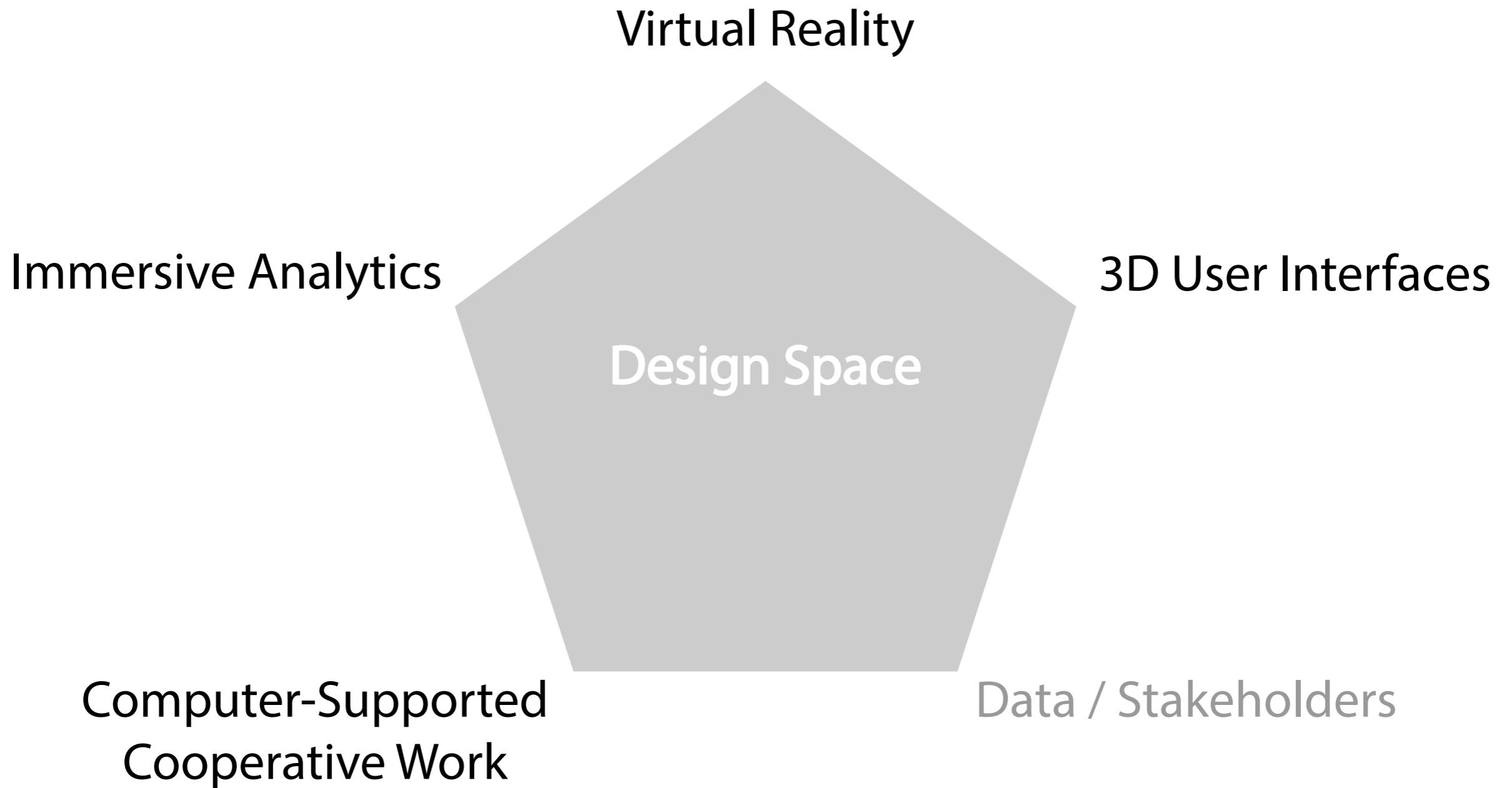


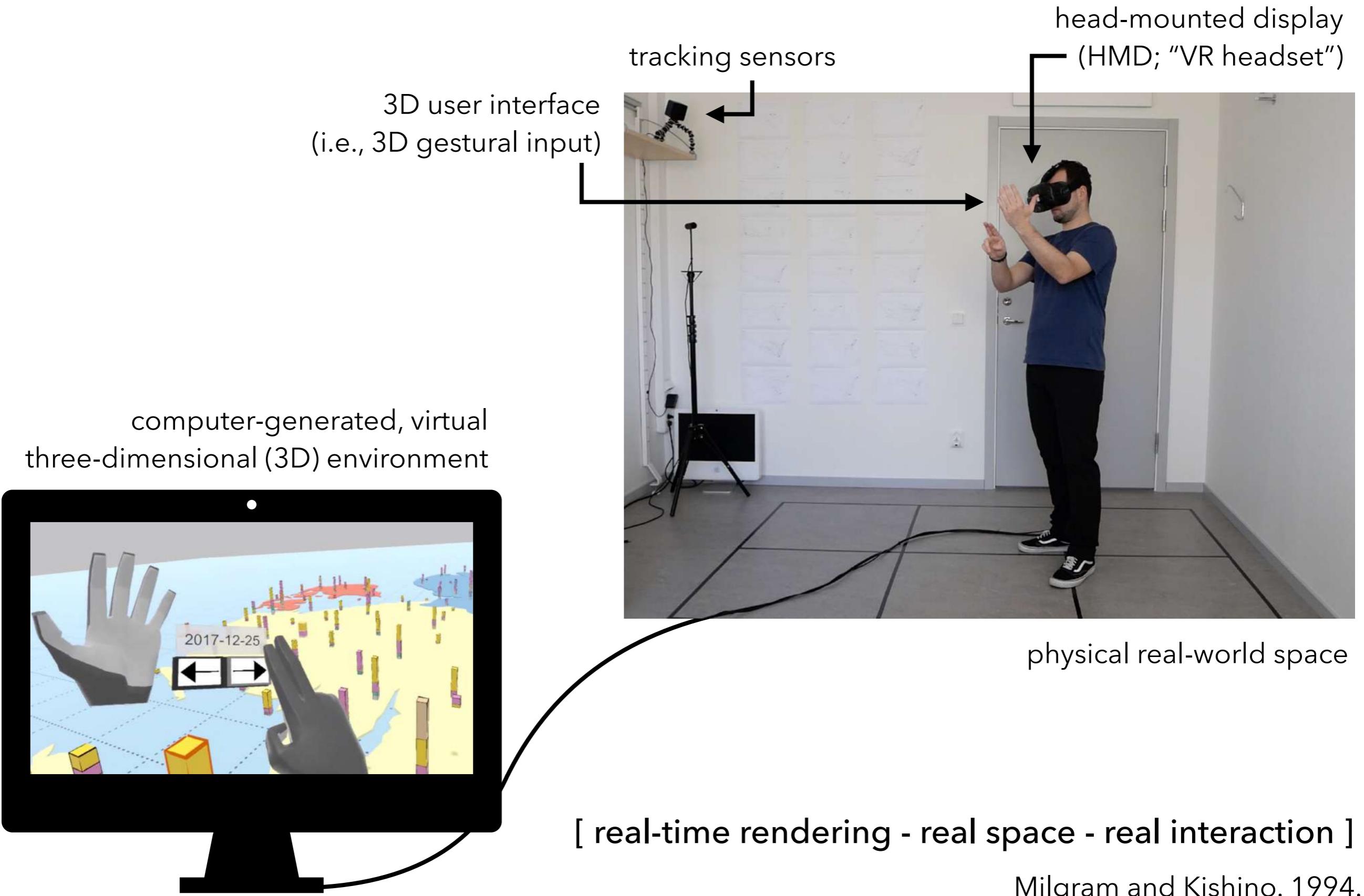
Collaborative immersive analytics: Building a virtual reality platform to support asymmetric data exploration

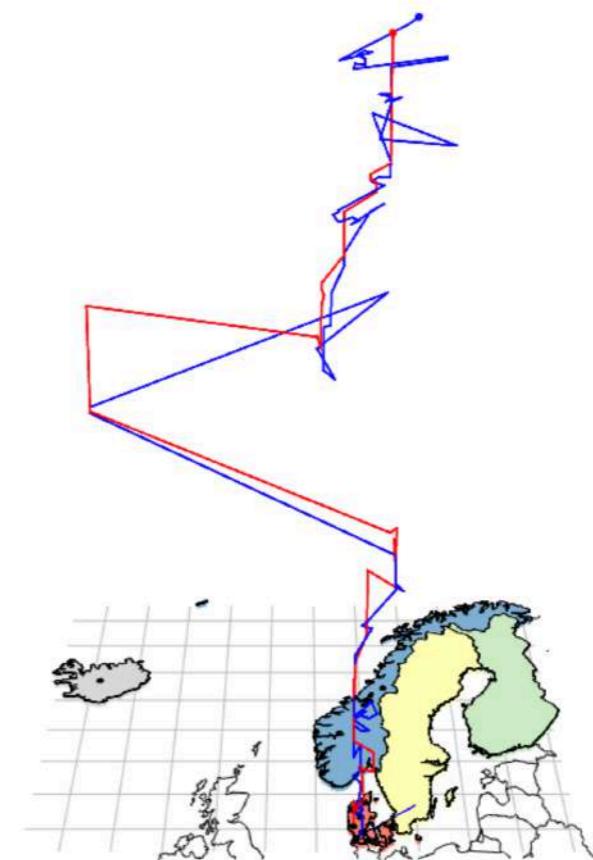
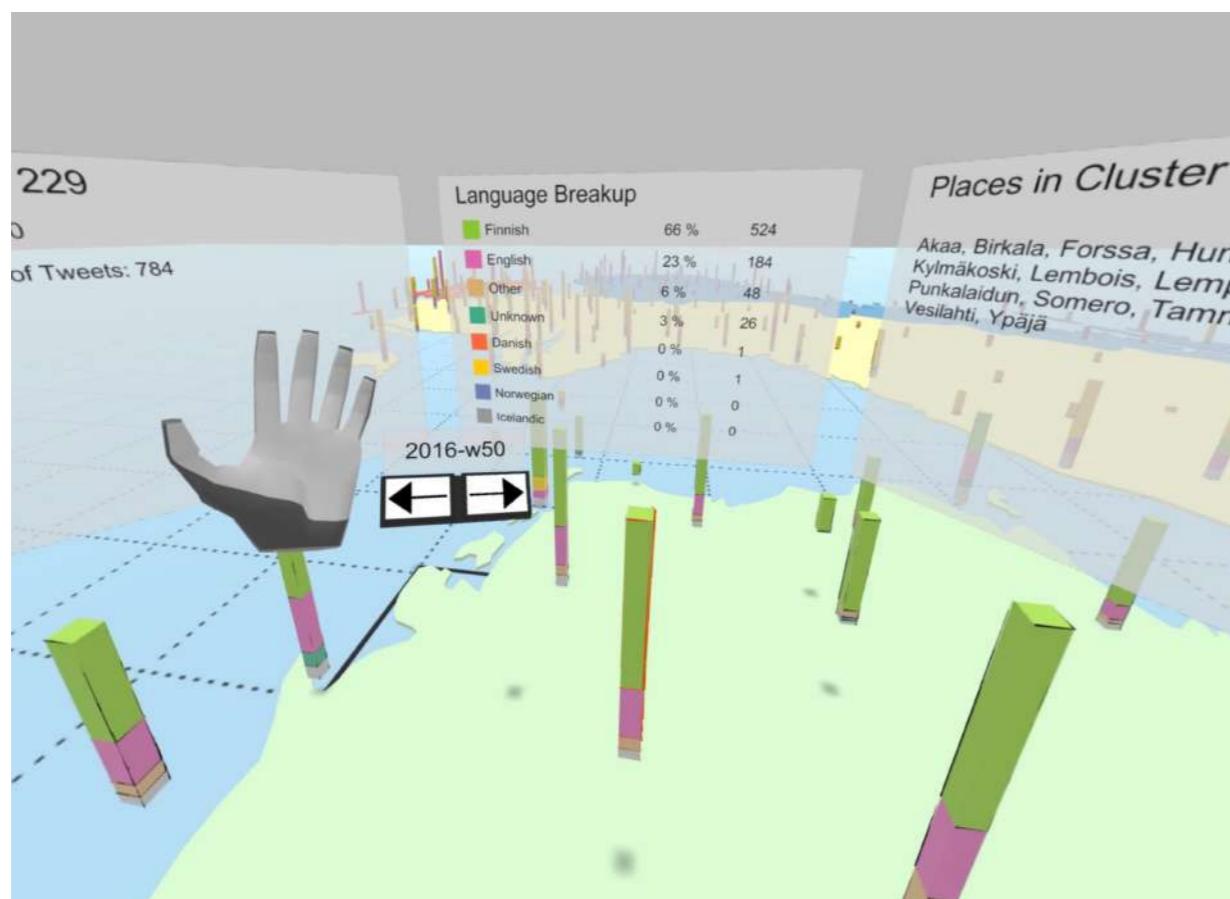
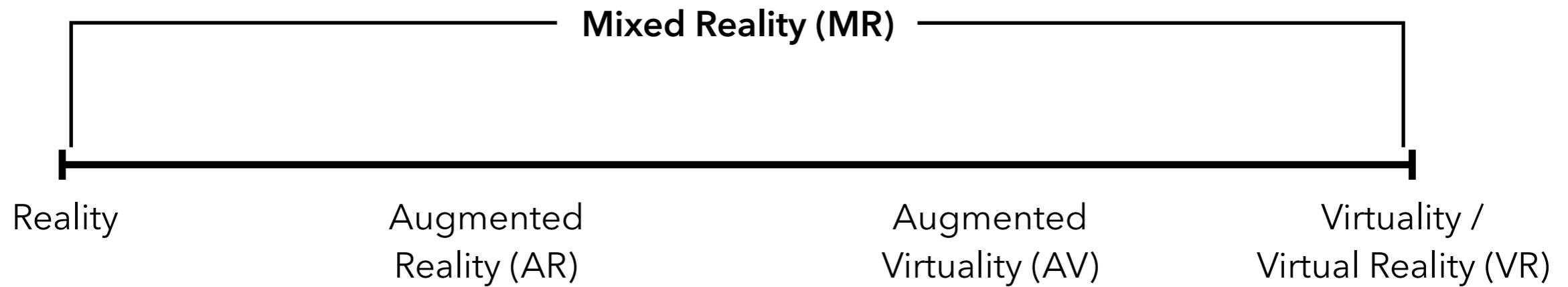
Nico Reski doctoral student

