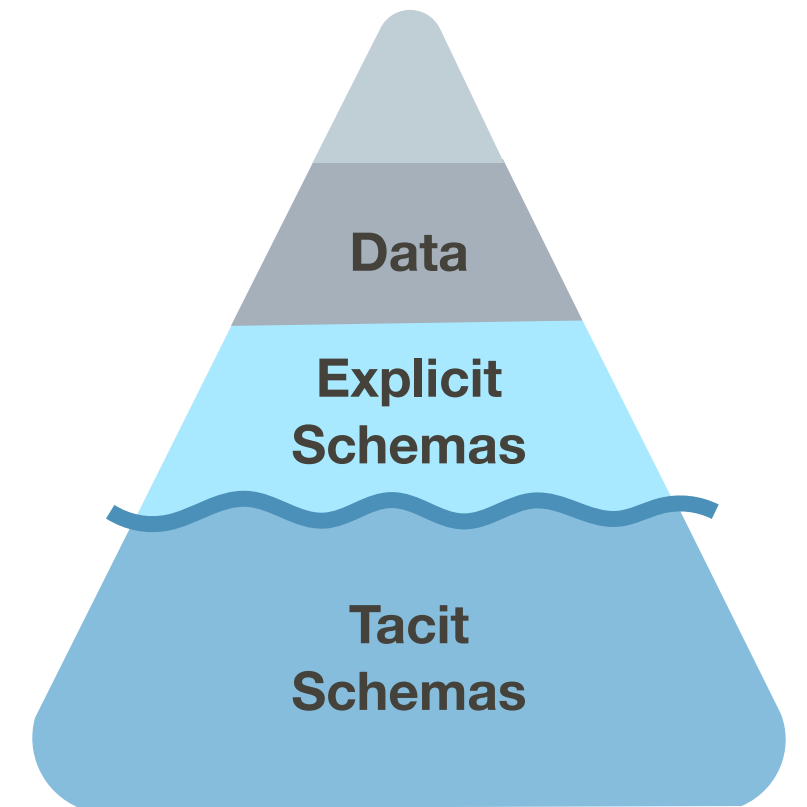


Iceberg Sensemaking: A Process Model for Critical Data Analysis

IEEE TVCG 31(9): 6067-6084, 2025

[doi: 10.1109/TVCG.2024.3486613](https://doi.org/10.1109/TVCG.2024.3486613) arxiv.org/pdf/2204.04758



Charles Berret

University of British Columbia
Linköping University
Enigma Technologies



Tamara Munzner

University of British Columbia



IEEE VIS 2025 Talk, 7 Nov 2025, Vienna Austria

<http://www.cs.ubc.ca/~tmm/talks.html#iceberg25>

 **@tamara@cosocial.ca**

Iceberg Sensemaking: Definitions and motivation

- **sensemaking**

- search for new understanding by gathering & analyzing data to answer task-specific questions

- **positivist** epistemology

- objective truth is accessible through experimental methods based in empirical observation

- **interpretivist** epistemology

- knowledge created through acts of interpretation, many different interpretations are viable

- call to action (Meyer and Dykes, VIS/TVCG 2019): need more interpretivism

- claim: new sensemaking models needed to navigate limitations of positivism

- responsible data analysis and visualization requires confronting the messy politics of knowledge

- angle of attack: rethink role of **schemas** in sensemaking

- cognitivist/positivist: individuals acquire structures of understanding, stable across contexts

