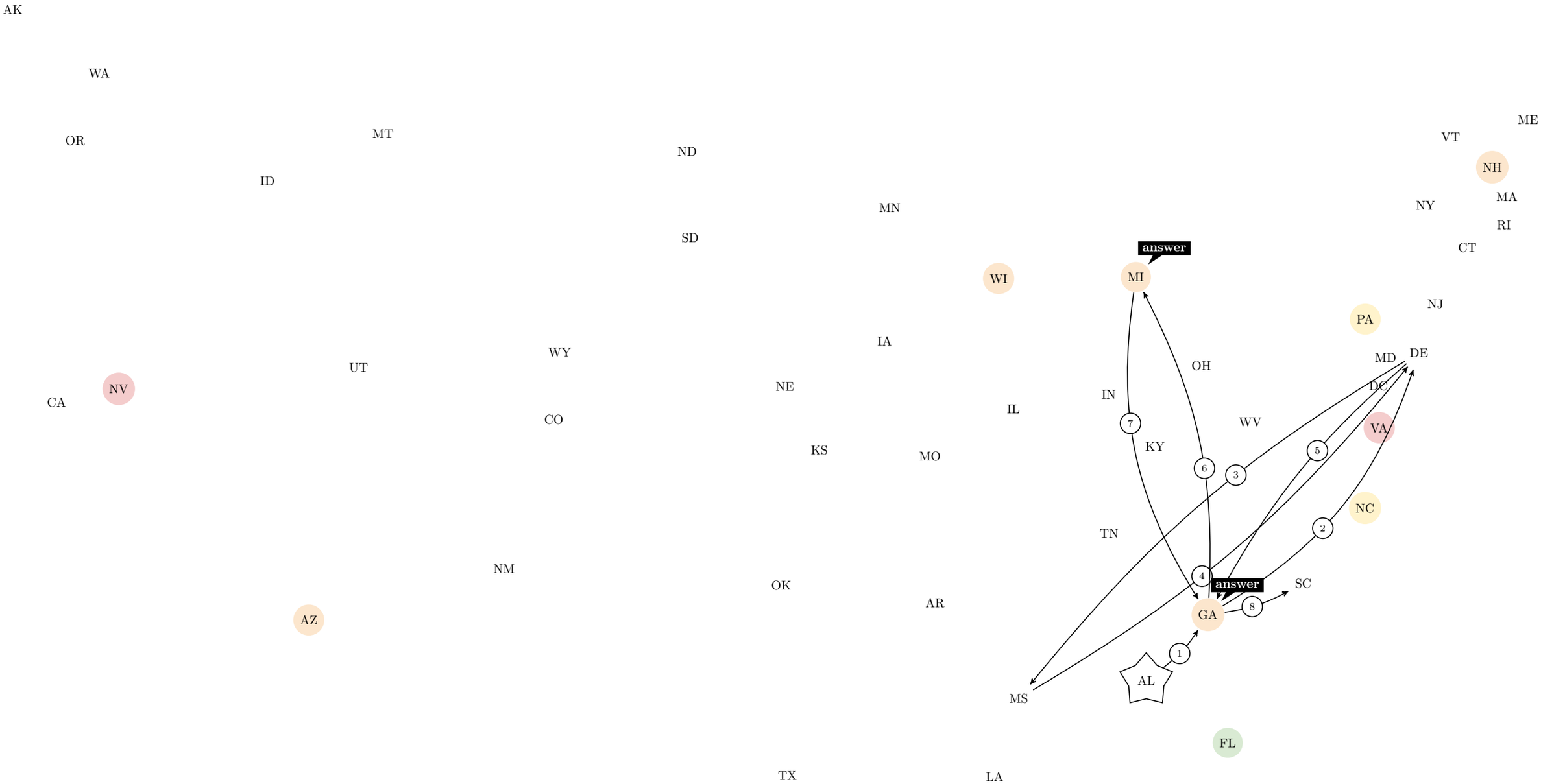
Reski and Alissandrakis. 2019.



Reski and Alissandrakis. 2019.

ODXVR results: Exploration behaviour - loops of lower complexity

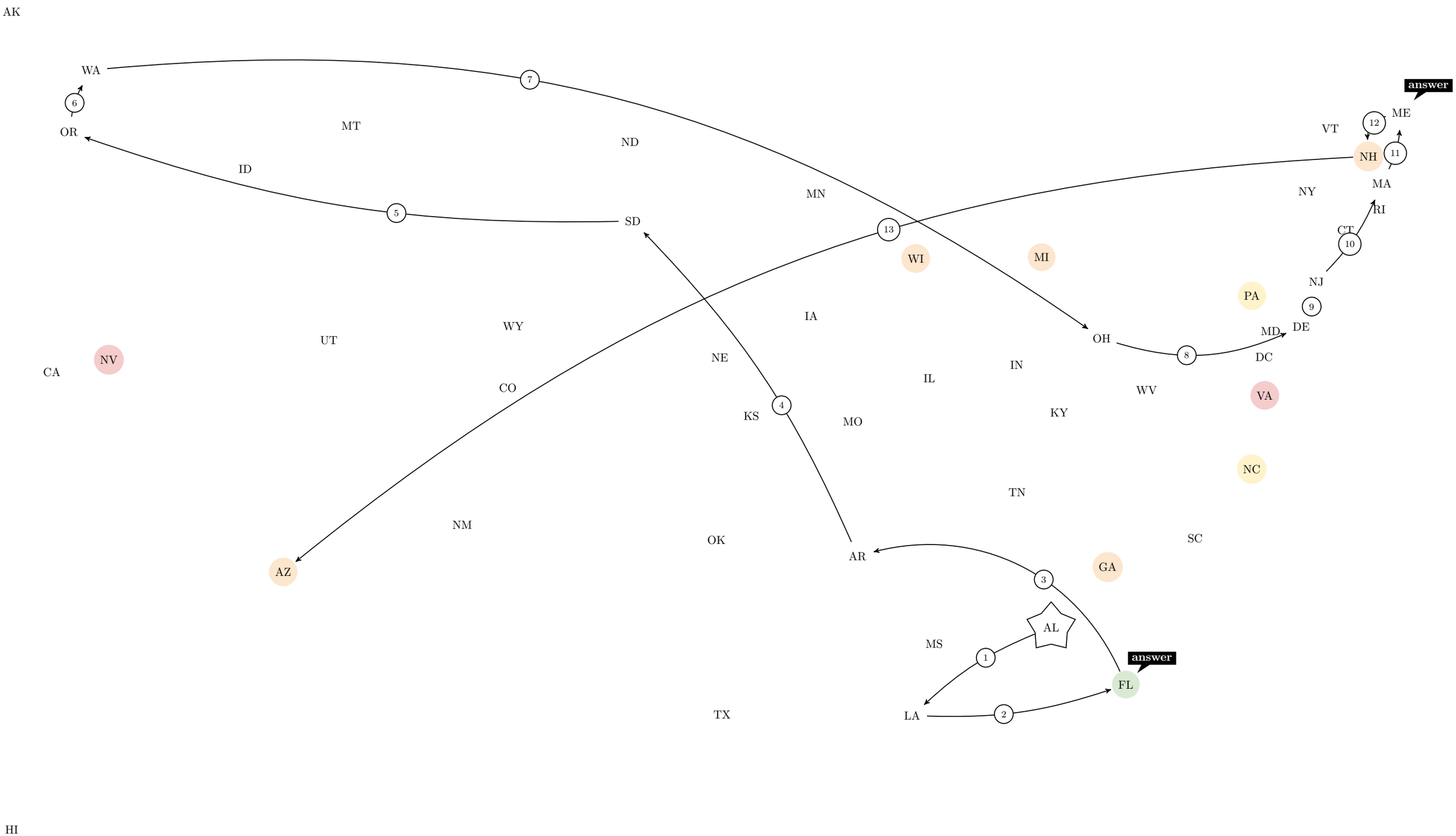
Collaborative immersive analytics using immersive VR and non-immersive technologies



Reski and Alissandrakis. 2019.

ODXVR results: Exploration behaviour - straight walk

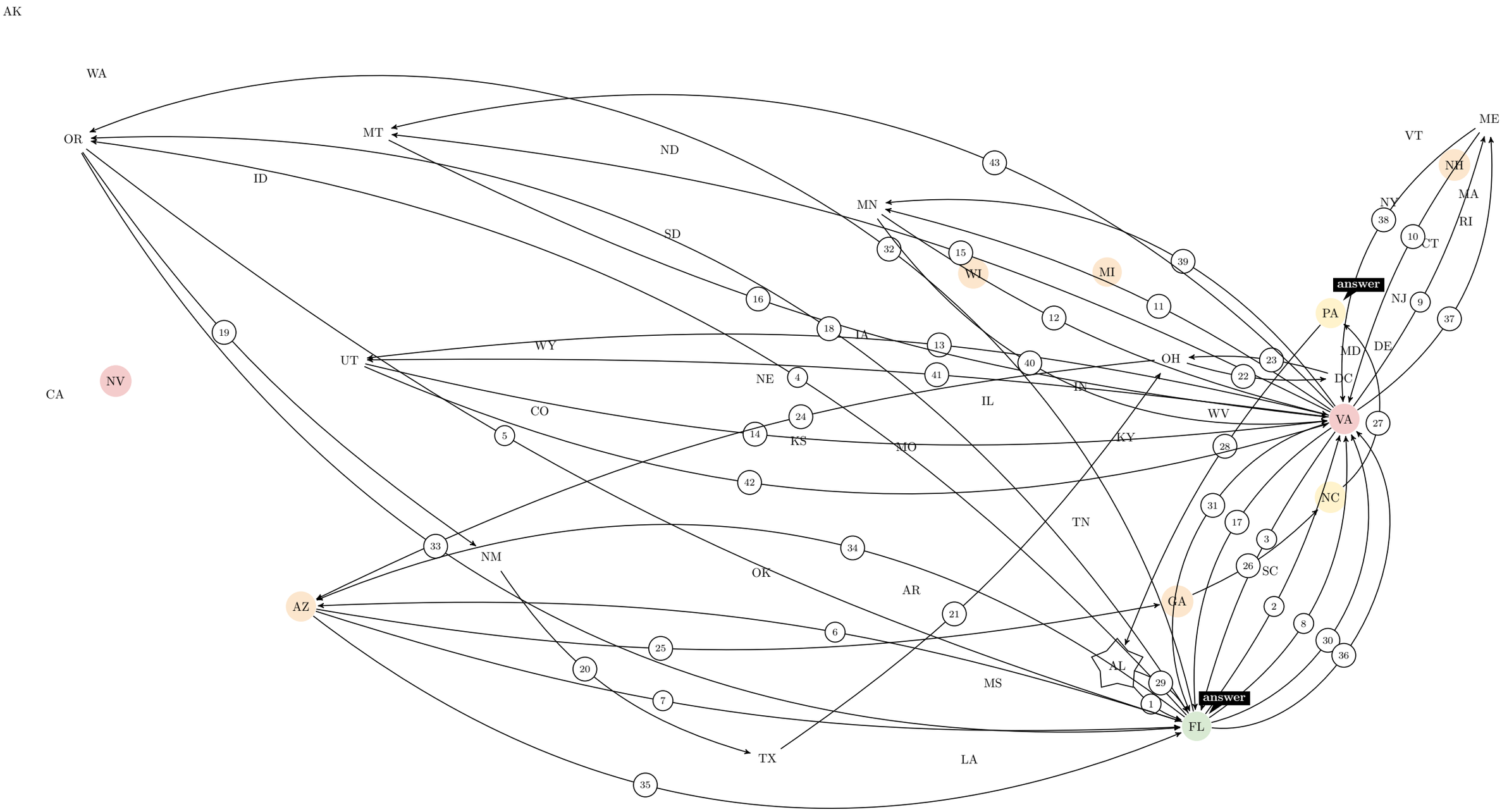
Collaborative immersive analytics using immersive VR and non-immersive technologies