Research Seminar, Linnæus University
18th September 2019

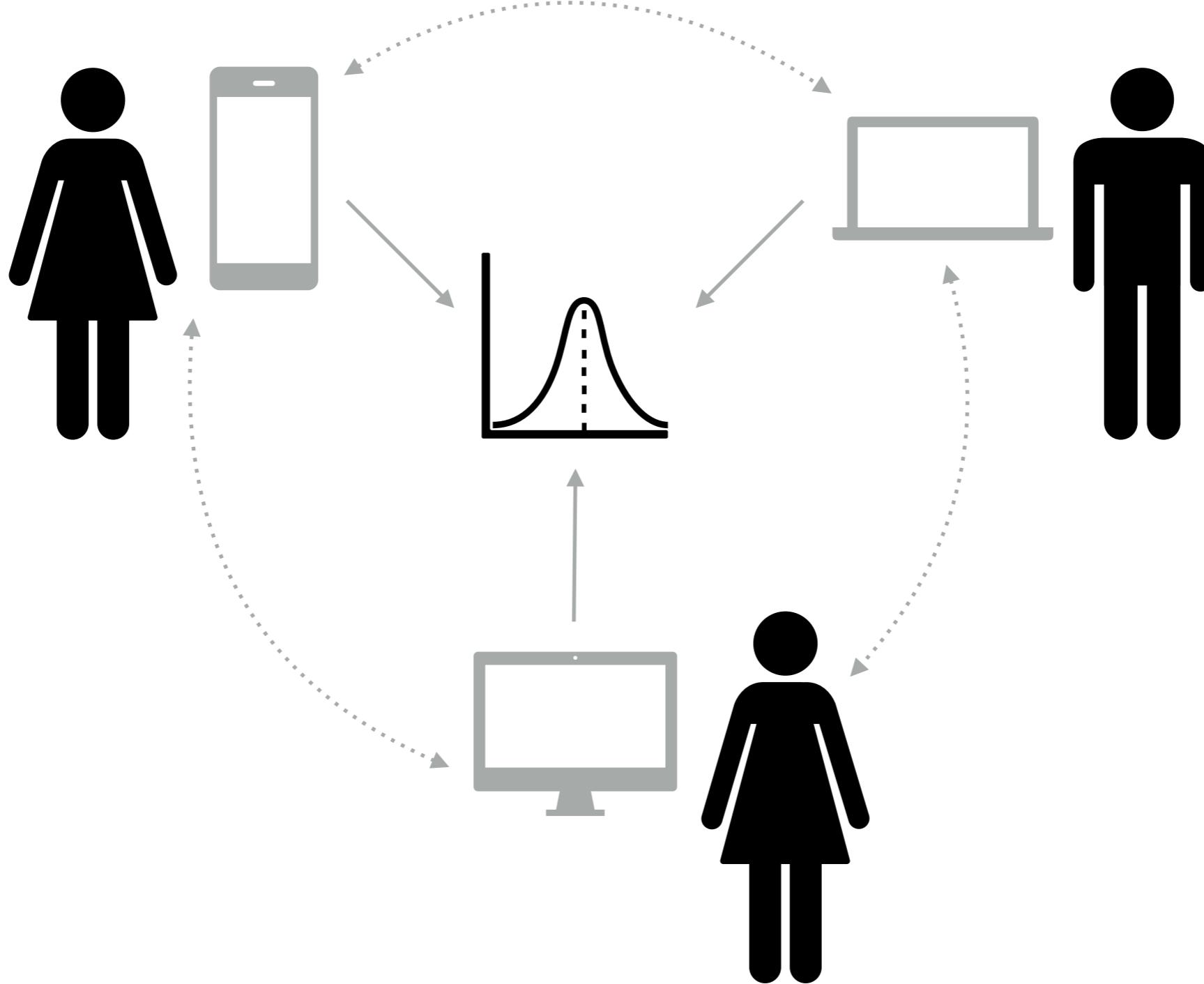


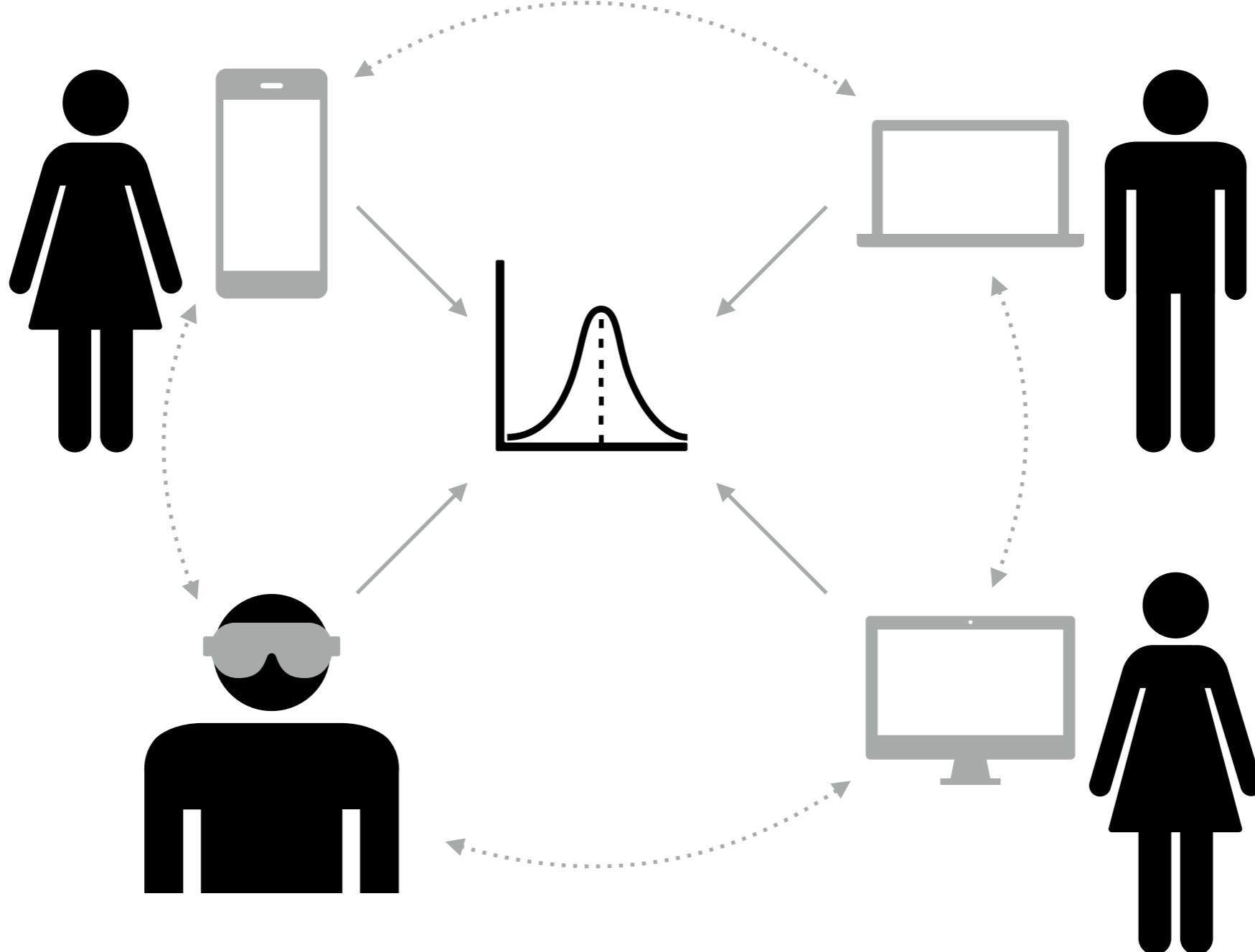






Milgram and Kishino. 1994.