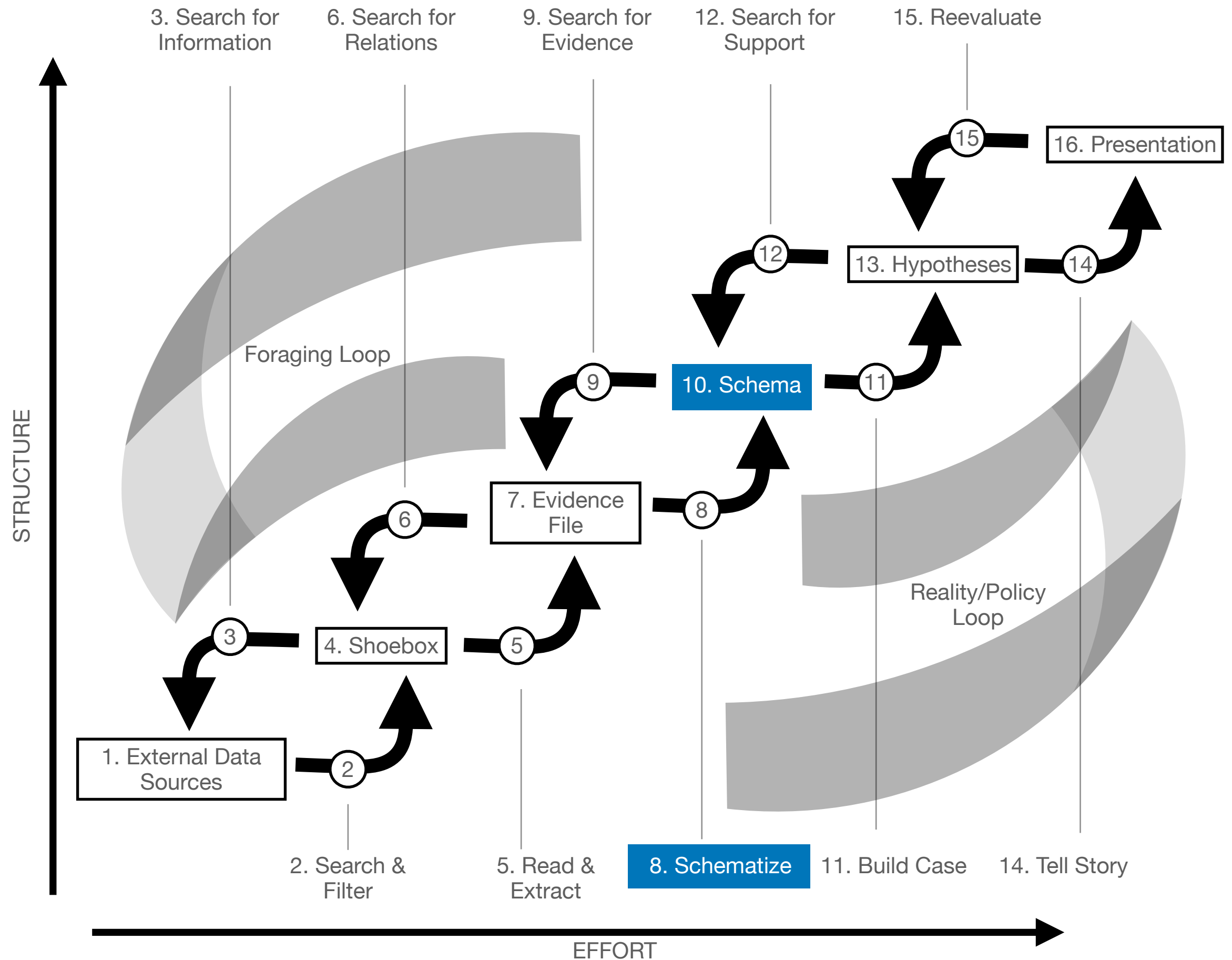
- interpretivist: we construct and acquire through social practices, systems, and institutions

Iceberg model: Key principles

- Tacit and Explicit Schemas
 - must consider schema of a sensemaking model at two different levels
 - **explicit** schema provided as documentation of a dataset
 - **tacit** schema encompassing unstated ideas on creation, context, interpretation, implications
- three more principles
 - Schemas First and Always
 - Schematic Multiplicity
 - Data as a Schematic Artifact