Reski and Alissandrakis. 2019.

ODXVR results: Exploration behaviour - highly complex and systematic

Collaborative immersive analytics using immersive VR and non-immersive technologies



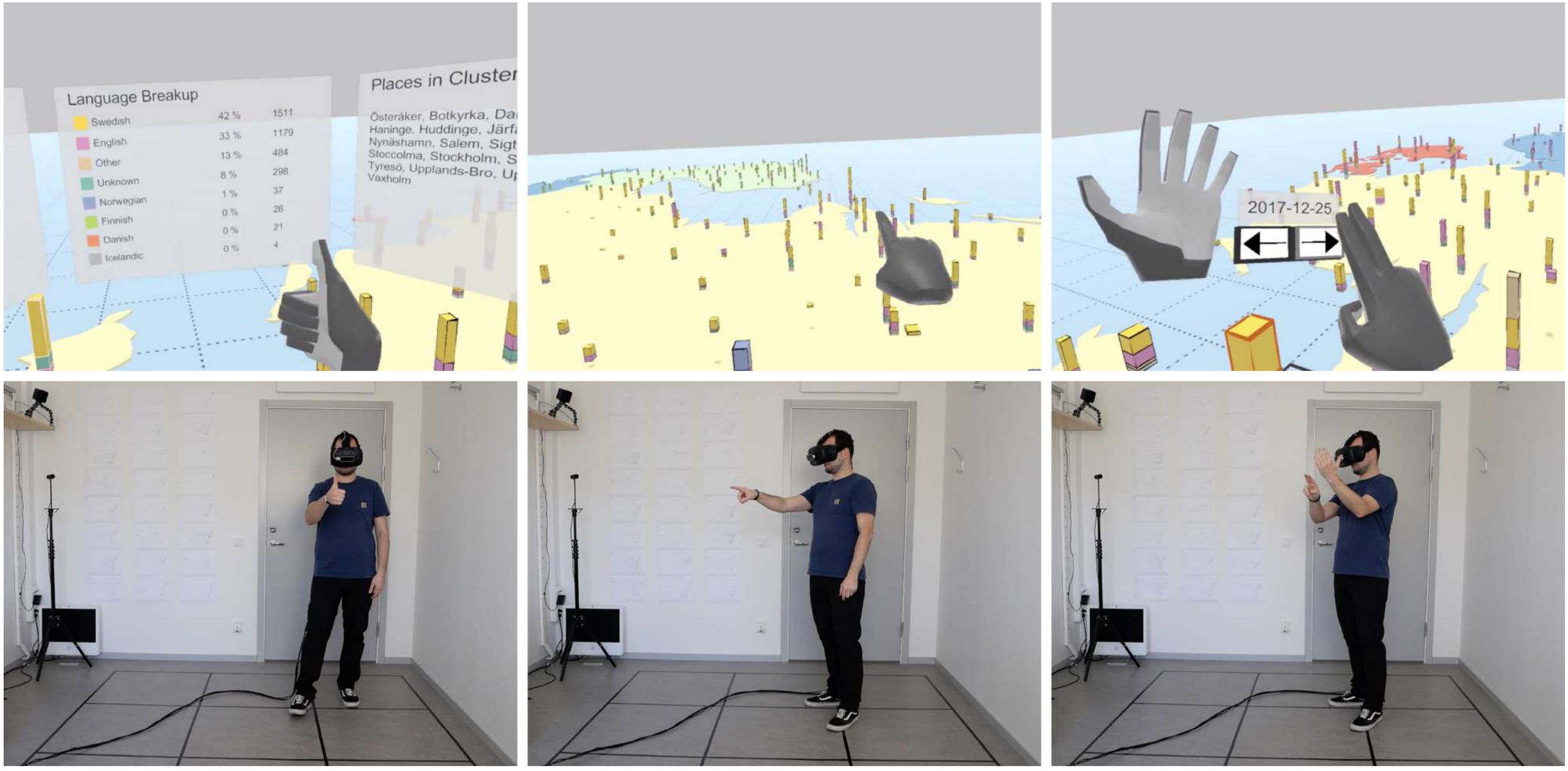
Reski and Alissandrakis. 2019.

The Nordic Tweet Stream (NTS) corpus

- cross-disciplinary project between computer scientists and a group of sociolinguists interested in language variability in general and English as a lingua franca (ELF)
- corpus of social media data: Twitter
- geolocated tweets sent from the five Nordic countries
- collected in real-time (Twitter Streaming API)
- rich meta-data
- project active since November 2016

Laitinen et al. 2018.
Alissandrakis et al. 2019 (accepted).

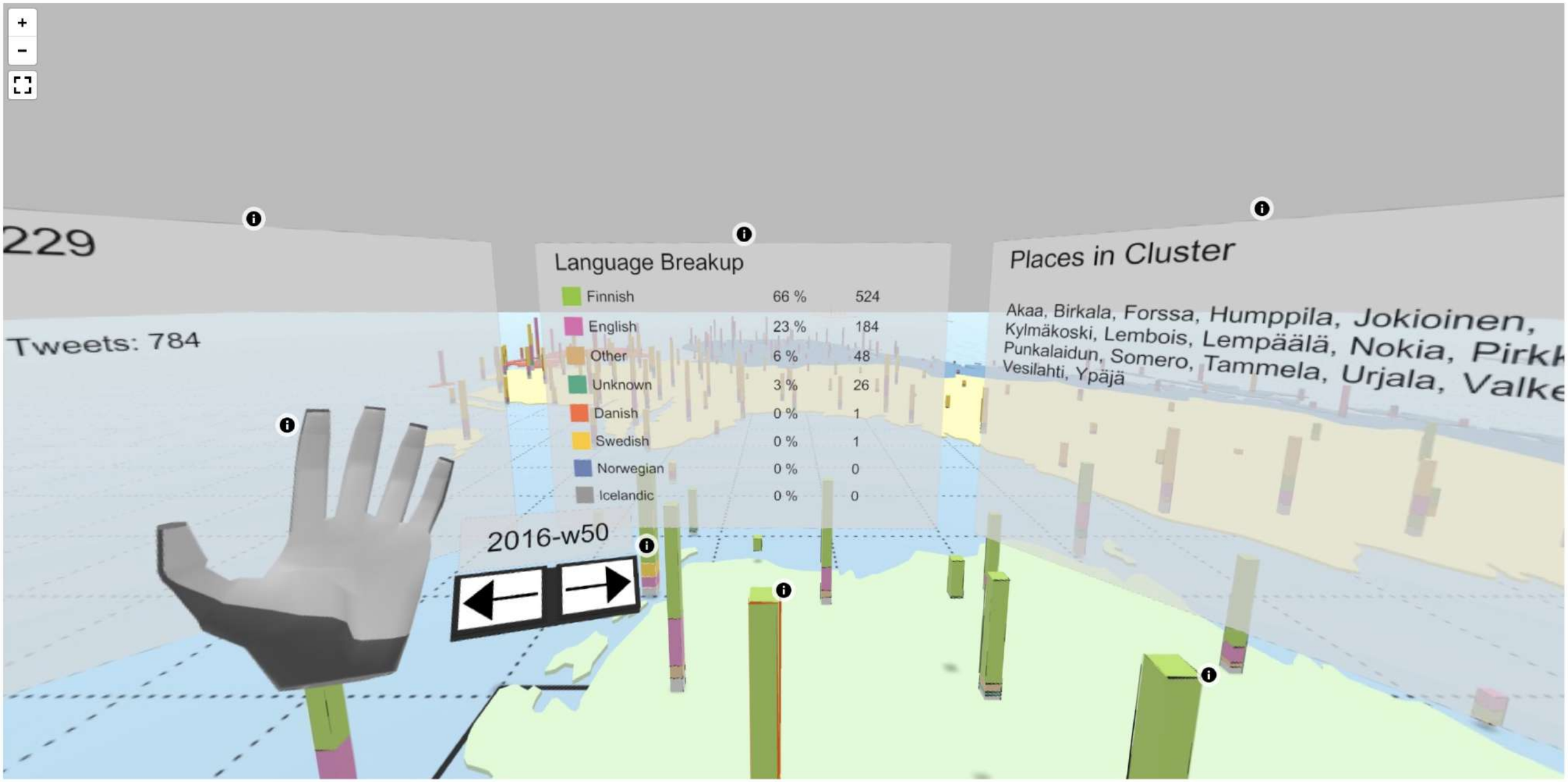
Using immersive technologies, such as VR, to explore language variability within tweets in the Nordic countries. Collaboration with Department of Languages at LNU.