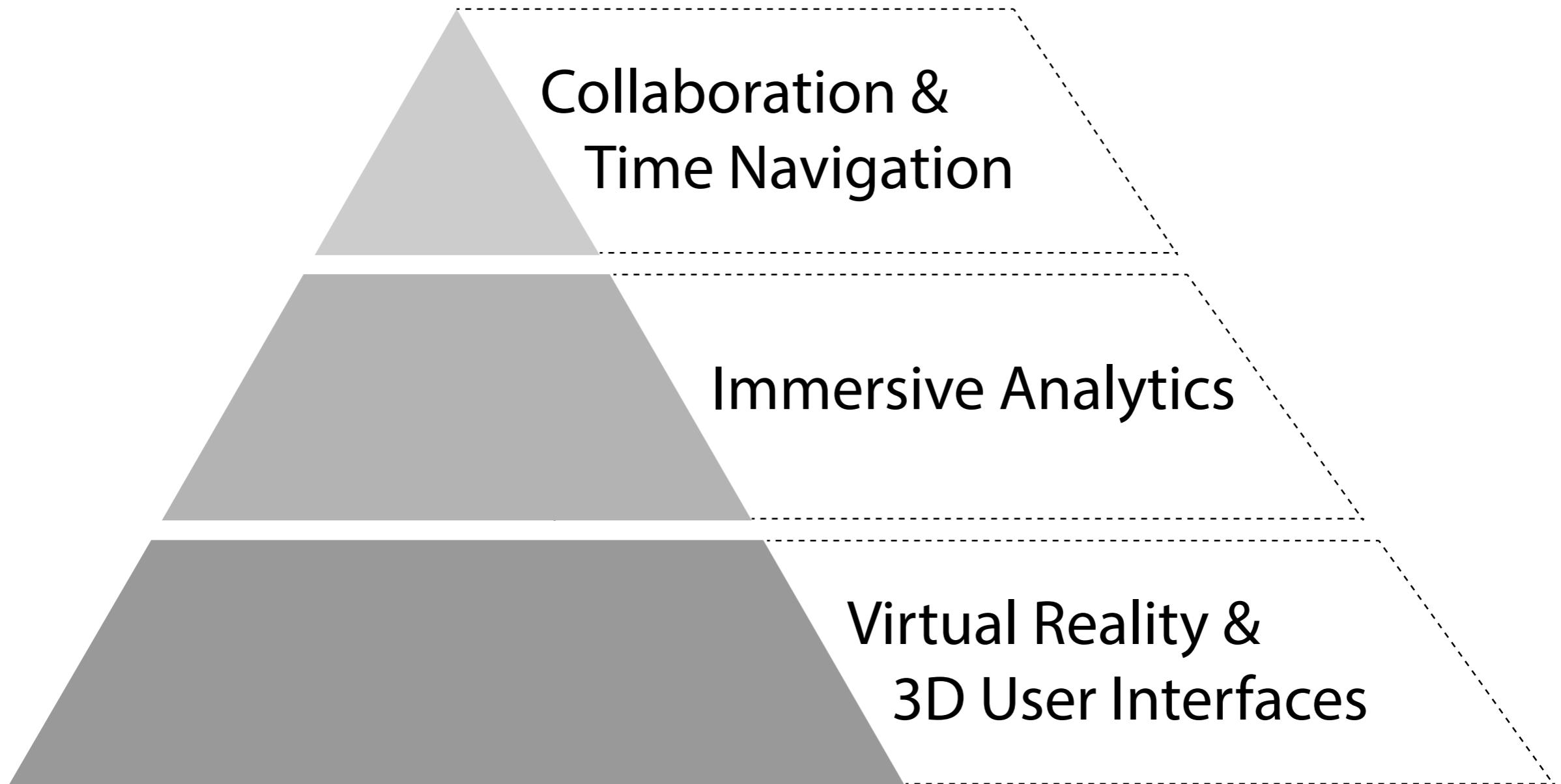
Research challenges

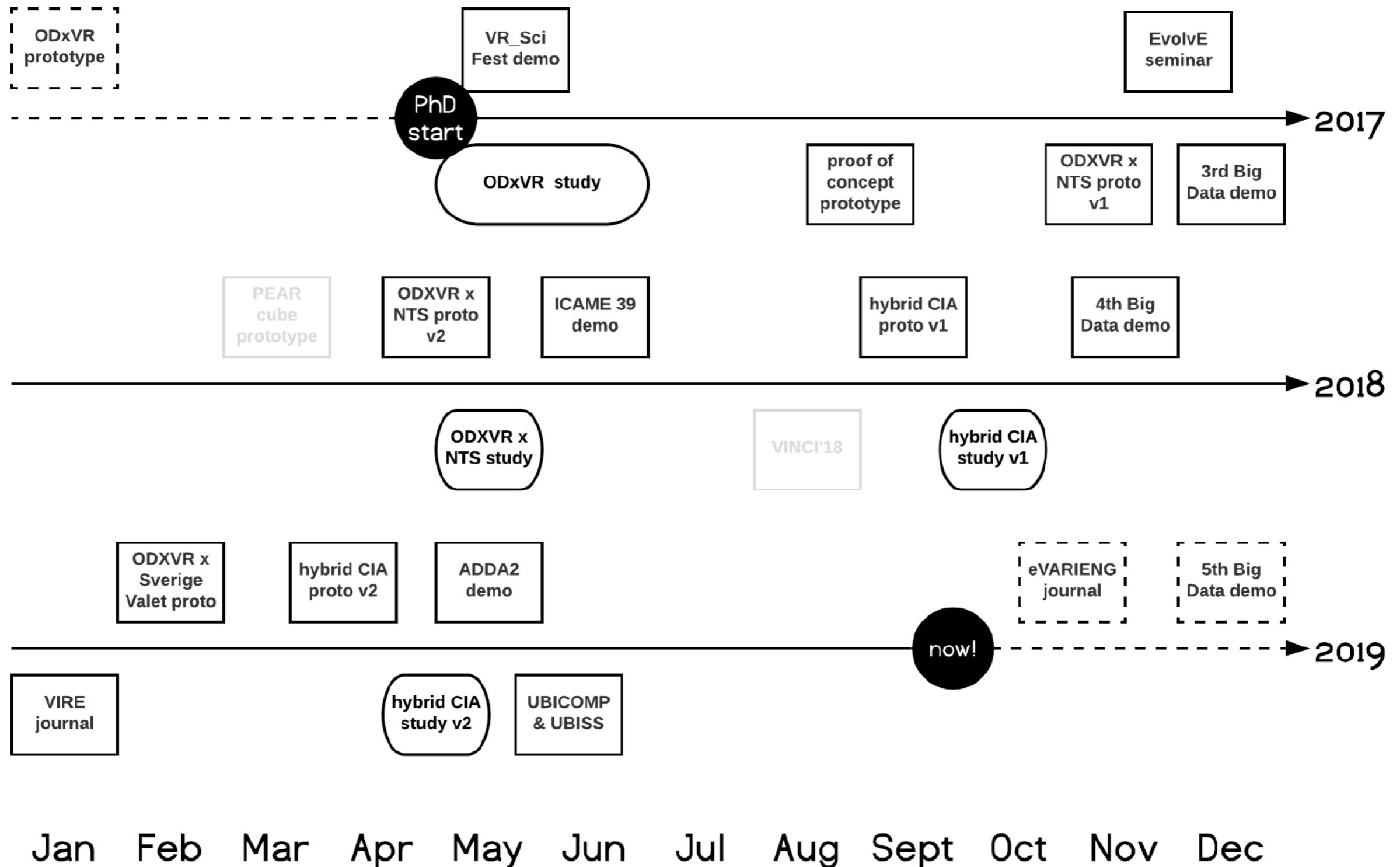
- development of methods and workflows to support 3D data exploration within the context of Immersive Analytics
 - 3D user interface design to support typical tasks in order to interact with multivariate data in the 3D space
 - collaborative aspects of the analytical process (versus) using immersive technologies
-
- investigation of taxonomies and frameworks in order to review complex real-world applications and scenarios, particularly in the context of Immersive Analytics

Research objectives

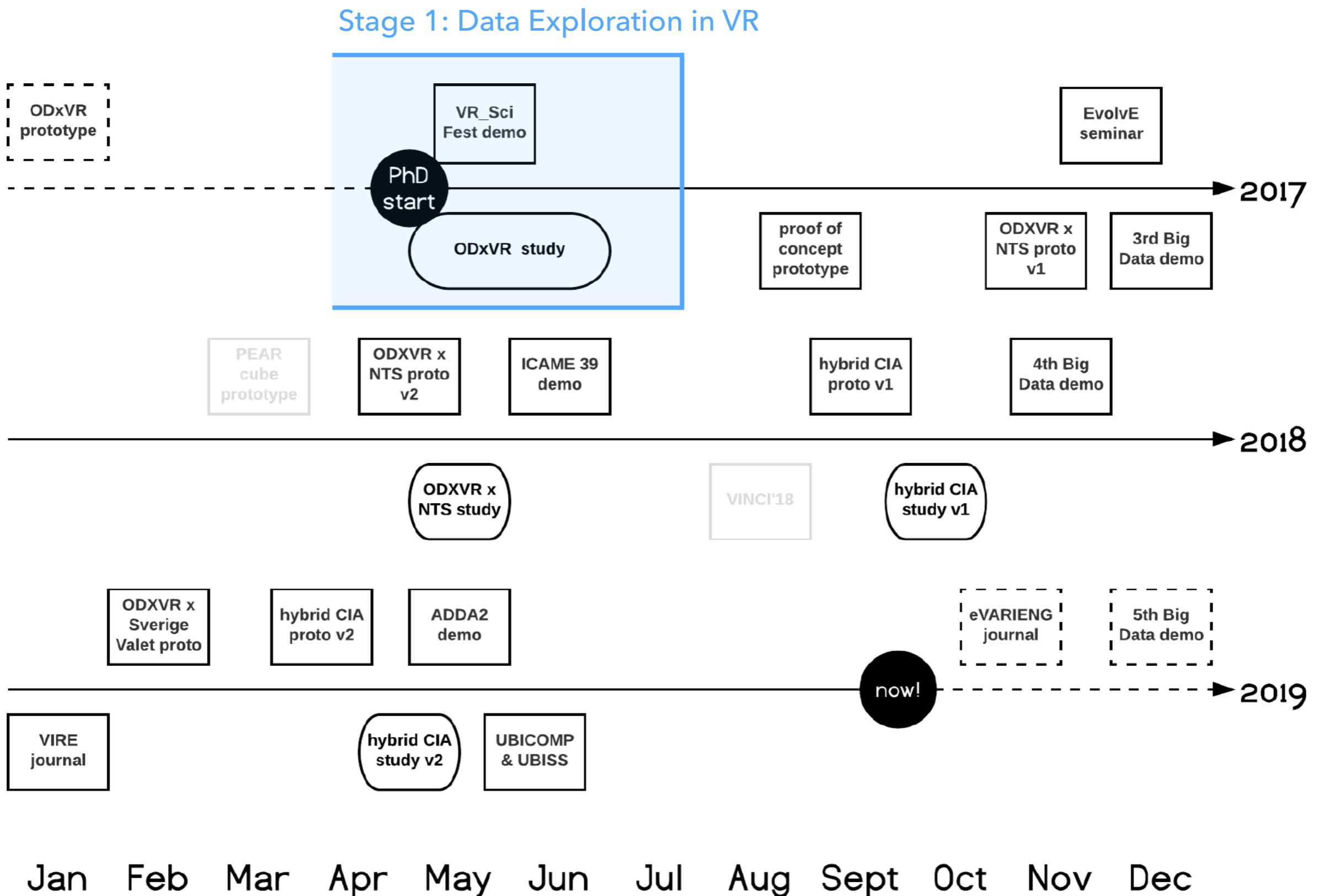
May 2017 – present (planned graduation: May 2022)

- **Objective 1:** Design and implementation of a system that allows data analysis using immersive technologies and interaction through 3D user interfaces.
- **Objective 2:** Investigation of 3D UI design approaches in order to navigate time within immersive data analysis.
- **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.

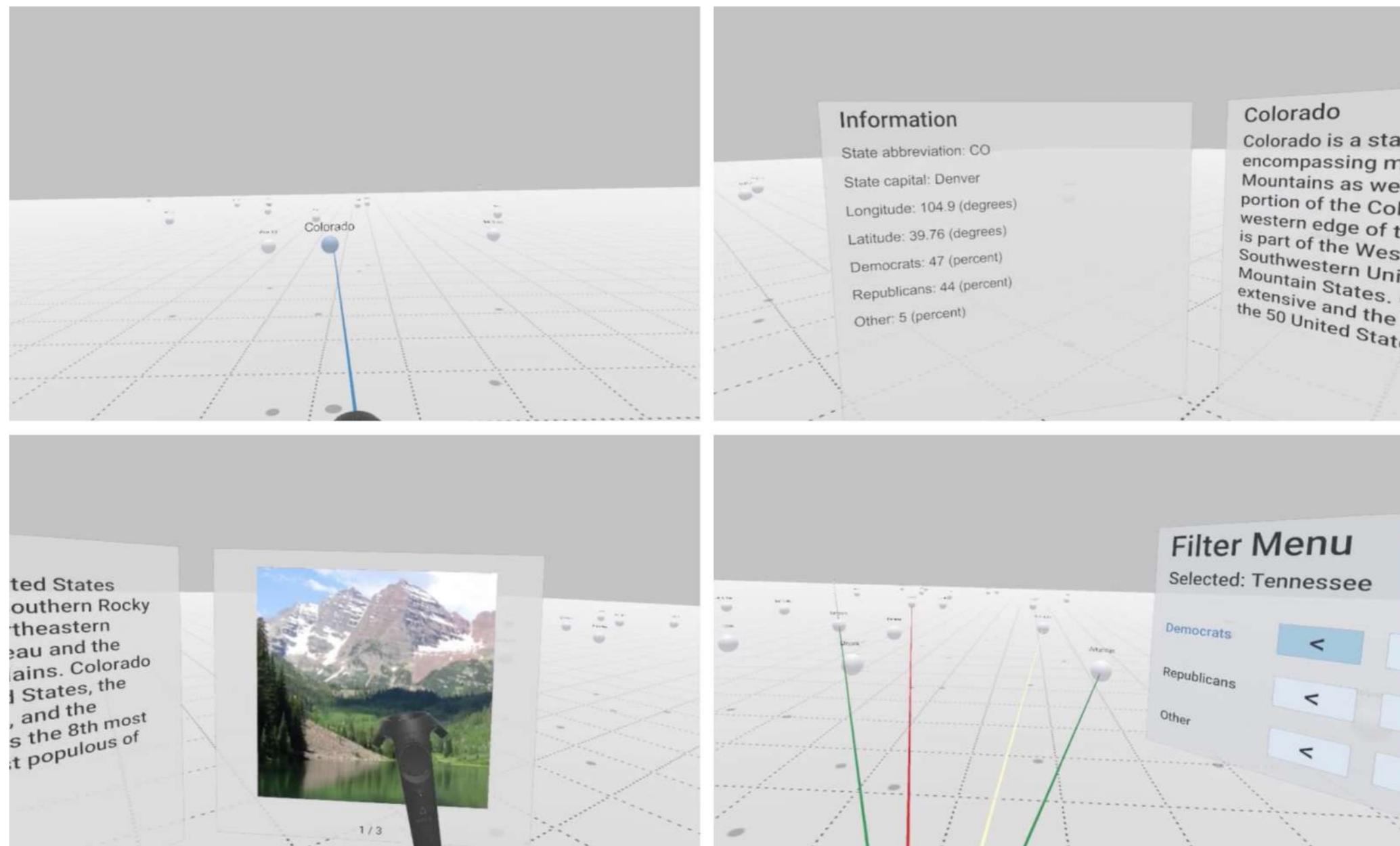




Stage 1: Data Exploration in VR



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).