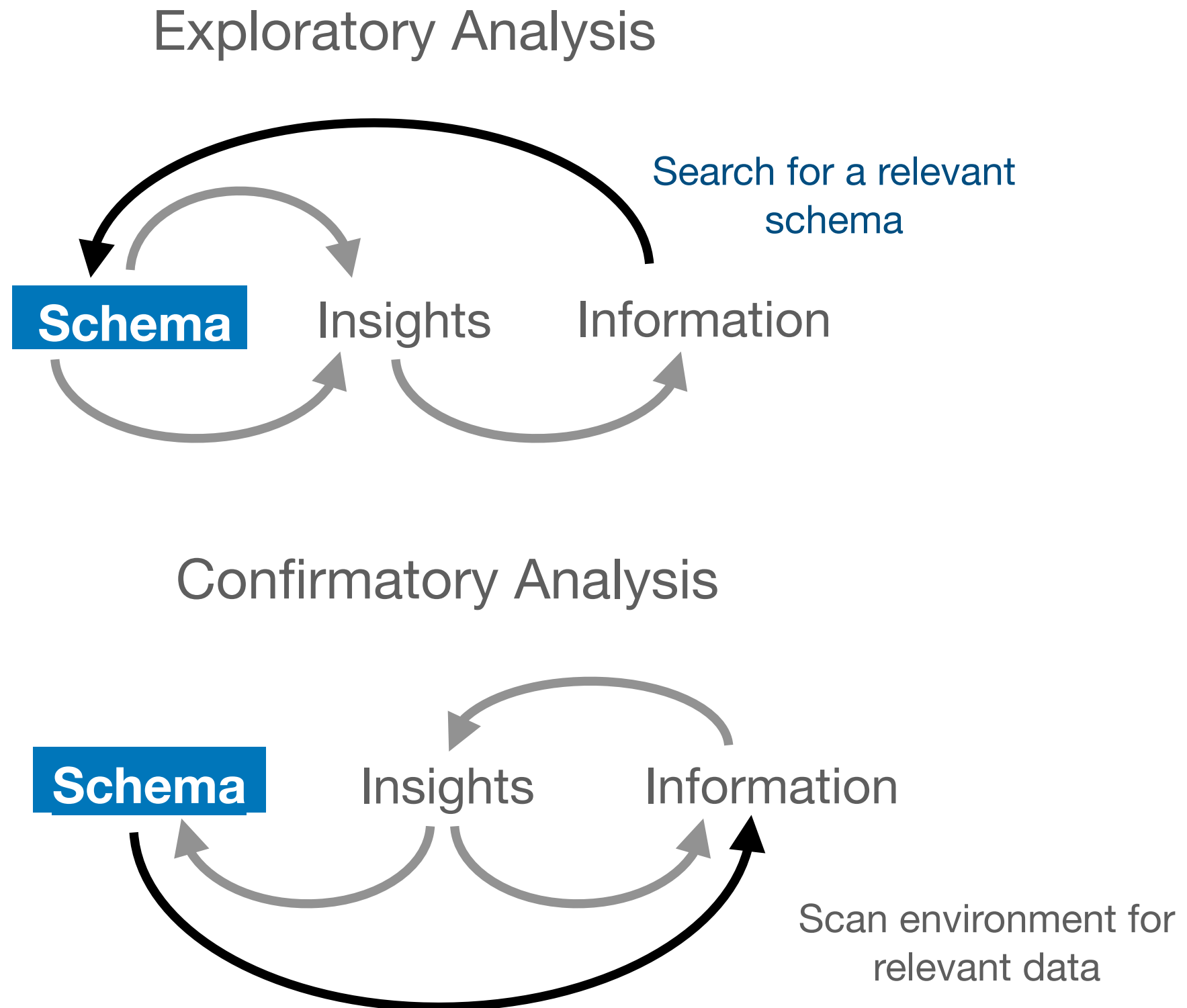
Sensemaking

- Pirolli & Card 2005
- schema halfway through
 - our principle: *Schemas First and Always*