Alissandrakis et al. 2018, 2019. / Reski et al. In preparation.

[vimeo.com/vrxar/hcia-wip2018]

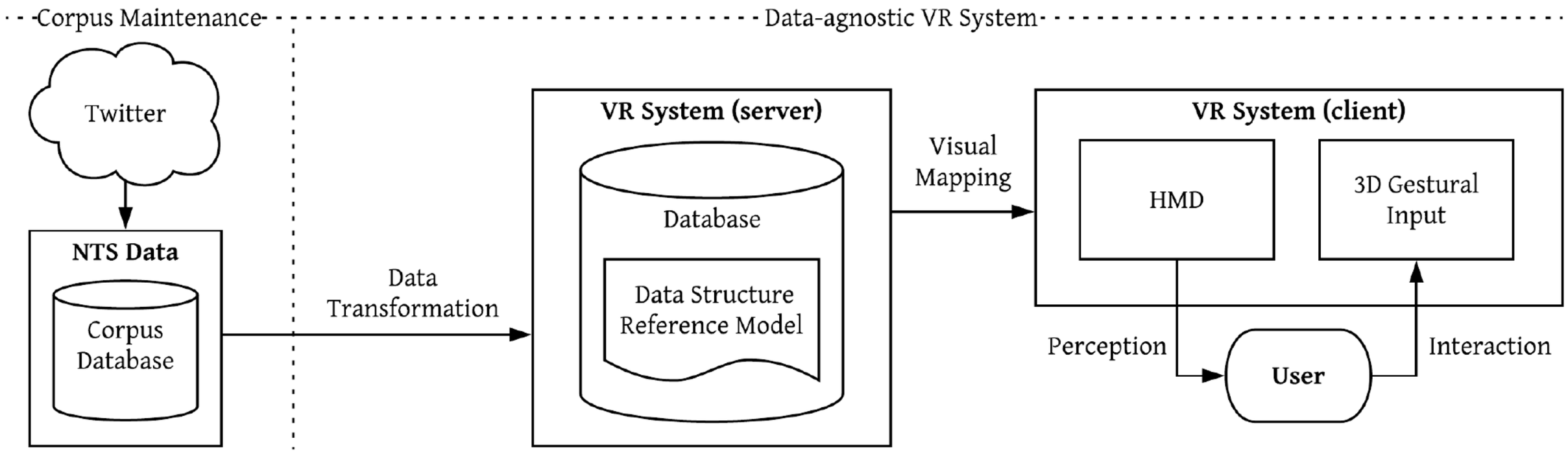
Try yourself, and get a “visual impression” (in 2D) of the computer-generated, virtual 3D environment (on your mobile or desktop device).



360° demo [vrxar.lnu.se/apps/odxvrxnts-360/]

360° time demo [vrxar.lnu.se/apps/odxvrxnts-360/time.html]

Planning and consideration of the overall data workflow,
from aggregation, to storage, to consumption / application.



Alissandrakis et al. 2019 (accepted).

Hybrid Collaborative Immersive Analytics

- developed a system that enables two users to explore data at the same time, one inside an immersive VR environment, and one outside VR using a non-immersive (companion / desktop) application

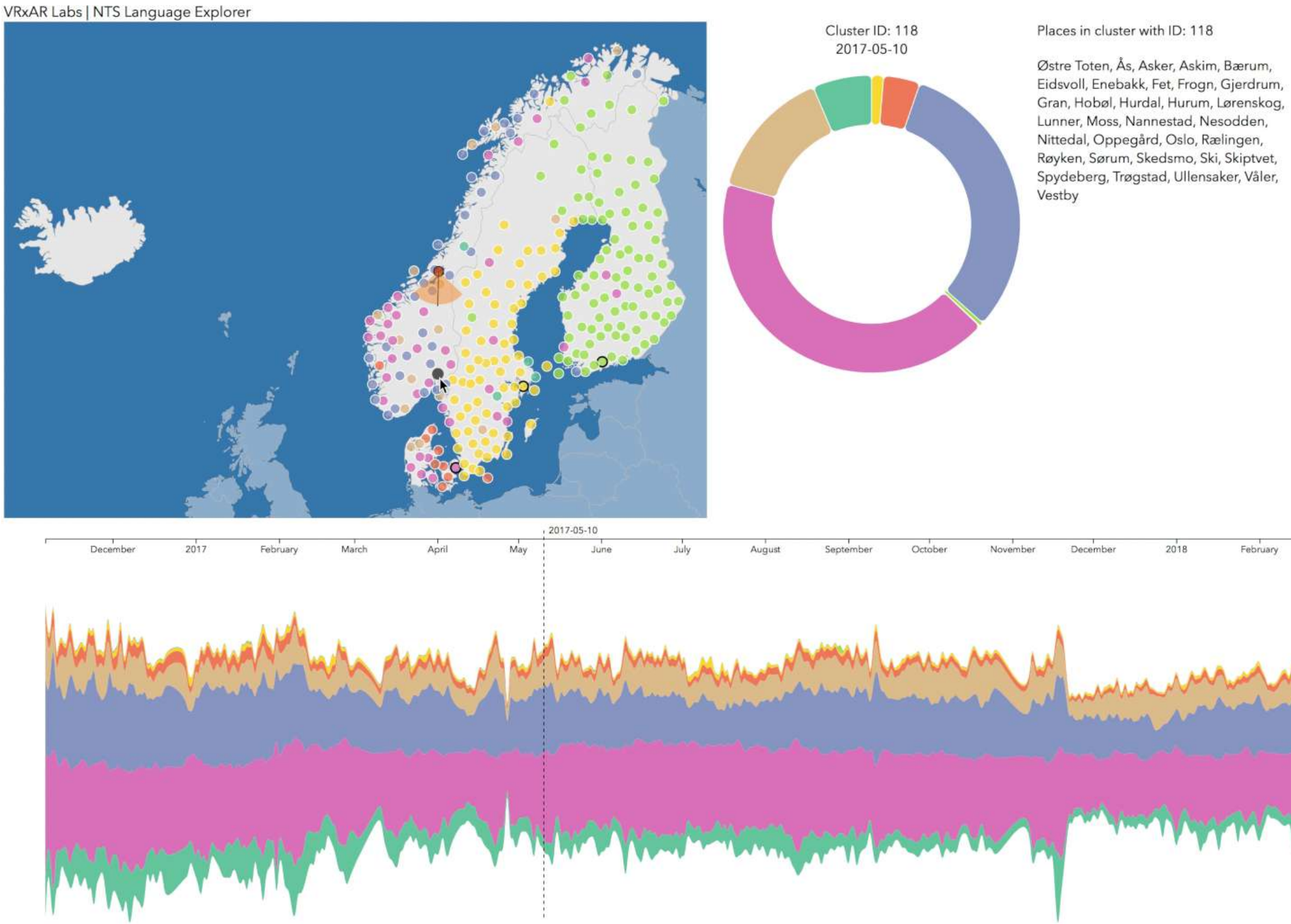
- Fall 2018: Proof-of-concept demo “NTS Language Explorer”

- Spring 2019: Follow-up investigation using “NTS Hashtag Explorer”

Reski et al. In preparation.
[vimeo.com/vrxar/hcia-wip2018]

Hybrid Collaborative Immersive Analytics
NTS Language Explorer (desktop app)

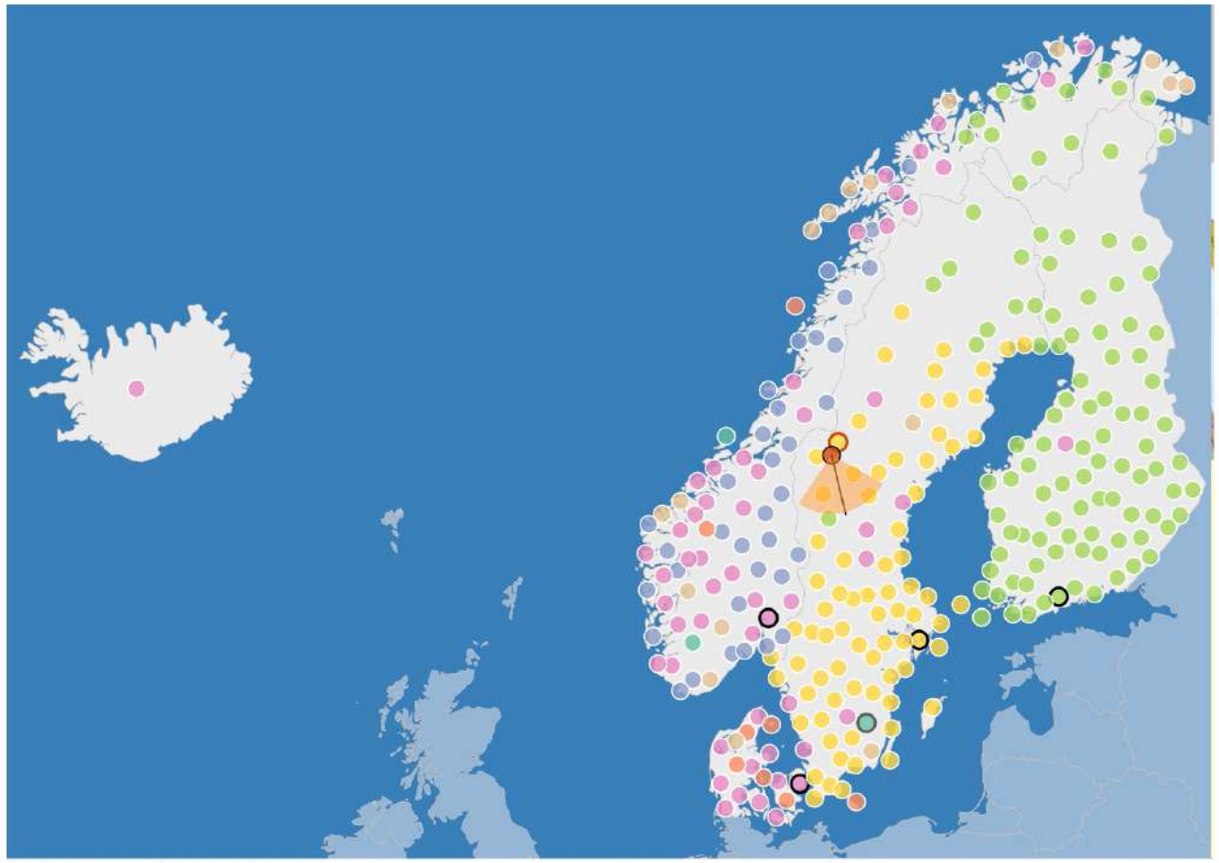
Collaborative immersive analytics using
immersive VR and non-immersive technologies