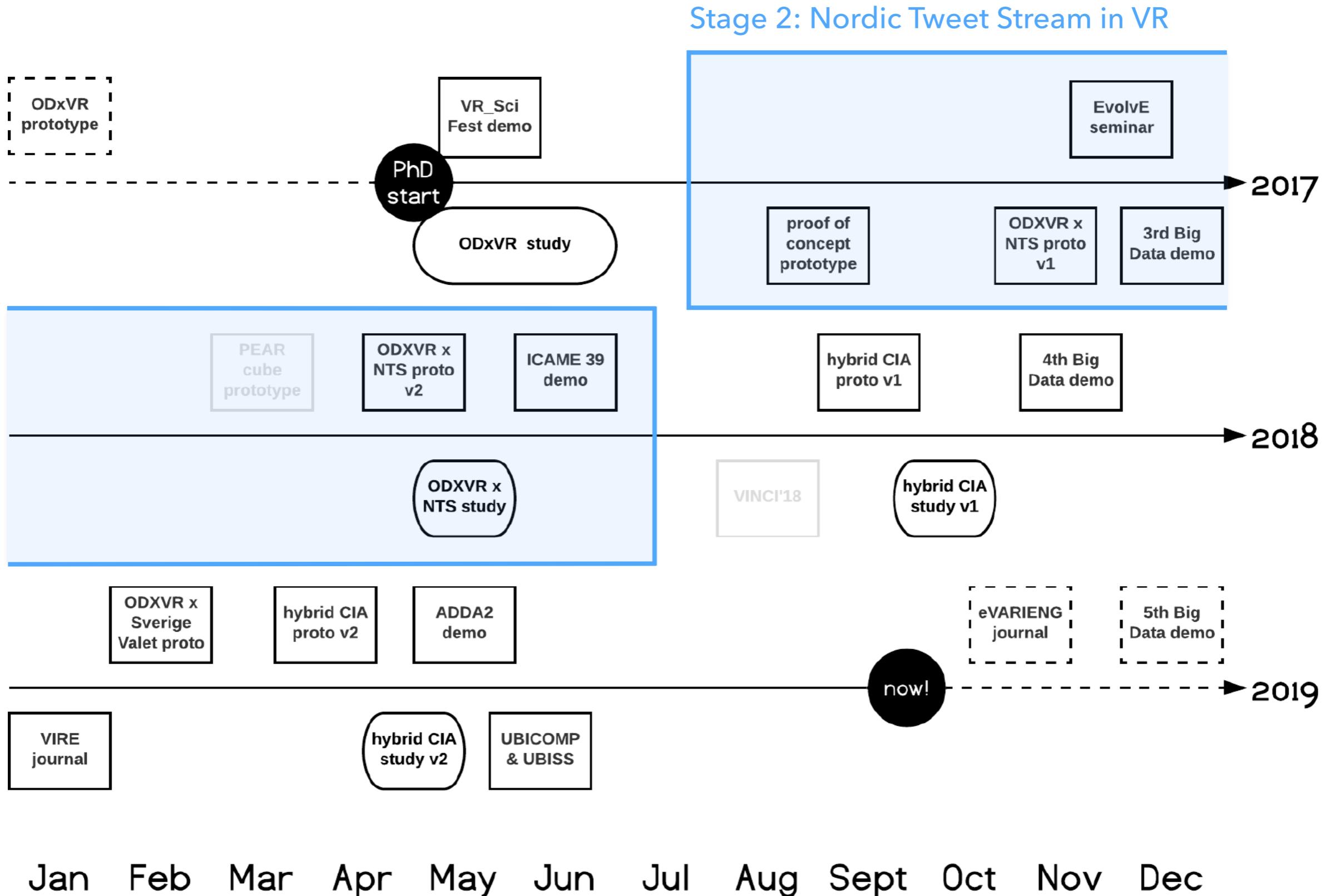


Comparison of using different types of input technologies in order to interact within an immersive VR environment in the context of data exploration (n=24).

Input device characteristics	GAMEPAD	Vision-based motion controls (V BMC)	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



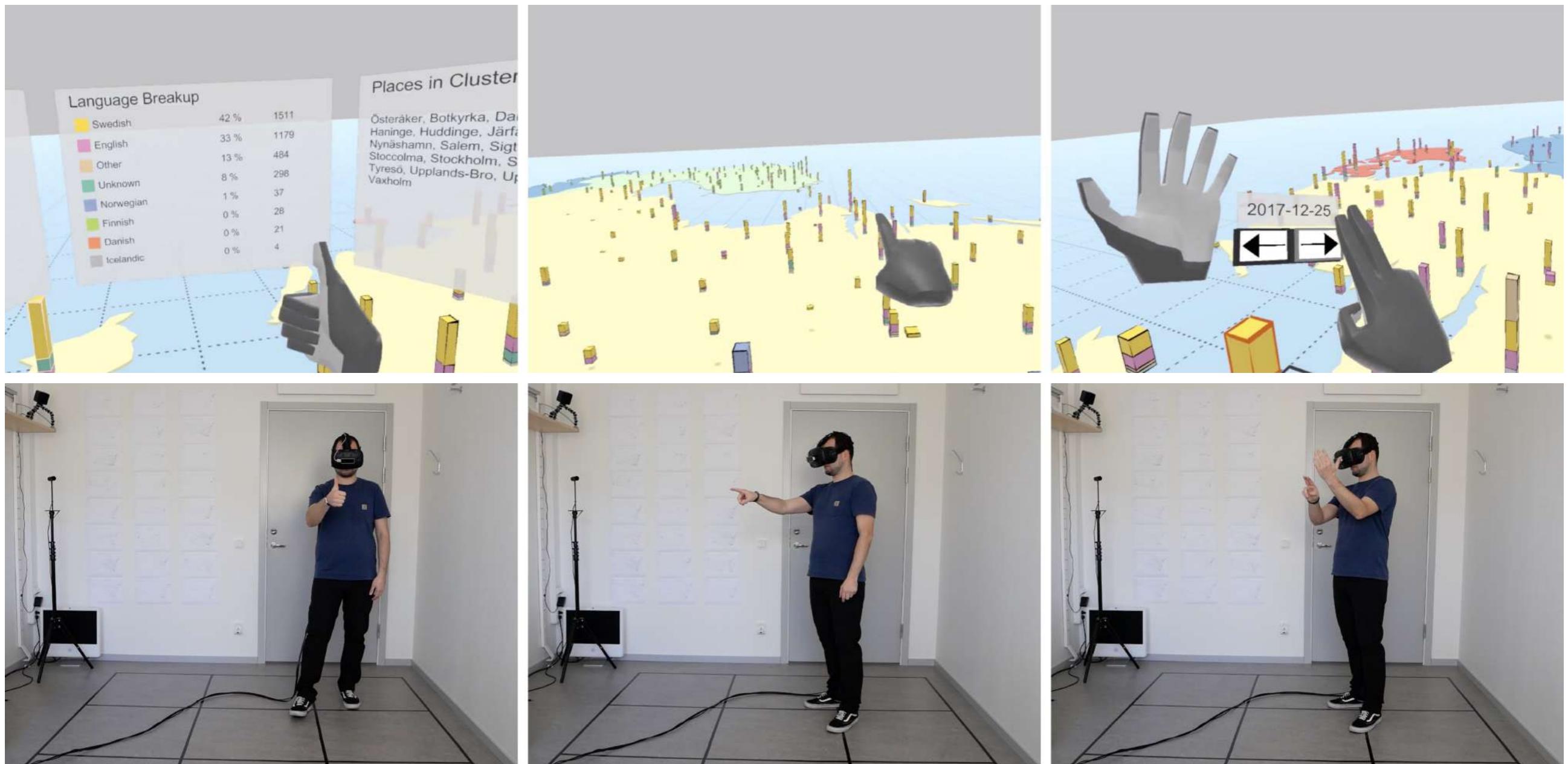
Stage 2: Nordic Tweet Stream in VR



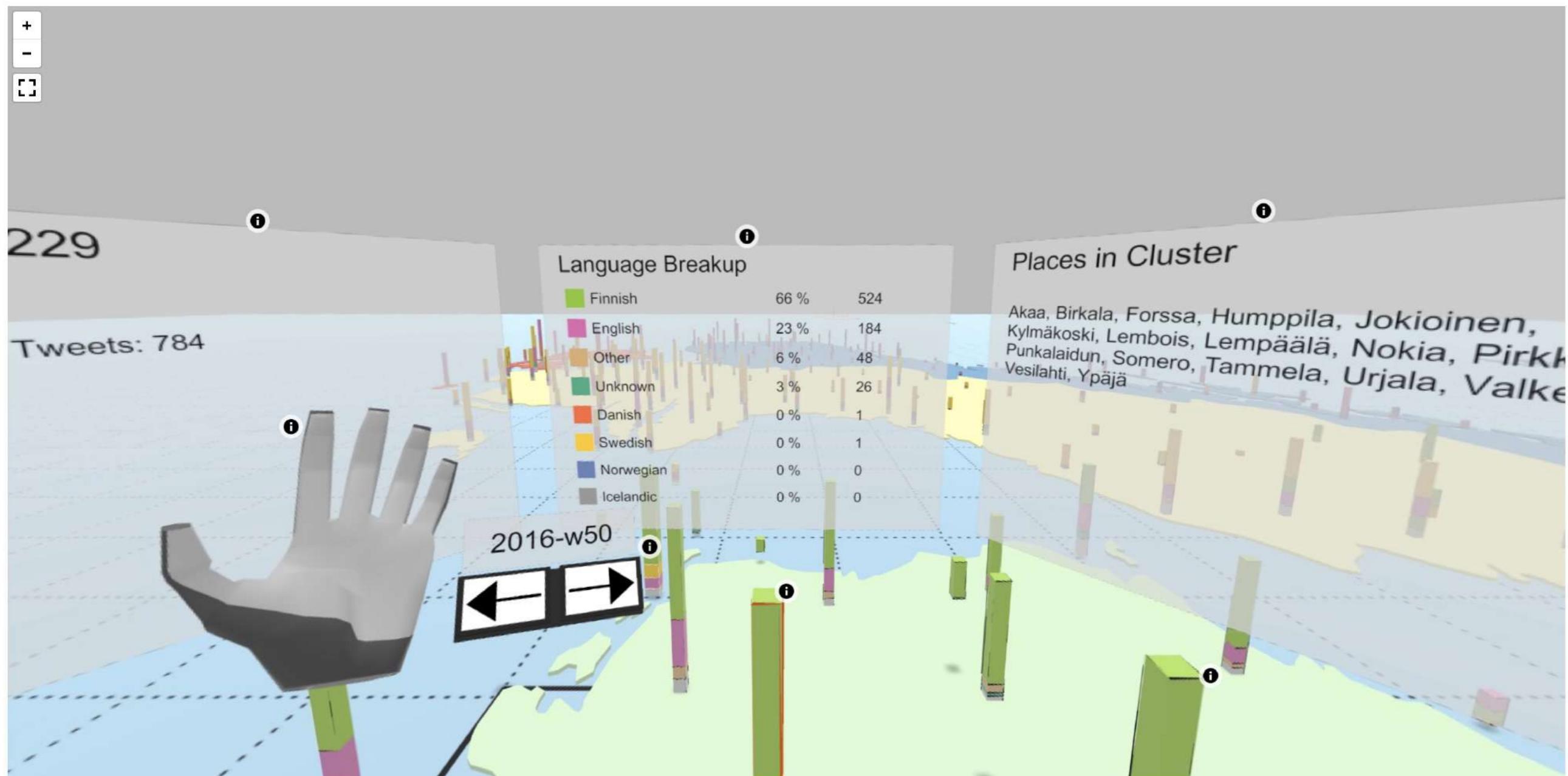
The Nordic Tweet Stream (NTS) corpus

- 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
- rich meta-data (currently over 1.5 billion meta-data points)
- collected in real-time (Twitter Streaming API)
- project active since November 2016

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



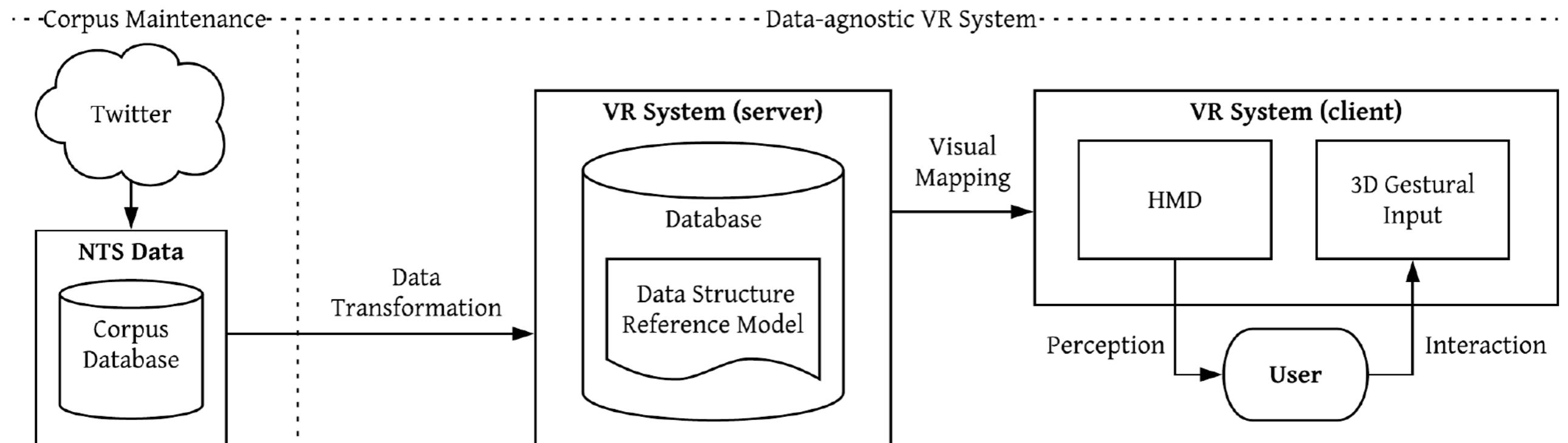
Try yourself, and get a “visual impression” (in 2D) of the computer-generated, virtual 3D environment (on your mobile or desktop device).