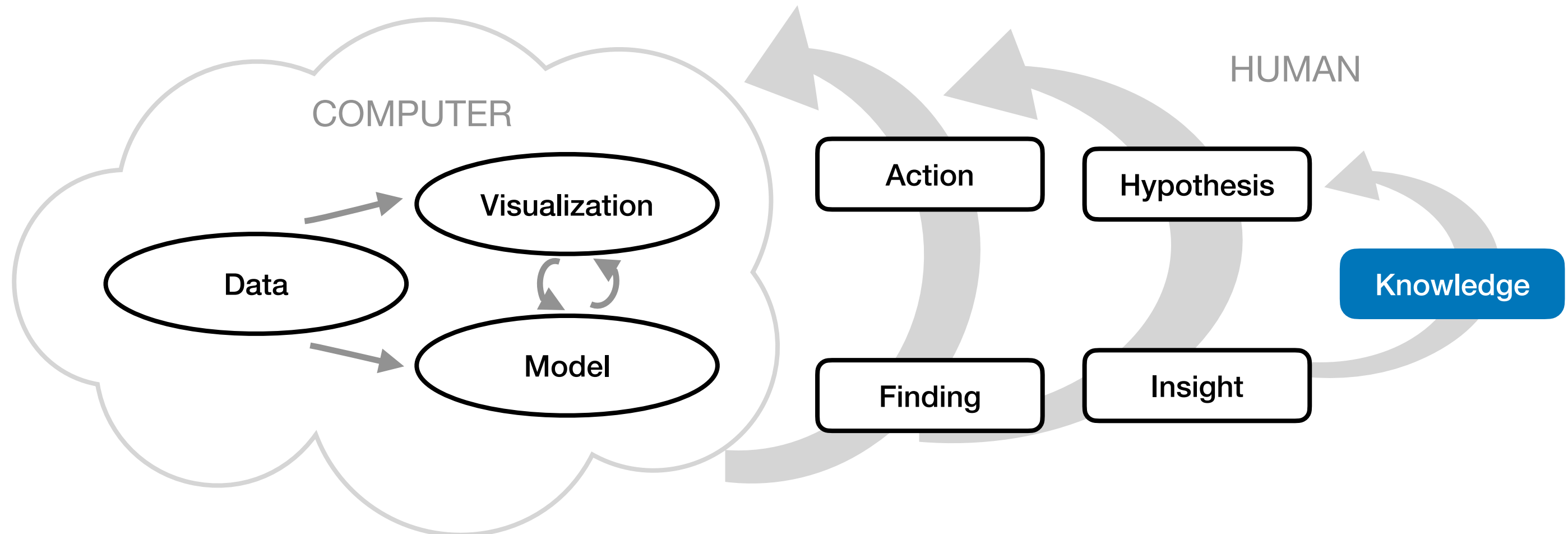
Sensemaking

- Grolemond & Wickham 2014
- single schema
 - our principle:
Schematic Multiplicity