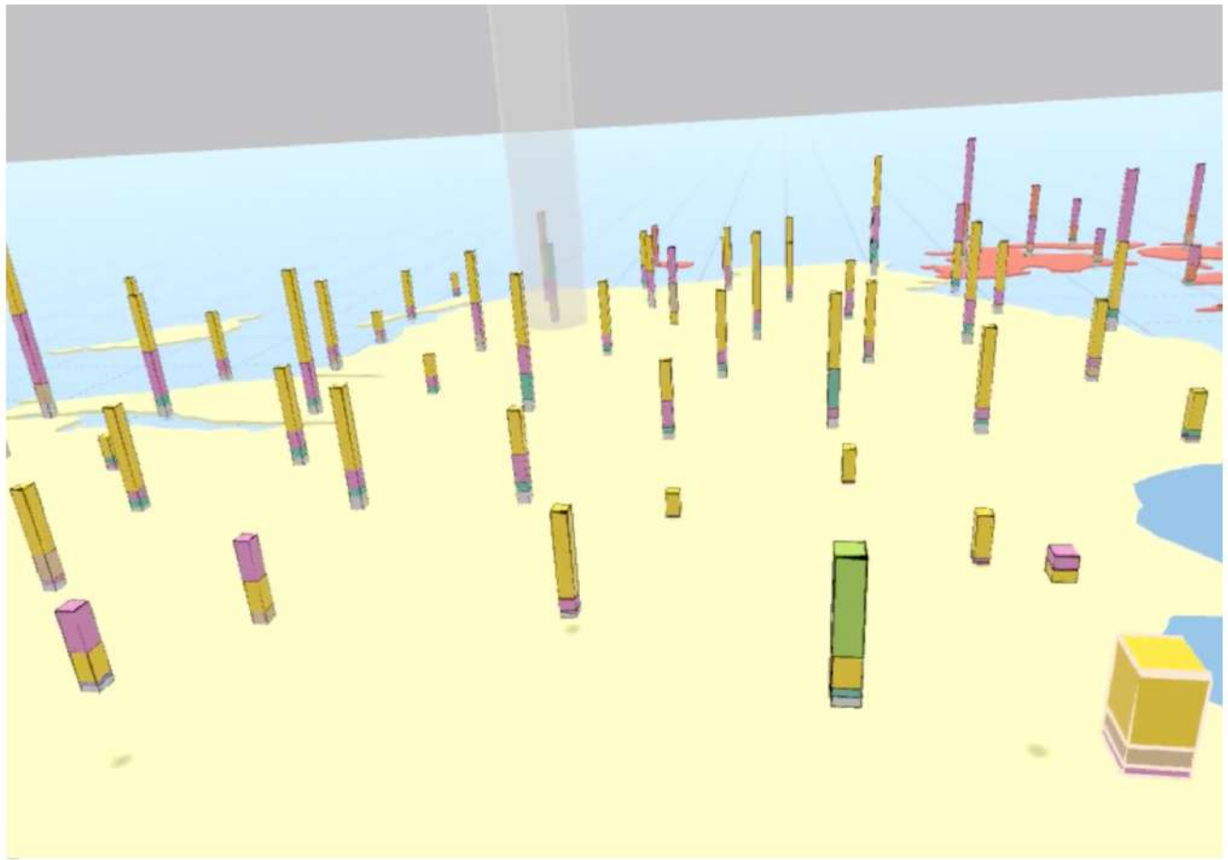


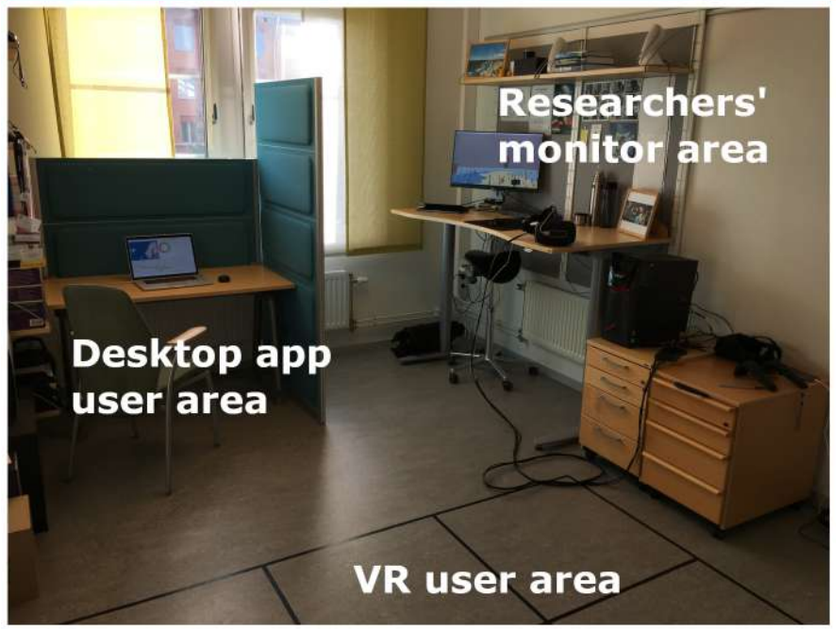
Reski et al. In preparation.
[vimeo.com/vrxar/hcia-wip2018]

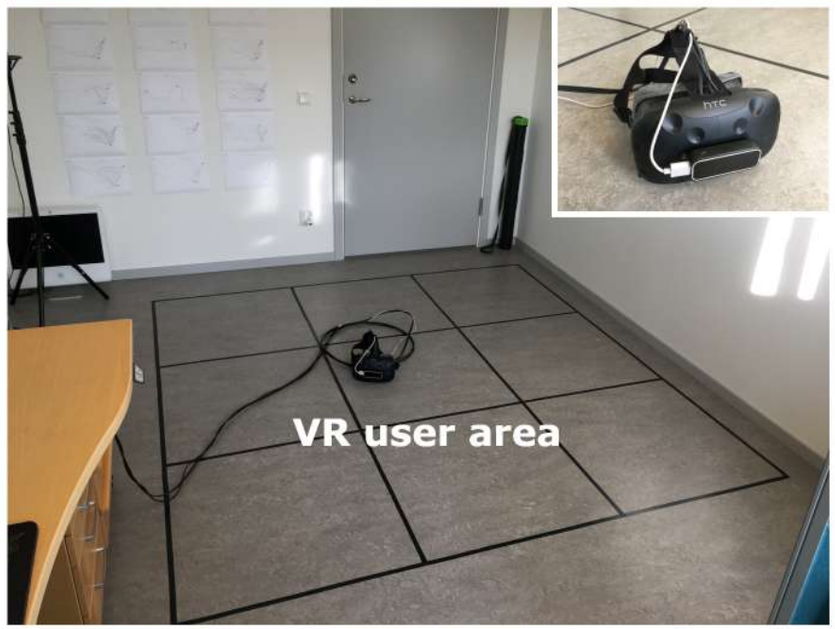
Hybrid Collaborative Immersive Analytics
NTS Language Explorer (collaboration)

Collaborative immersive analytics using
immersive VR and non-immersive technologies