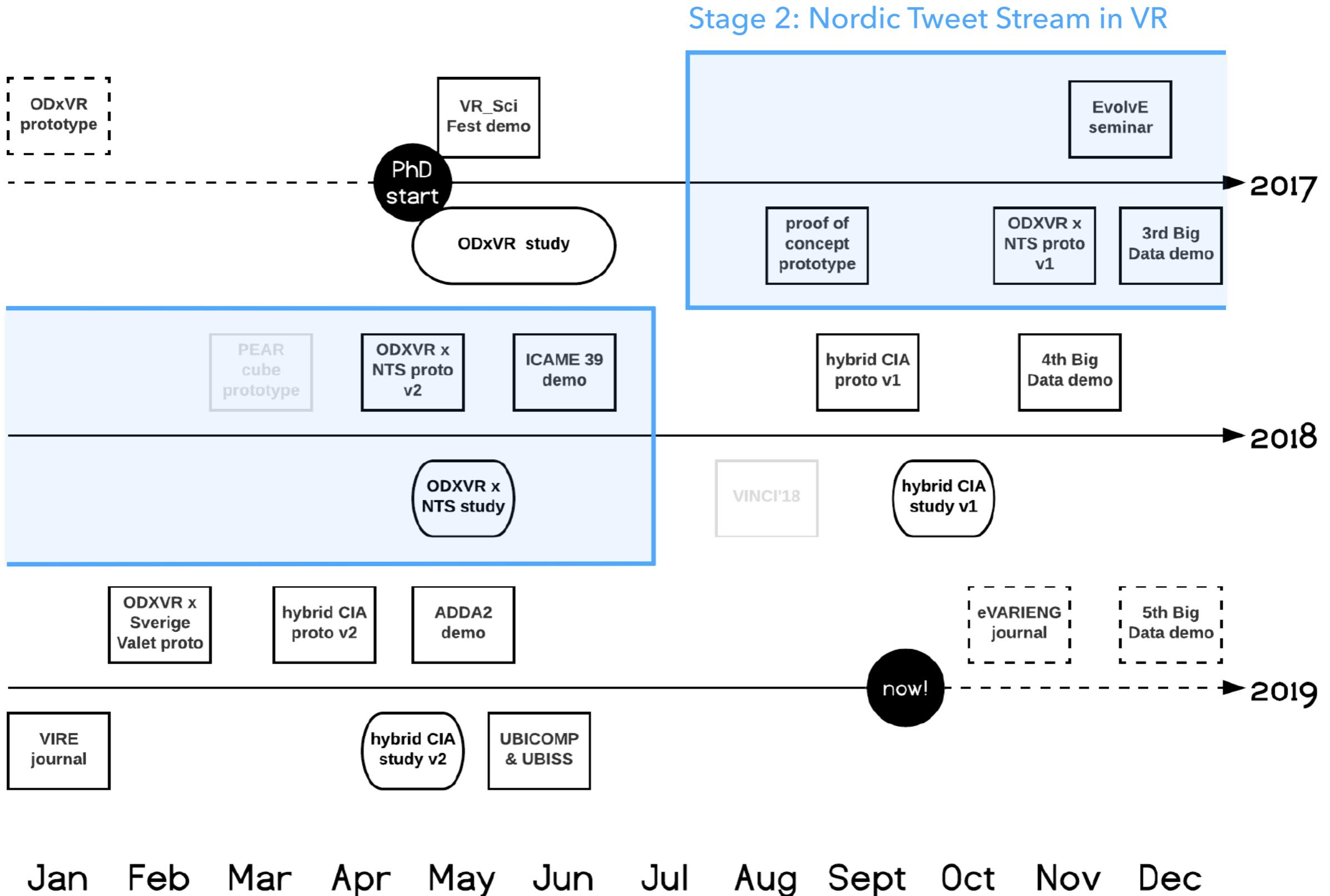
360° demo [vrkar.lnu.se/apps/odxvrxnts-360/]

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

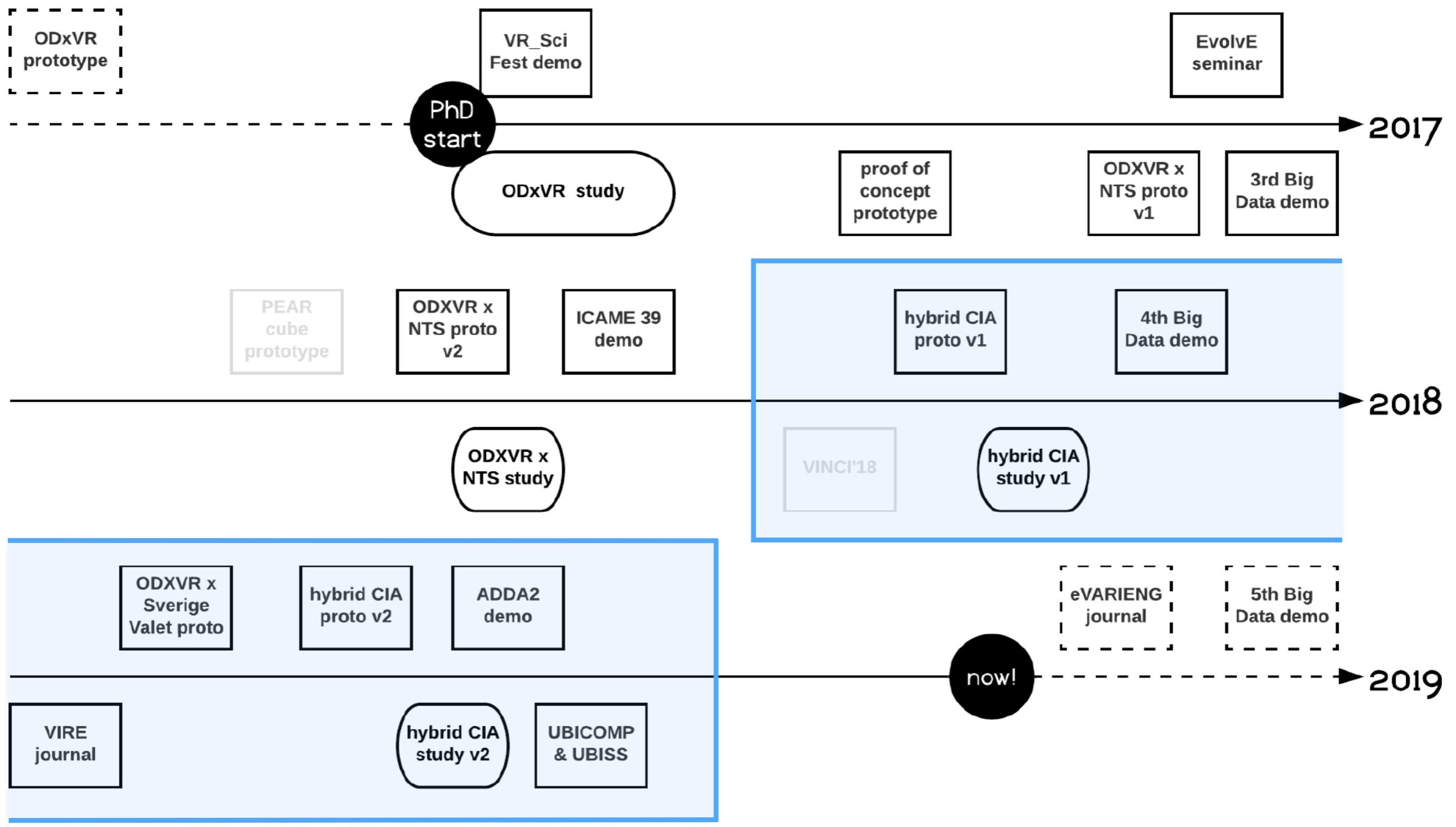
Planning and consideration of the overall data workflow, from aggregation, to storage, to consumption / application.



Stage 2: Nordic Tweet Stream in VR



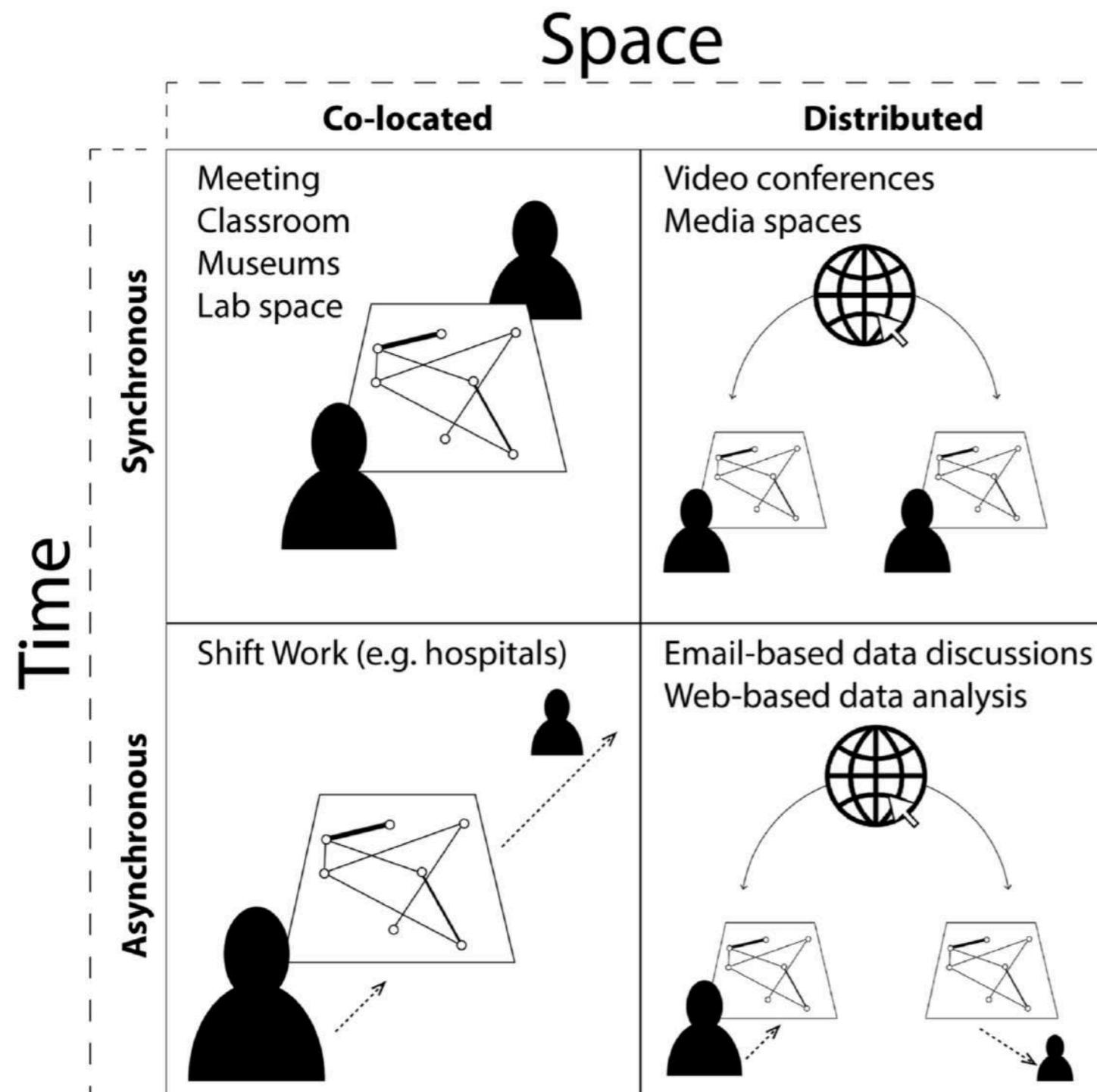
Stage 3: Hybrid Collaborative Immersive Analytics

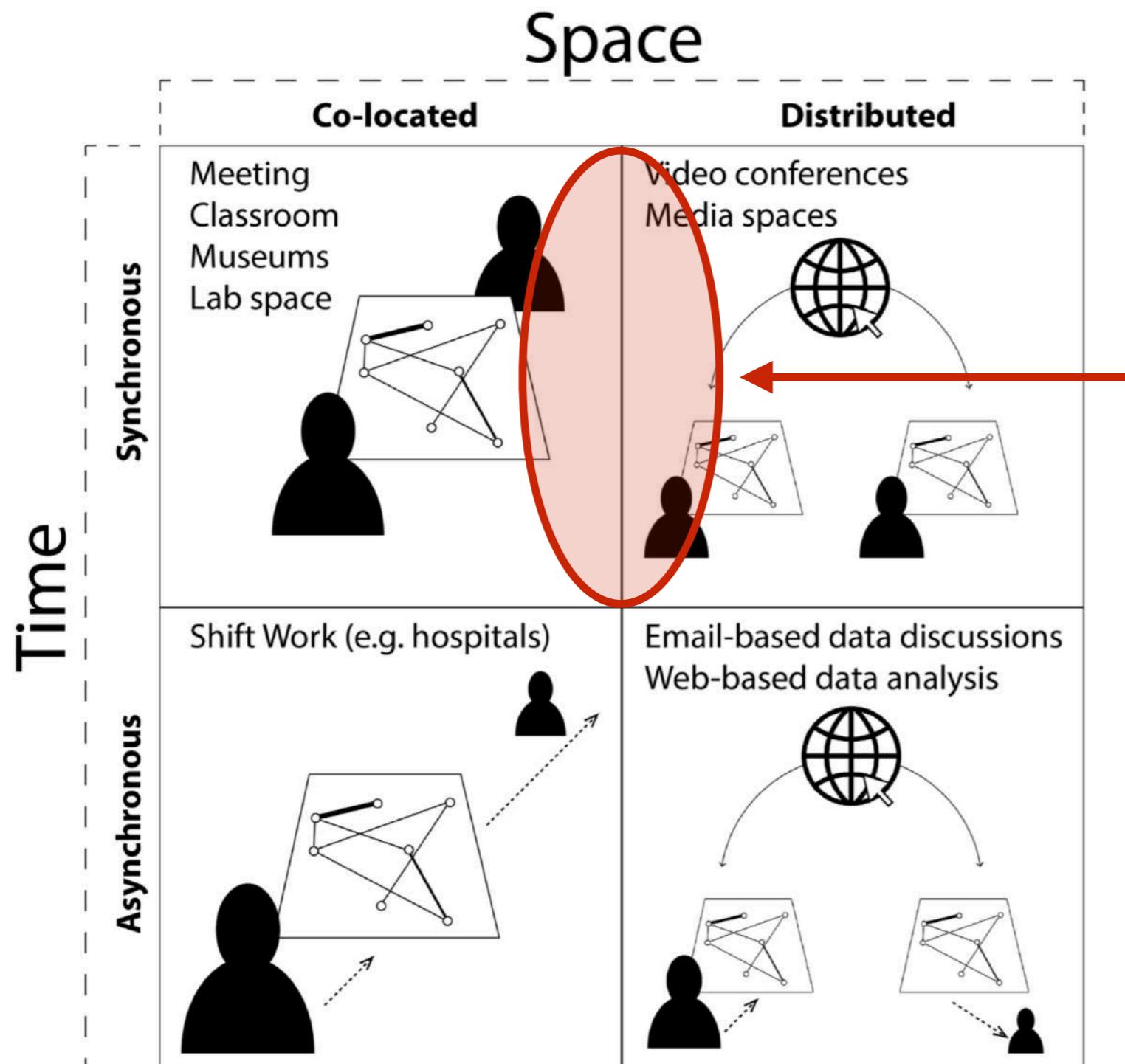


Stage 3: Hybrid Collaborative Immersive Analytics

Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec







synchronous
collaboration between a
HMD-wearing and outside
user ...?

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

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”

Some observations and experiences...

Immersive Technologies

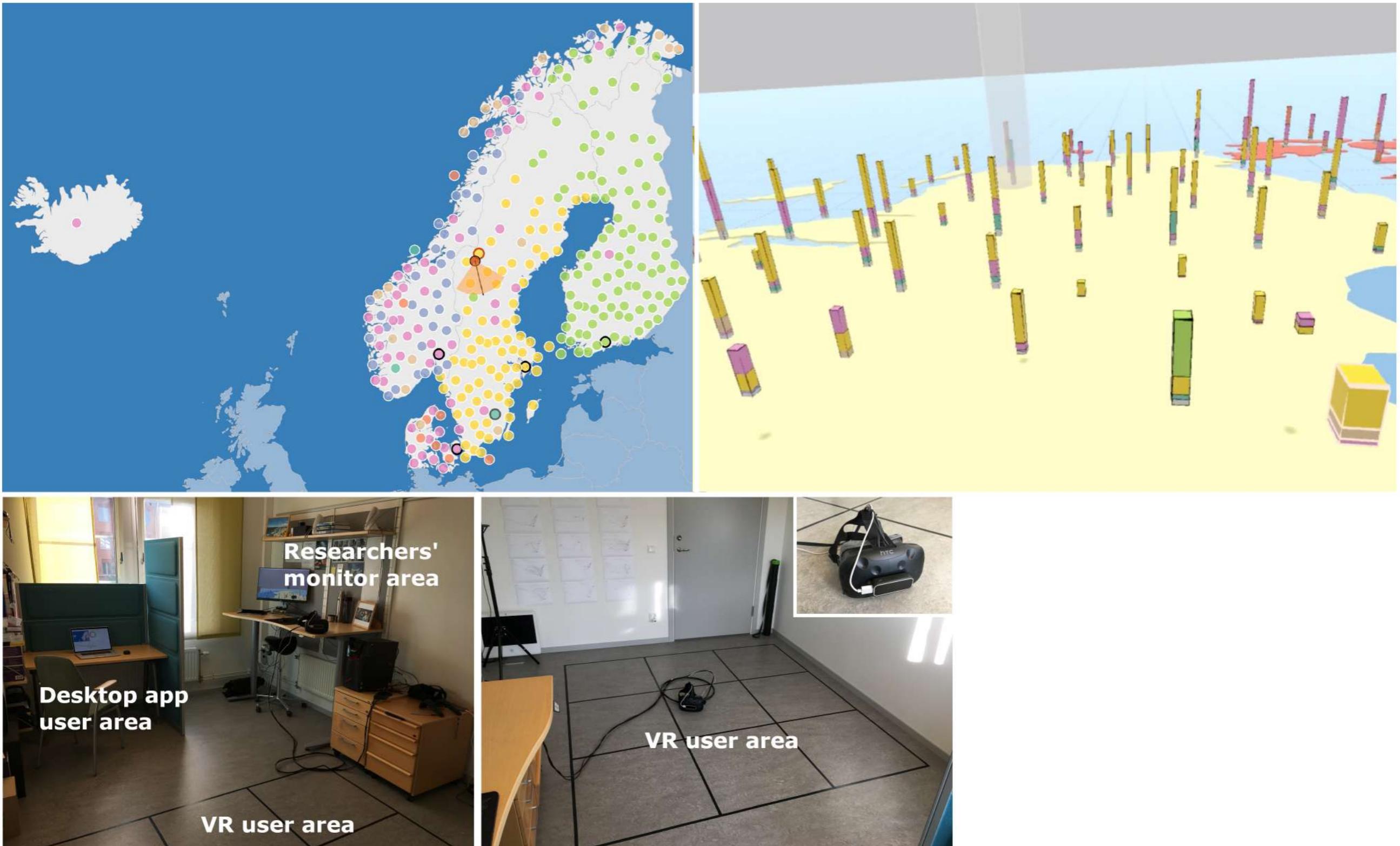
- not a substitution for 2D
- synergize / complement existing 2D practices
- + support perspective / identification of patterns
- + facilitate engagement and motivation

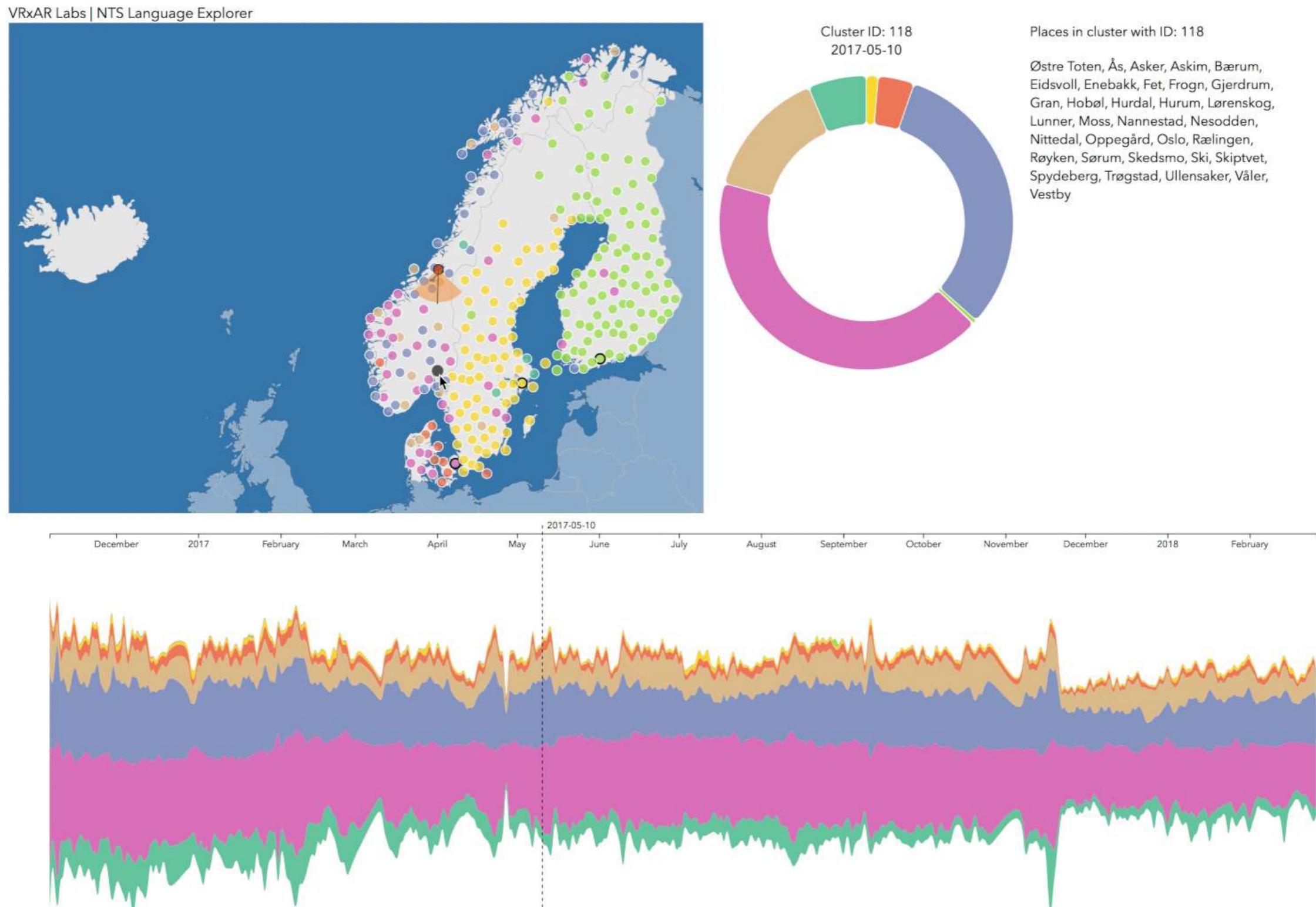
- read large amounts of text
- expensive in terms of physical space / resources