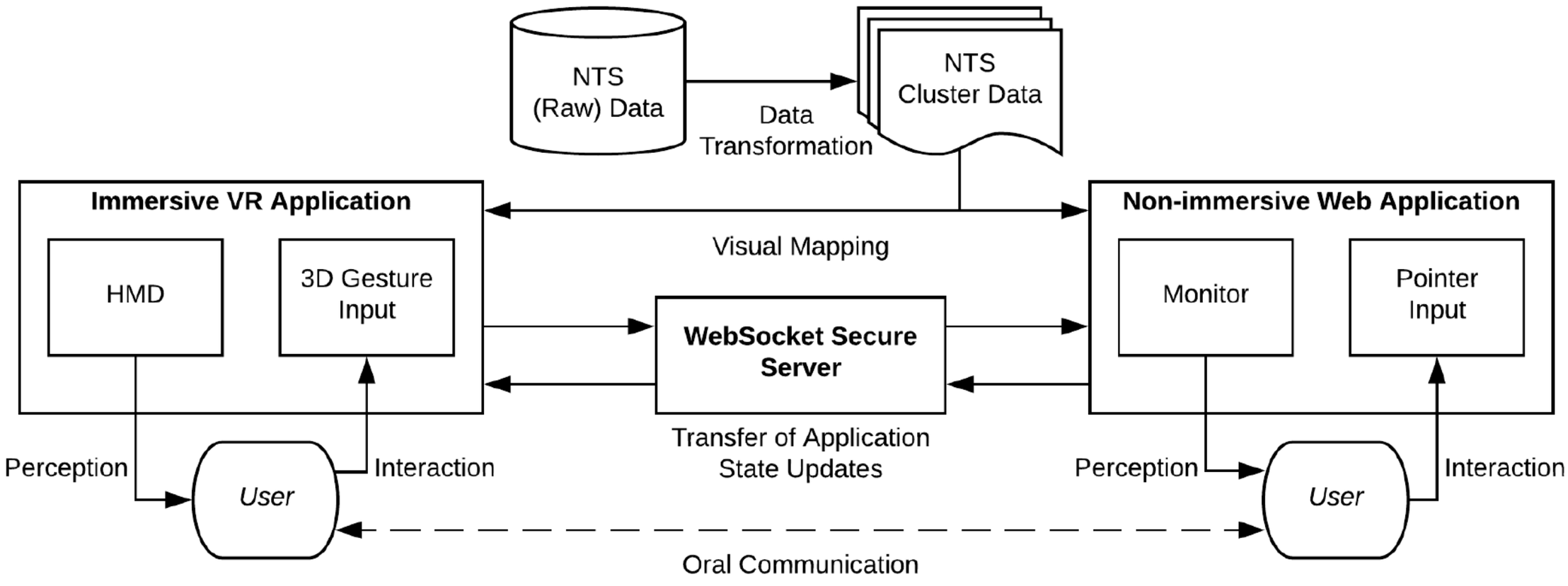




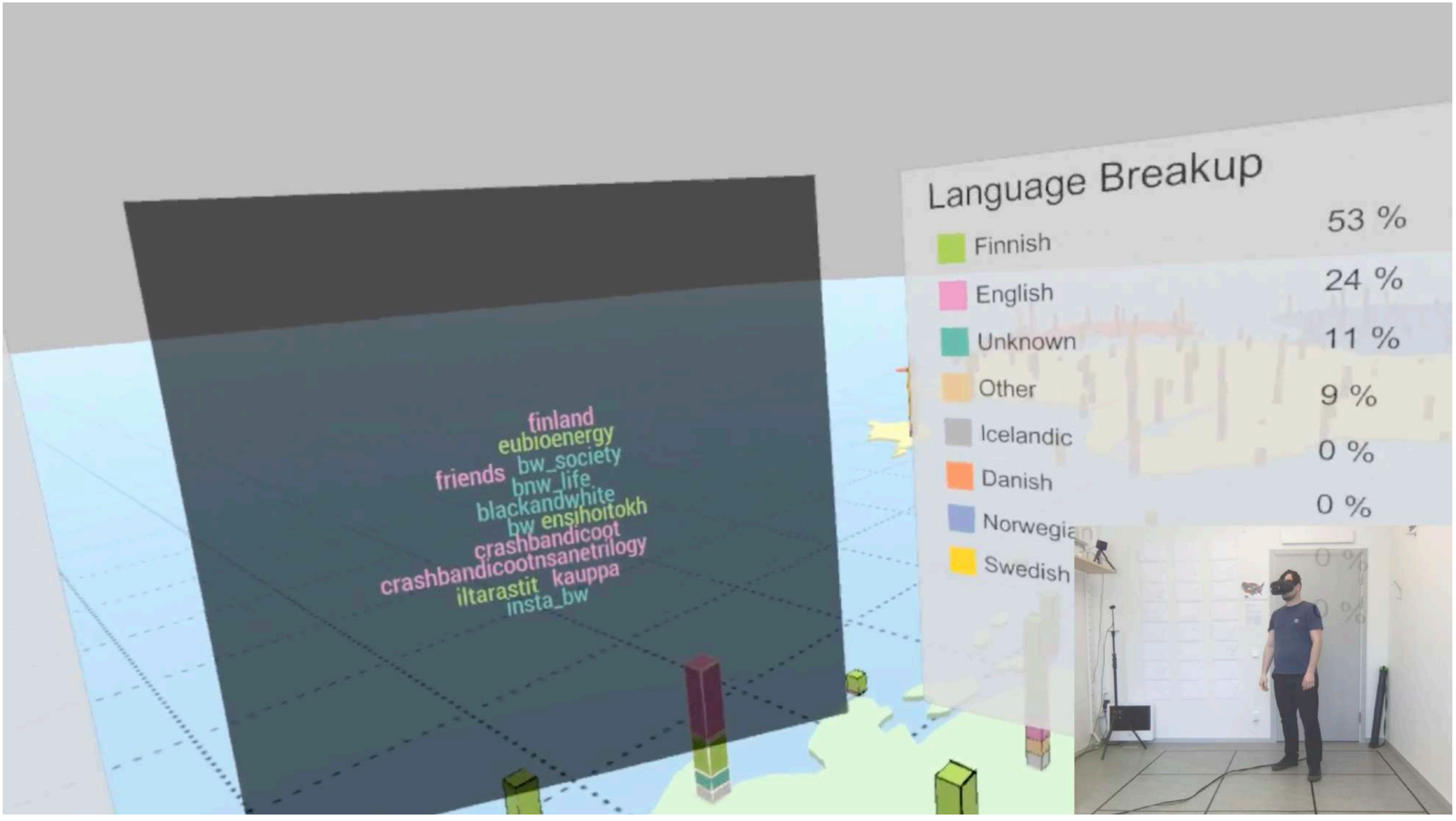




Reski et al. In preparation.
[vimeo.com/vrxar/hcia-wip2018]



Reski et al. (In preparation).

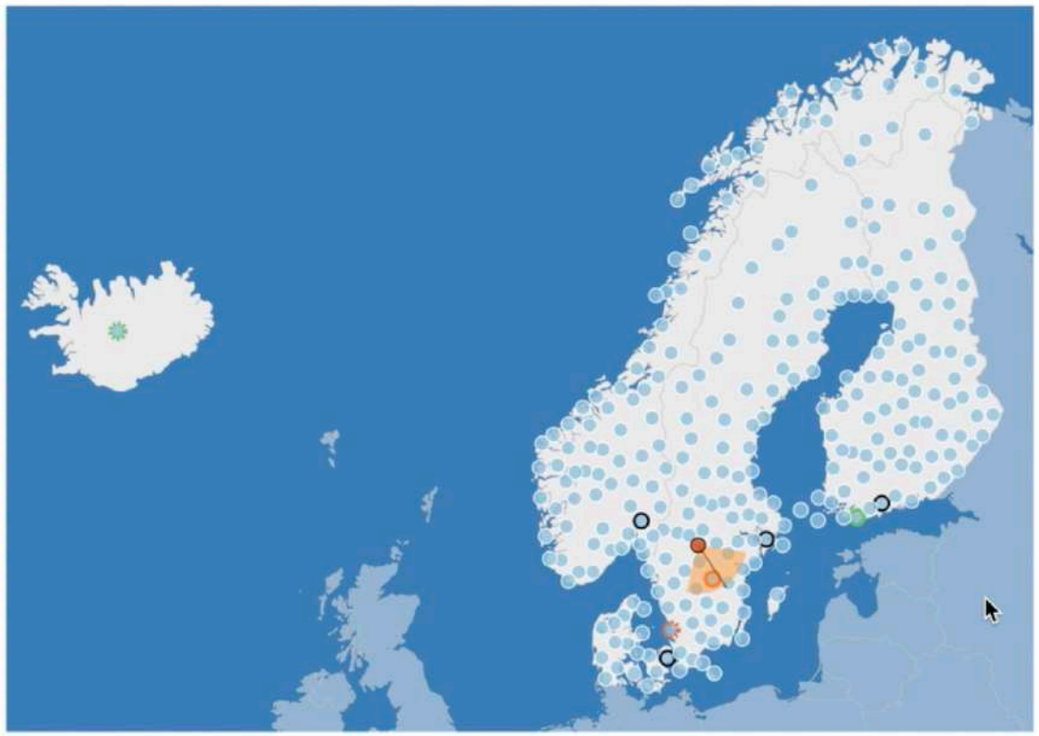


Reski et al. In preparation.

VRxAR Labs | NTS Hashtag Explorer

Freq	#Hashtag ↑	Lang
17	17	2
1	#4thofjuly	en
1	#america	en
1	#blacksmith	fi
1	#catalonia	en
1	#finland	en
1	#independenceday	en
1	#landofdreams	en
1	#maakarhunpaja	fi
1	#masuuniensepät	fi
1	#pöydänjalat	fi
1	#seppä	fi
1	#siipikarja	fi
1	#spain	en
1	#tablelegs	fi
1	#travelblog	en
1	#usa	en
1	#vienti	fi

Freq	#Hashtag ↑	Lang
446	331	11
1	#тупики	und
1	#120fps	en
2	#220hfj	und
1	#4k	en
2	#4thofjuly	en
1	#4thofjuly	und
1	#áframbreiðholt	is
1	#airport	en
1	#alltafgaman	und
1	#aluminium	is
1	#amazing	und
1	#amazingearth	in
1	#america	en
1	#anecs	is
1	#apie	es
1	#aquíyallá	es
1	#architecture	sv
1	#art	is



Selected time: 2017-07-04

Places (selected; ID = 249): Hangö, Hanko, Raasepori, Raseborg, Salo

Places (bookmarked; ID = 309): Ísland, Iceland, Island, Islande, Islandia

Places (VR selected; ID = 33): Ödeshög, Aneby, Boxholm, Mjölby, Motala, Tranås, Vadstena, Ydre

Places (VR bookmarked; ID = 45): Båstad, Falkenberg, Höganäs, Halmstad

Languages & Colors
Danish
English
Finnish
Icelandic
Norwegian
Other
Swedish
Unknown

Freq	#Hashtag ↑	Lang
12	12	2
1	#1572challange	en
1	#anywheregraciegoes	en
1	#aska	sv
1	#farfarsstugan	en
1	#gräslök	sv
1	#köksfönster	sv
1	#livetpålandet	sv
1	#odling	sv
1	#pelargoner	sv
1	#sommarkväll	sv
1	#sweden	en
1	#vadstena	sv