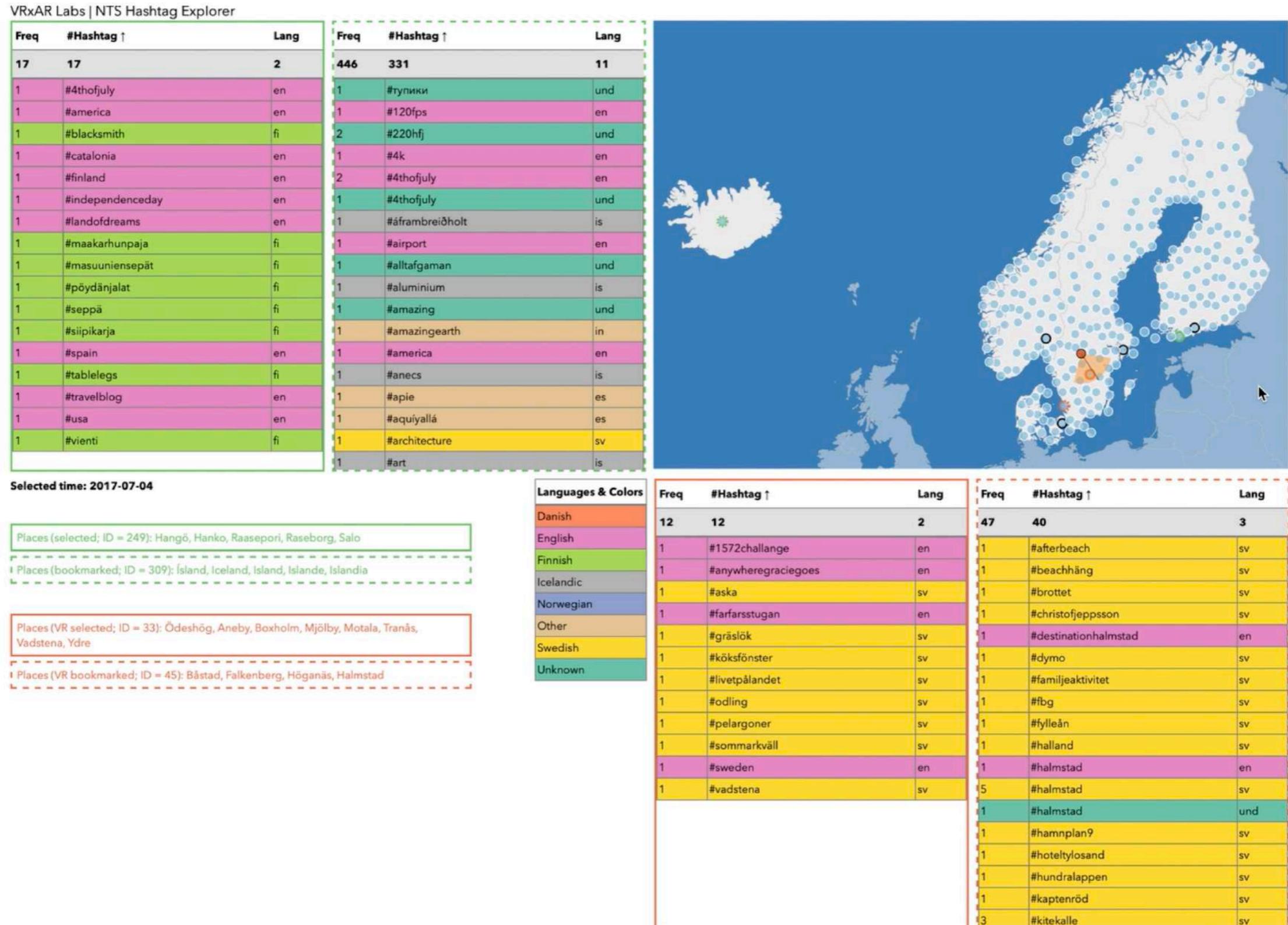
Non-immersive Technologies

- + established theories and practices
- (arguably) sometimes rather "dull" when exploring large amounts of data

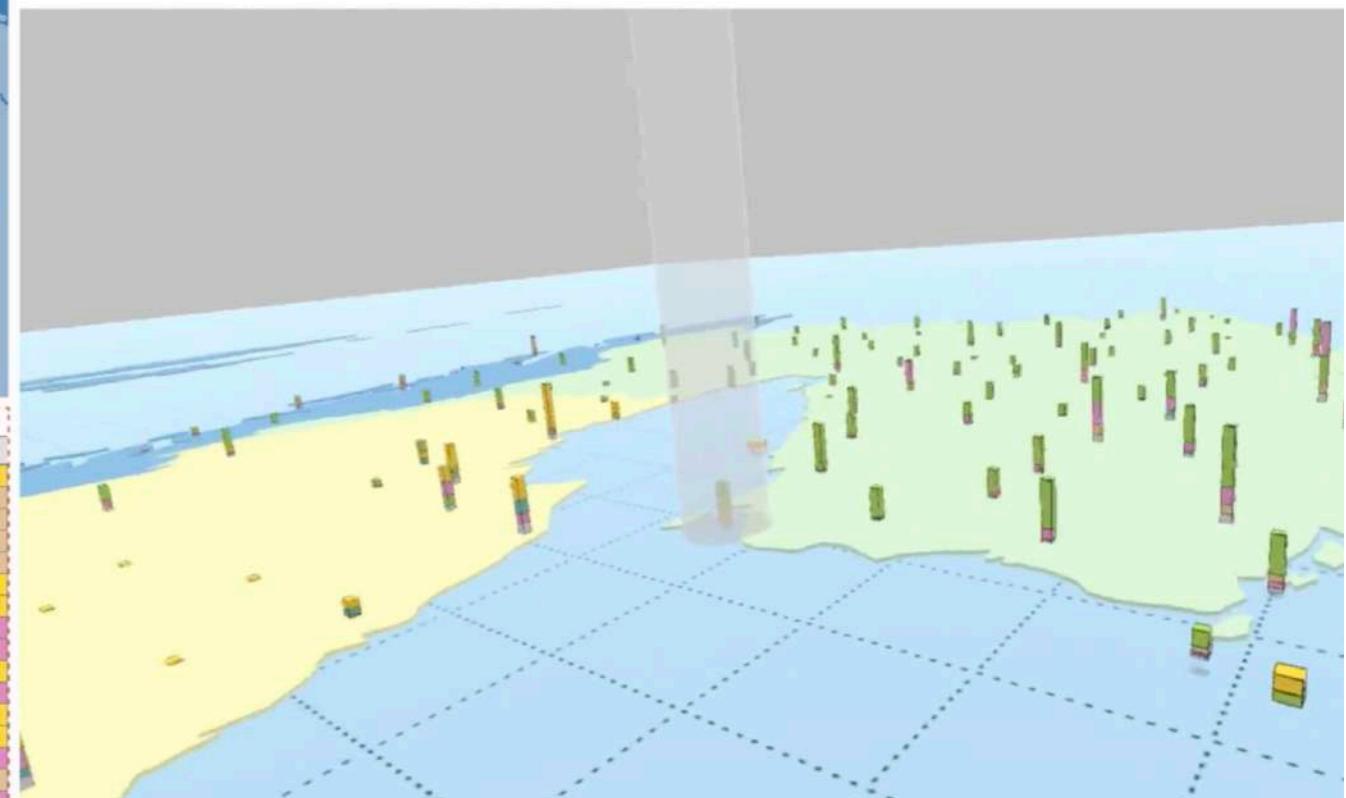
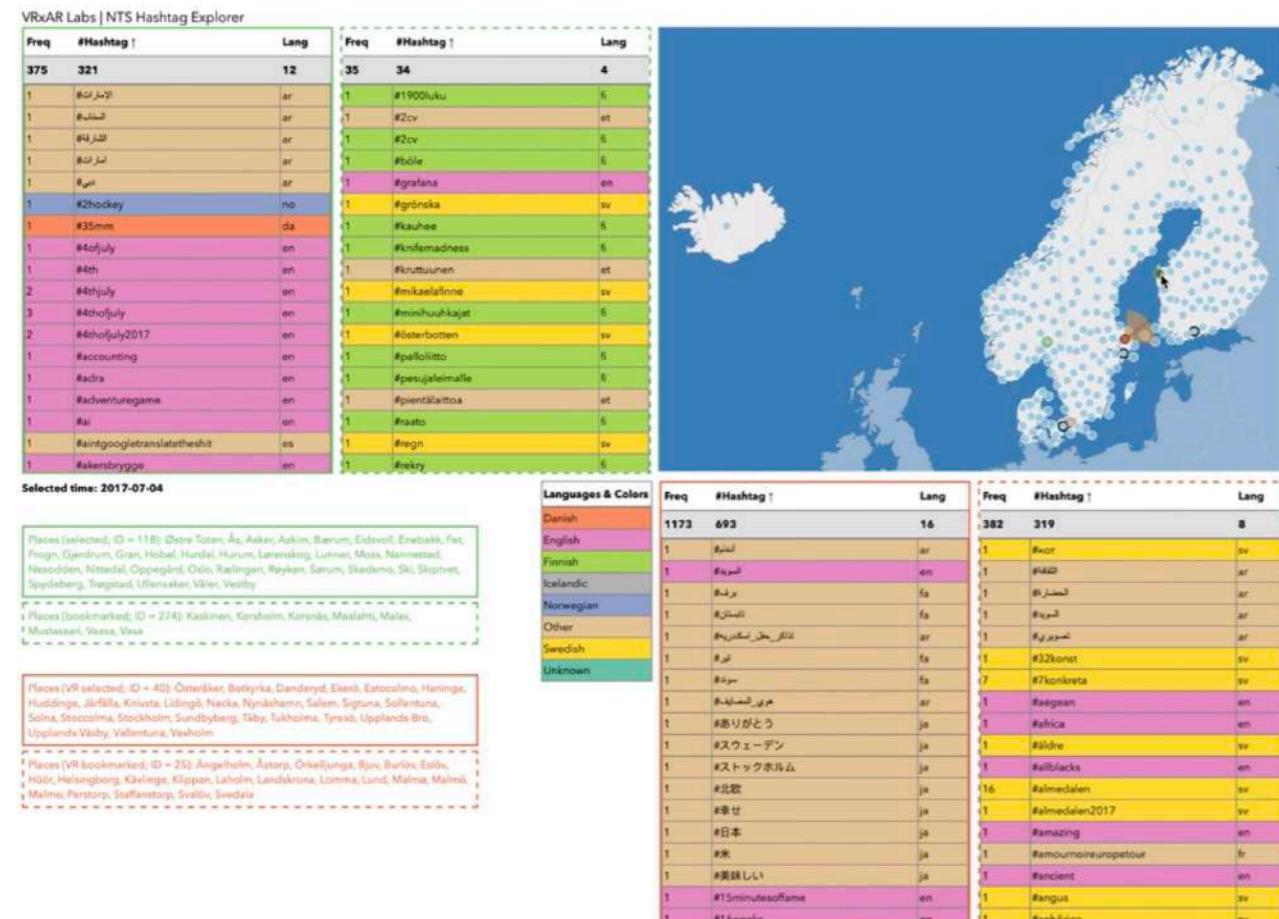
- + read large amounts of text
- + inexpensive (run on "normal" computing devices)



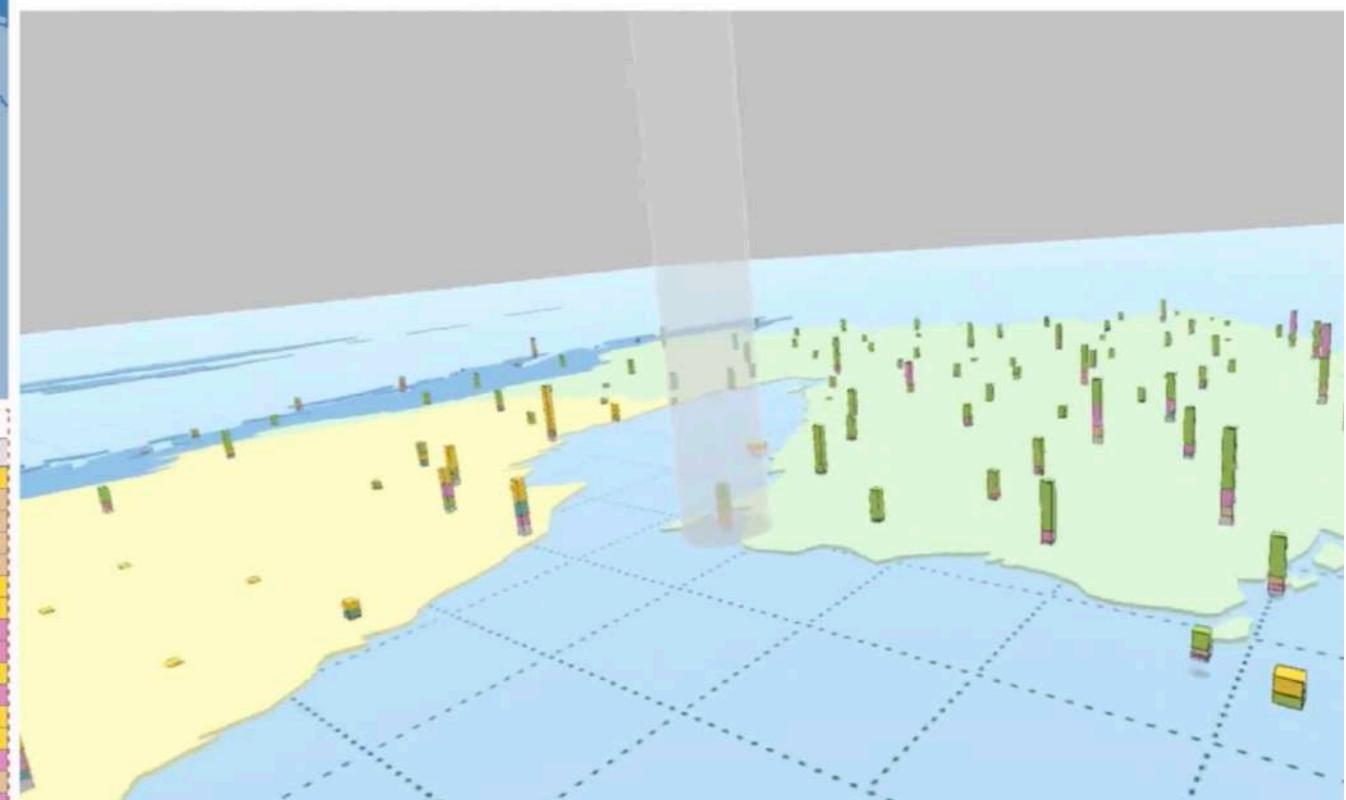
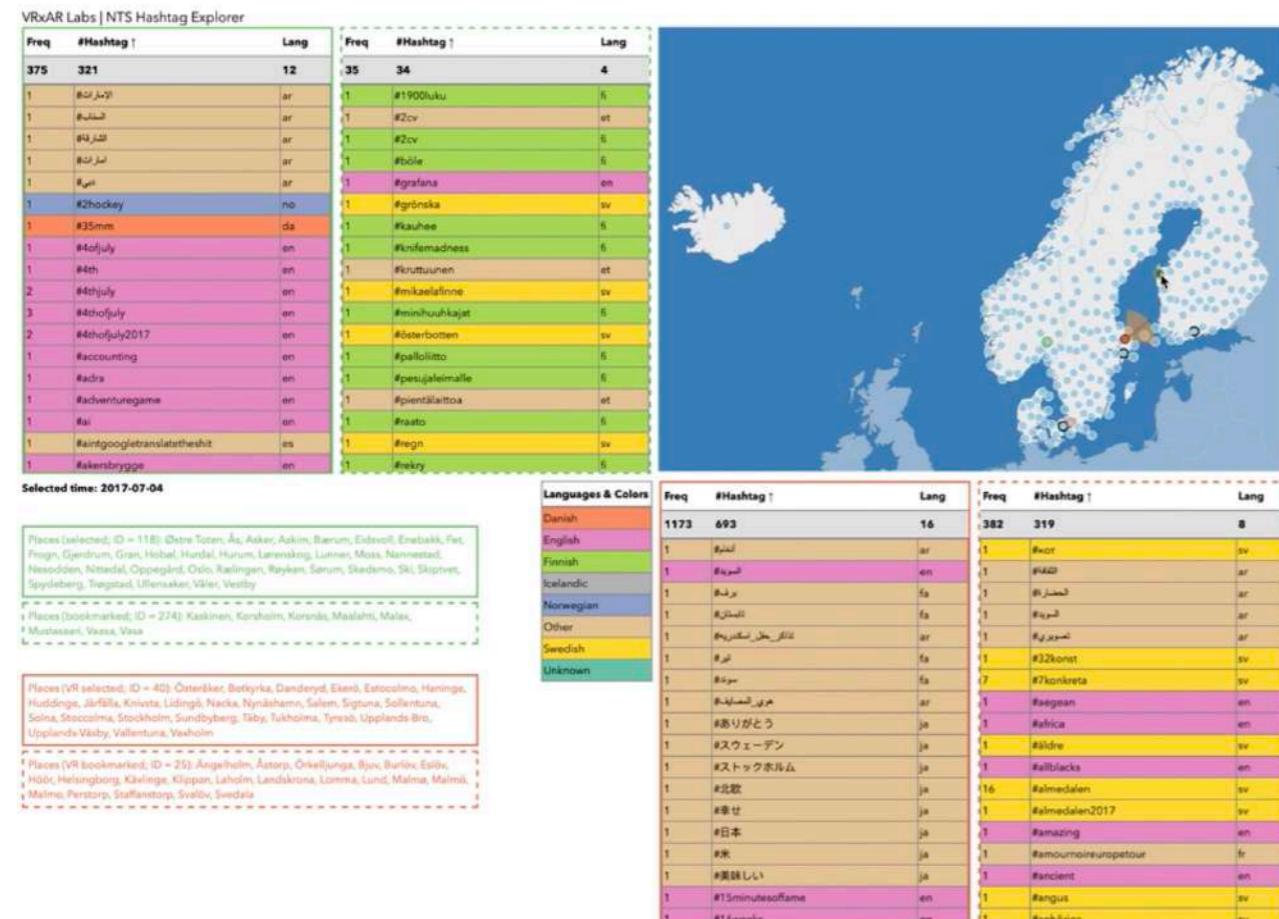




Web application Virtual Reality application

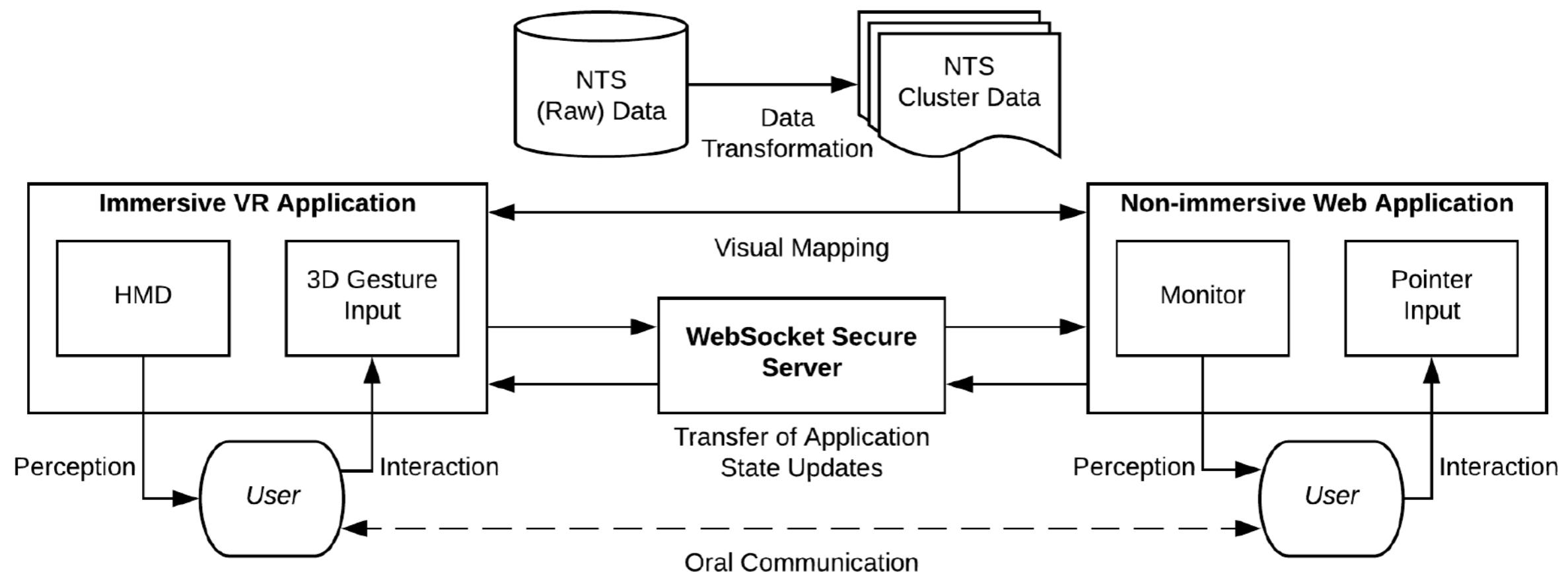


Web application Virtual Reality application



Quantitative

Qualitative

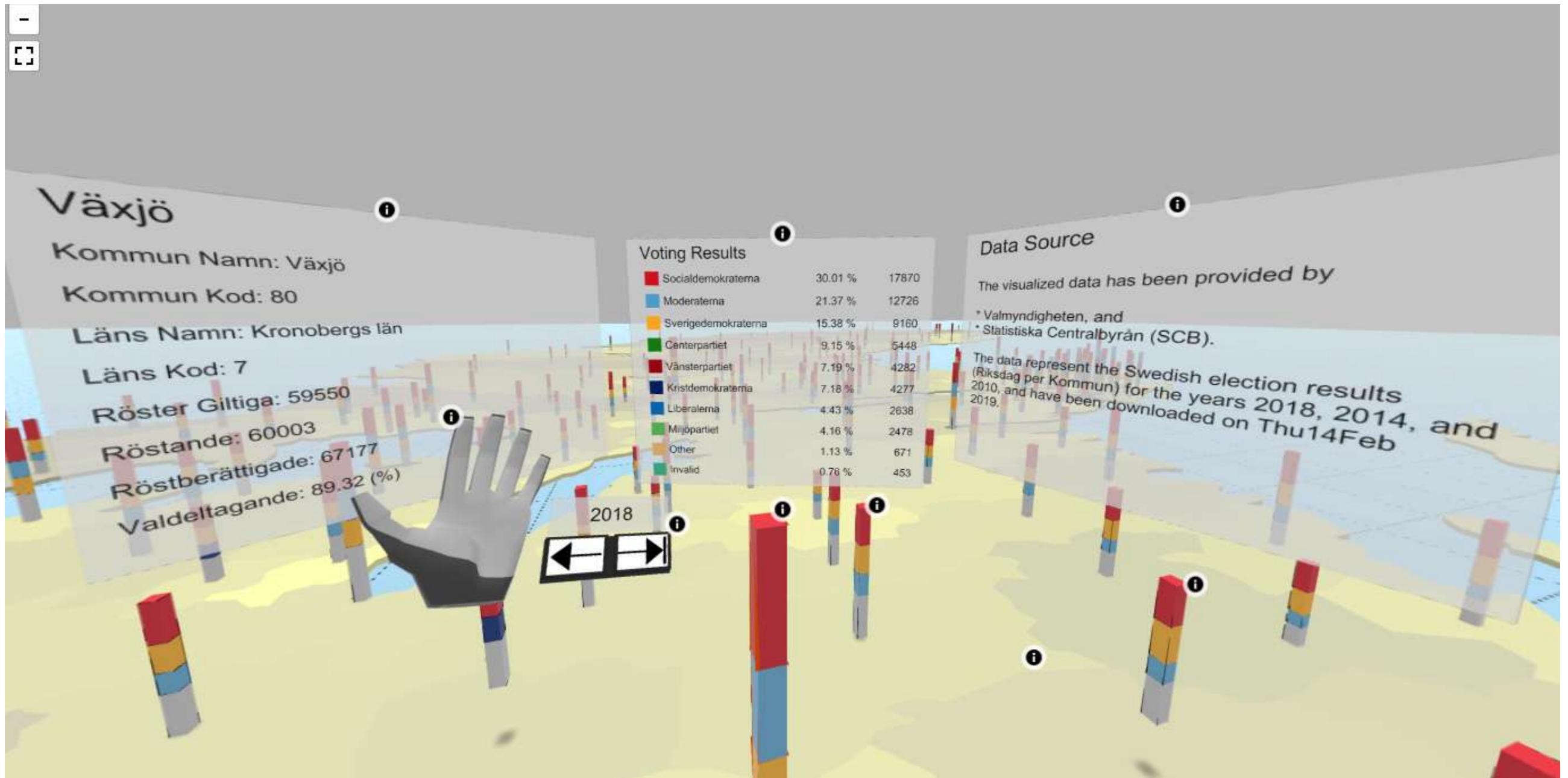


Research objectives - Revisited

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

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



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

Reflections on research perspective

- user-centered approach
- real-world scenarios and use-cases
- VR as a tool, not just for games and entertainment
- develop applications that can be used regularly
- embrace multi-disciplinary research
- collaborative (CSCW) aspects are often relevant in the real world

Thank you for your attention!

Questions?

(we have also videos...)

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PGP Fingerprint: E826 C9FF 1701 0BAC
CA98 308C 6772 4499 B061 D75B)

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VRxAR Labs



Department of Computer Science
and Media Technology (CM)

Faculty of Technology
Linnæus University, Växjö



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