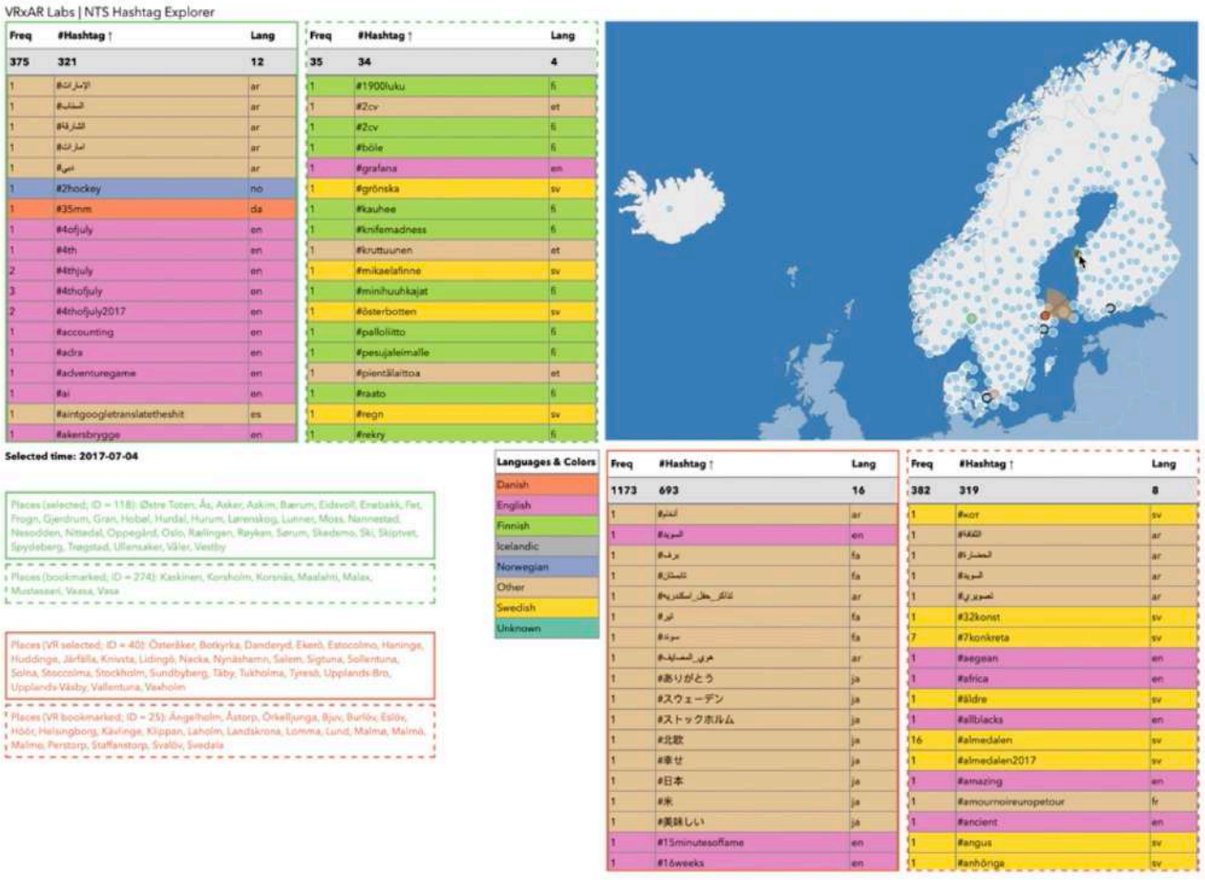
Freq	#Hashtag ↑	Lang
47	40	3
1	#afterbeach	sv
1	#beachhäng	sv
1	#brottet	sv
1	#christofjeppsson	sv
1	#destinationhalmstad	en
1	#dymo	sv
1	#familjeaktivitet	sv
1	#fbg	sv
1	#fylleån	sv
1	#halland	sv
1	#halmstad	en
5	#halmstad	sv
1	#halmstad	und
1	#hamnplan9	sv
1	#hoteltylosand	sv
1	#hundralappen	sv
1	#kaptenröd	sv
3	#kitekalle	sv

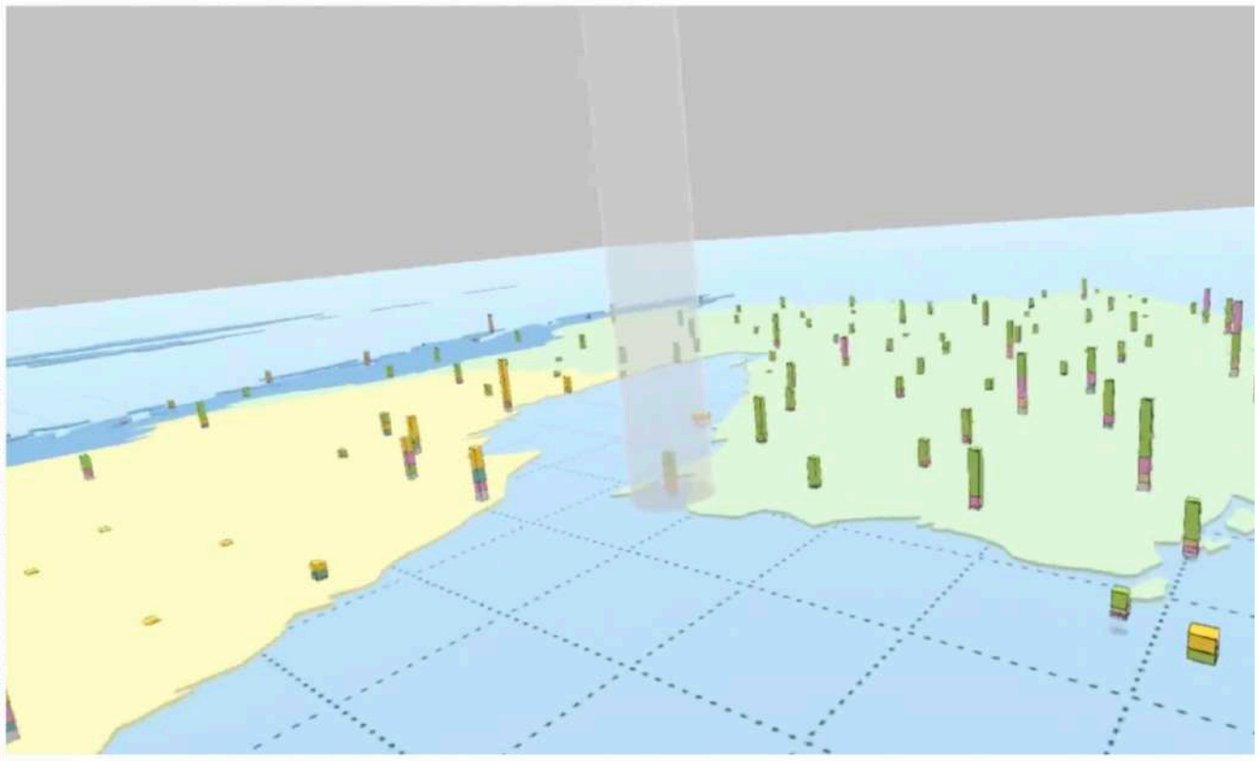
Reski et al. In preparation.

Hybrid Collaborative Immersive Analytics
NTS Hashtag Explorer (collaboration)

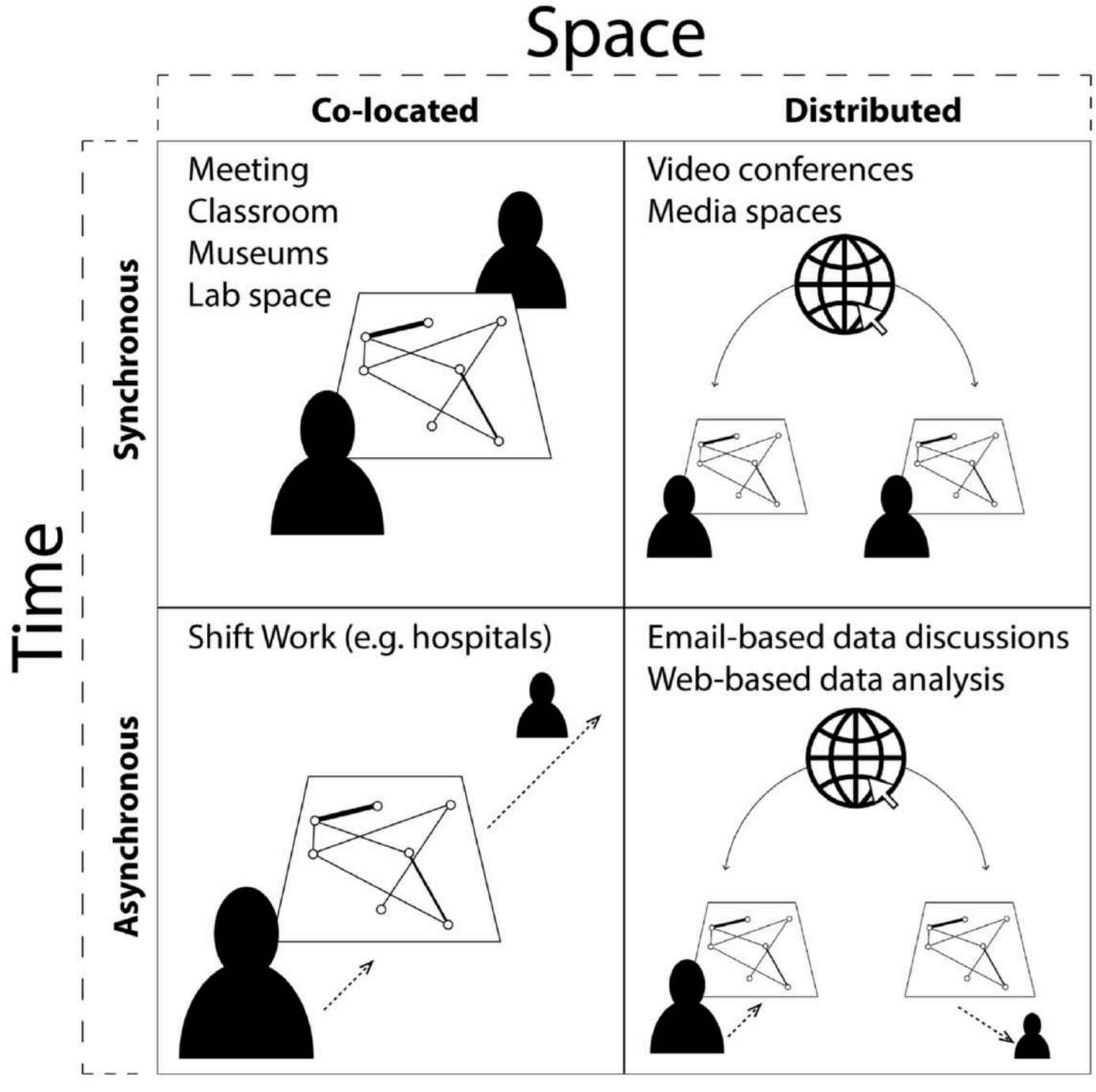
Collaborative immersive analytics using
immersive VR and non-immersive technologies

Web application · Virtual Reality application

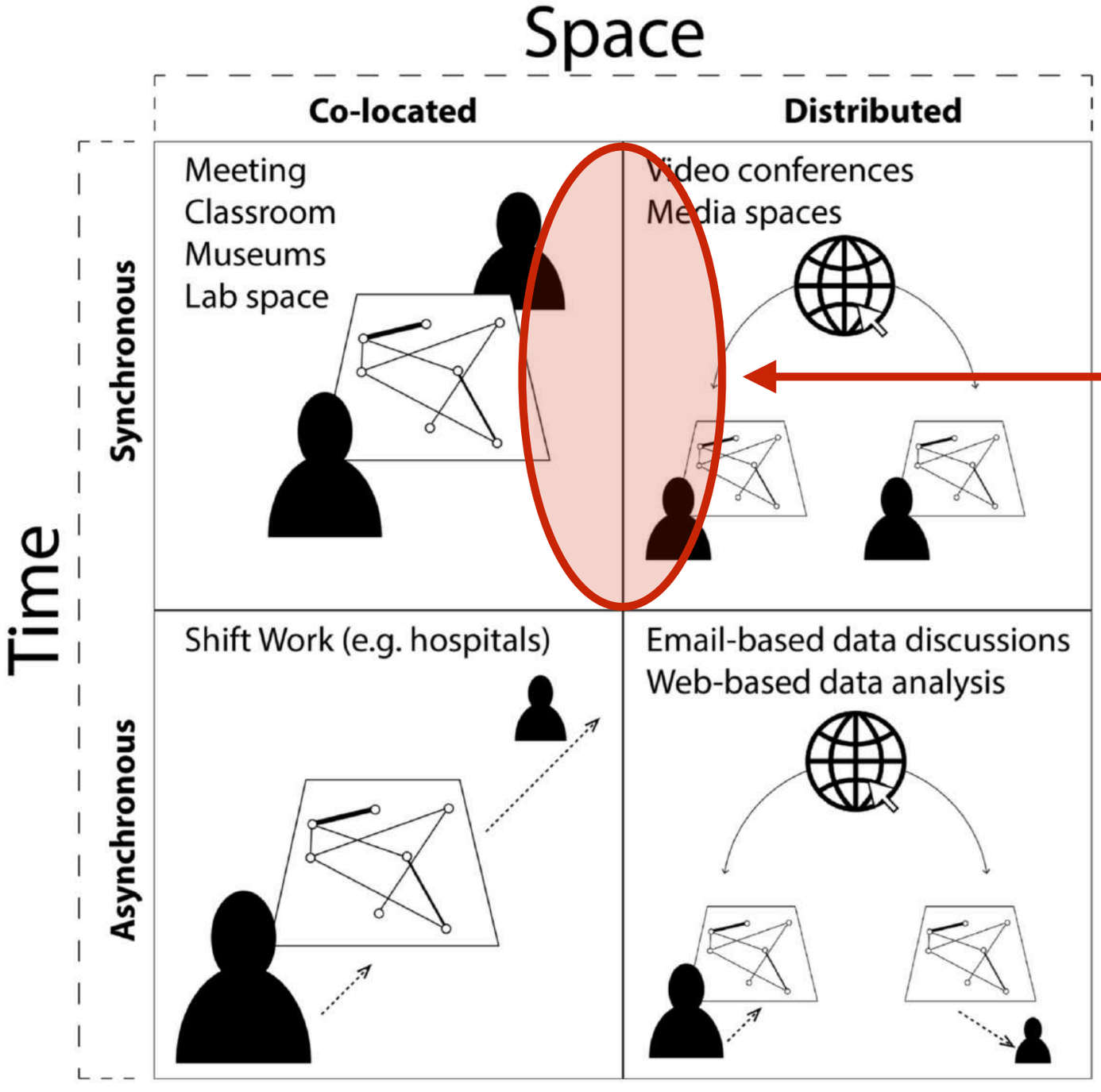




Reski et al. In preparation.



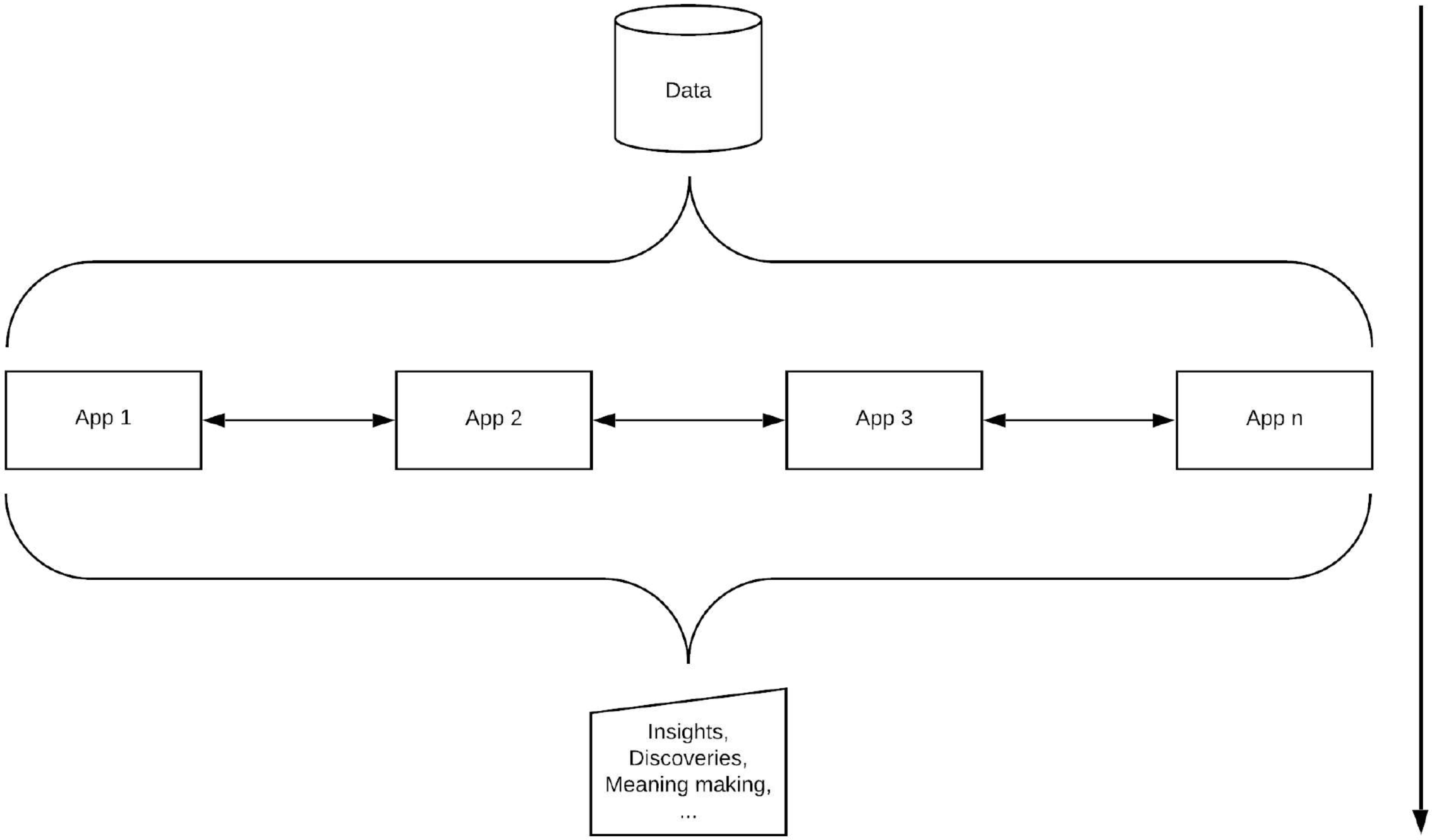
Isenberg et al. 2011.
via Billinghurst et al. 2018.



synchronous collaboration between a HMD-wearing and desktop user …?

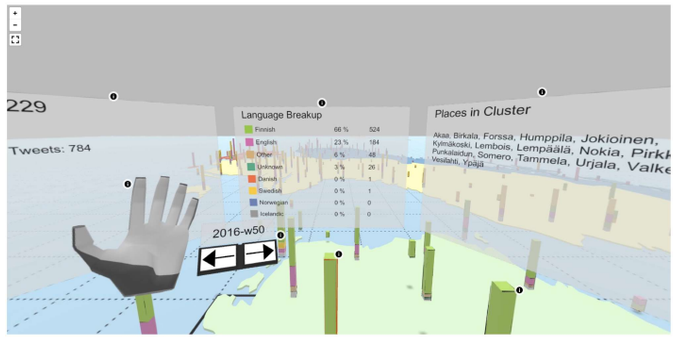
some characteristics of both co-located and distributed scenario arguably apply …

Isenberg et al. 2011.
via Billinghurst et al. 2018.


Data
App 1
App 2
App 3
App n
Insights,
Discoveries,
Meaning making,
...

Exploration and analysis of data:
a workflow

Collaborative immersive analytics using
immersive VR and non-immersive technologies



Data

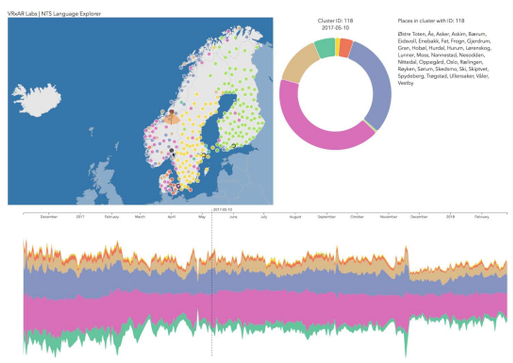
?

App 1

App 2

App 3

App n



Insights,
Discoveries,
Meaning making,
...

Multidisciplinary research

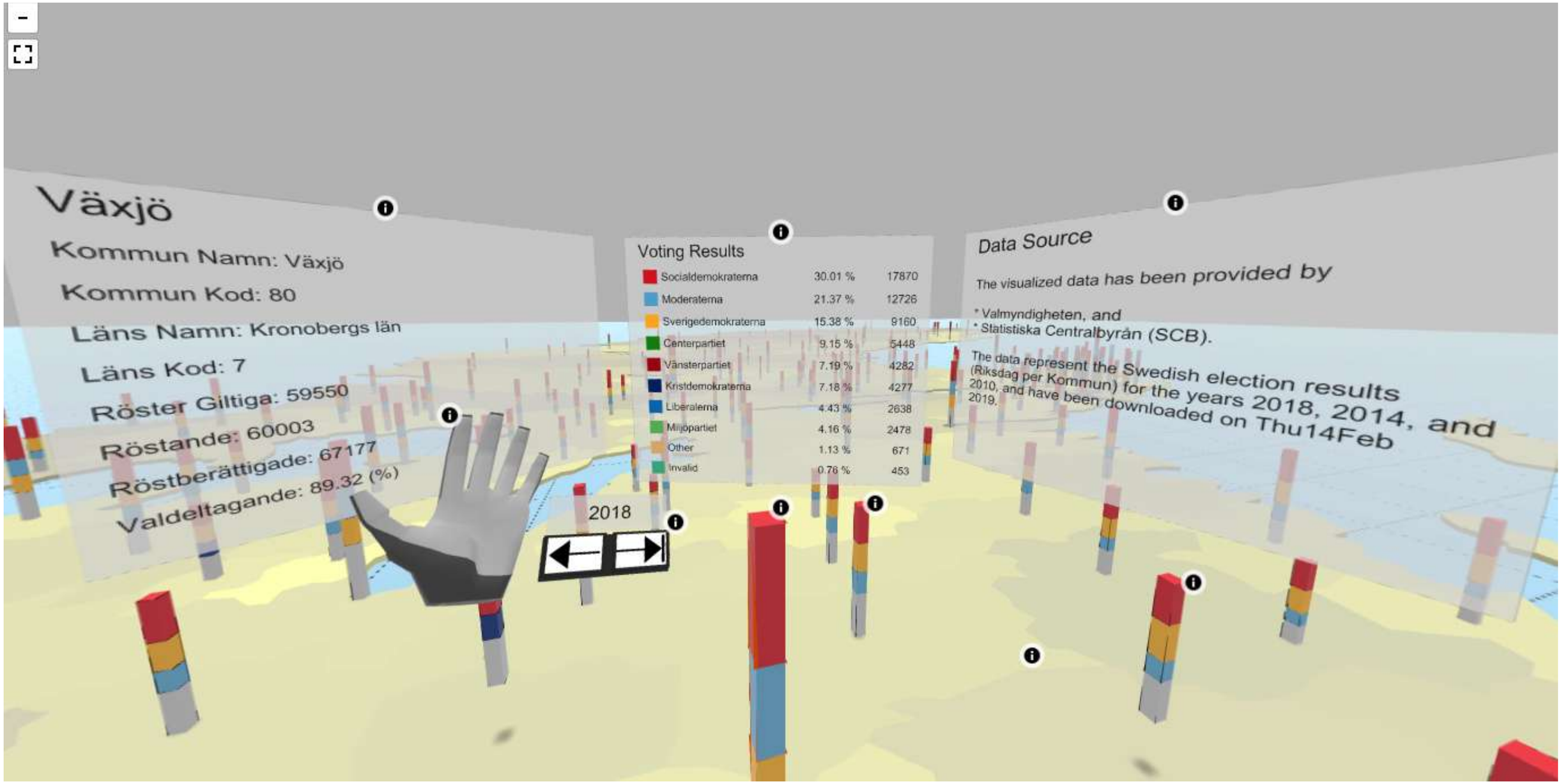
- HCI: investigation of 3D user interfaces and application of immersive technologies, cognitive science, …

- Information Visualization: how to visually present data

- data: stakeholders want to explore and discover “interesting things in the data” (learn about the data), as well as investigating new tools to support the data analysis workflow

- collaboration: investigate the interplay between human individuals and the dynamics that come with the activity

Using the developed (data-agnostic) “ODXVR engine”, visualization and interaction with other data is possible, e.g. voting results of the Swedish elections (“Riksdag per kommun”; data via Statistiska Centralbyrån and Valmyndigheten).



360° demo [vrxar.lnu.se/apps/odxvrxvalet-360/]
video [vimeo.com/vrxar/odxvrxvalet-wip2019]

Doctoral studies continued

May 2017 – present (planned graduation: May 2022)

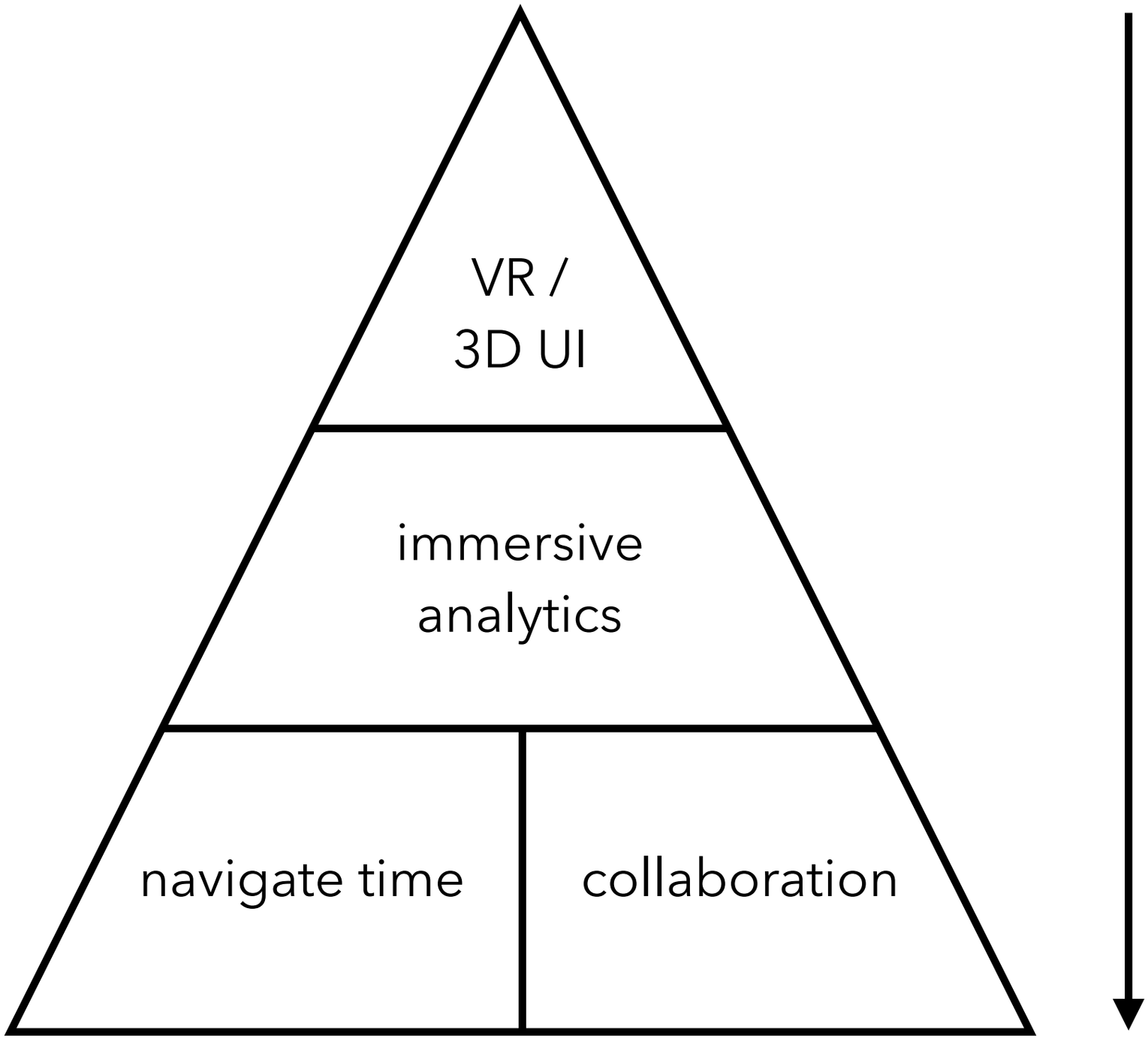
- **Objective 1:** Design and implementation of a system that allows data analysis using immersive technologies and interaction through 3D user interfaces.
  [completed]

- **Objective 2:** Investigation of 3D UI design approaches in order to navigate time within immersive data analysis.
  [about to start]

- **Objective 3:** Extension of the immersive data analysis system to support collaboration using immersive and non-immersive technologies to facilitate the processes of data analysis and meaning making.
  [in-progress]

Research focus of doctoral studies
(simplified)

Collaborative immersive analytics using
immersive VR and non-immersive technologies



References

- Alissandrakis, A., Reski, N., Laitinen, M., Tyrkkö, J., Lundberg, J., and Levin, M. (accepted 2019) Visualizing rich corpus data using virtual reality. *Corpus Approaches into World Englishes and Language Contrasts (Studies in Variation, Contacts and Change in English XX)*, eds. by Hanna Parviainen, Mark Kaunisto, and Päivi Pahta, Helsinki: VARIENG.
- Alissandrakis, A., Reski, N., Laitinen, M., Tyrkkö, J., Levin, M., and Lundberg, J. (2018). Visualizing dynamic text corpora using Virtual Reality, in *Proceedings of The 39th Annual Conference of the International Computer Archive for Modern and Medieval English* (ICAME39): Corpus Linguistics and Changing Society. Tampere, Finland, 30 May – 3 June, 2018, p 205.
- Aigner, W., Miksch, S., Schumann, H., and Tominski, C. (2011) Visualization of Time-Oriented Data. Human-Computer Interaction Series (HCIS). Springer London, 1st edition.
- Billinghurst, M., Cordeil, M., Bezerianos, A., and Margolis, T. (2018) Collaborative Immersive Analytics. In: Marriott K. et al. (eds) *Immersive Analytic*s. Lecture Notes in Computer Science, vol 11190. Springer, Cham

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