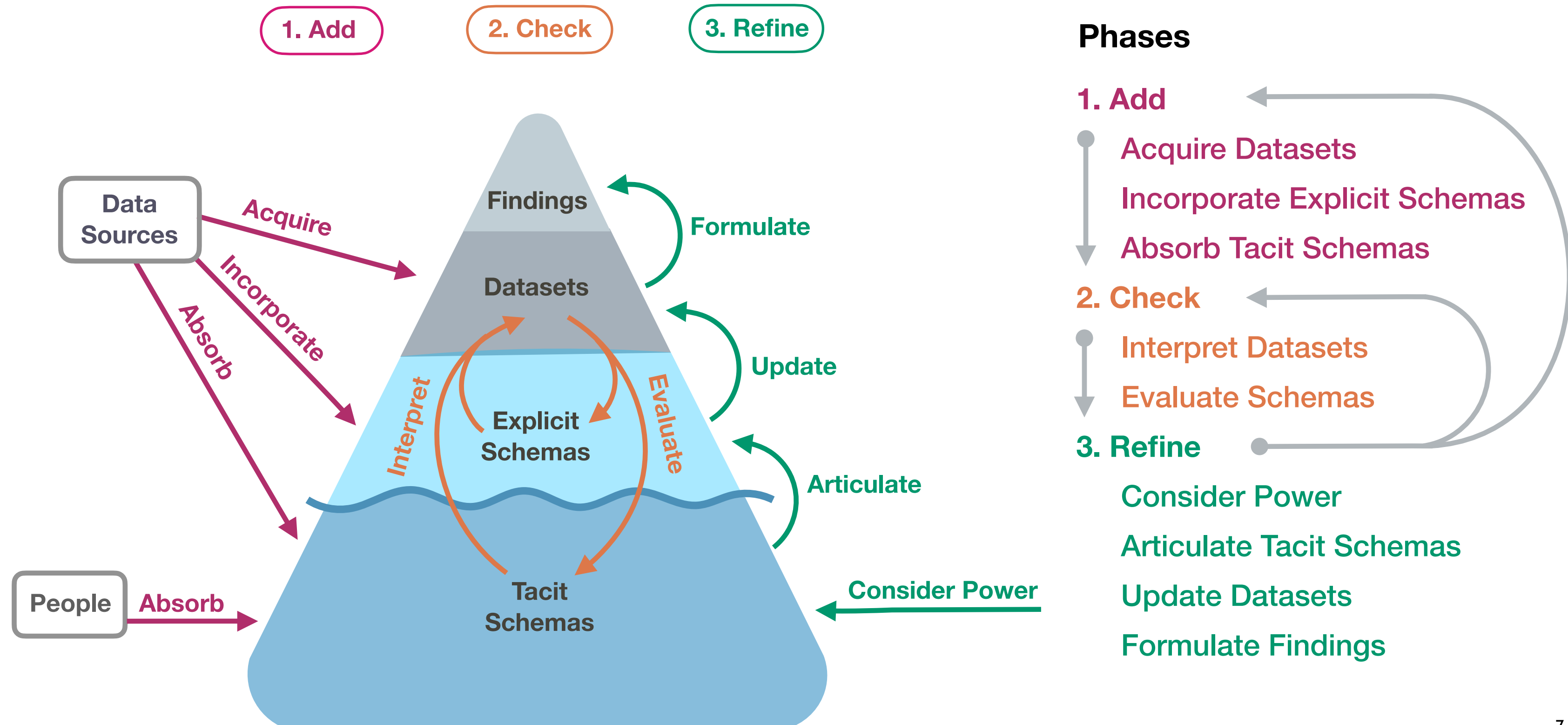


Sensemaking

- Sacha, Stoffel, Stoffel, Kwon, Ellis & Keim 2014
- knowledge (vs schema)
simply framed as "justified belief"
 - our principle:
Data as a Schematic Artifact



Iceberg Sensemaking Process Model



Scenarios

- Noticing Uncollected Data
- Learning to Wrangle Data
- Downplaying Inconvenient Data
- Measuring With Sensors

Scenarios

- **Noticing Uncollected Data**
- Learning to Wrangle Data
- Downplaying Inconvenient Data
- **Measuring With Sensors**

Scenario: Noticing Uncollected Data (Criminality)

- when model not followed, positivist sensemaking falls short
 - **Add**: **acquire** dataset from local police, **incorporate** explicit, **absorb** tacit
 - **Check**: high rates of shoplifting in poor neighbourhoods are not surprising
 - **Refine**: don't **consider** power, skip **articulate** phase, **formulate** uncritical findings
- when model followed, interpretivist sensemaking reveals nuances
 - **Refine**
 - **consider** the role of power/politics
 - some crimes not tracked: embezzlement, wage theft, civil asset forfeiture by police themselves
 - **articulate** these realizations, moving from tacit to explicit schema
 - **update** data to include white-collar crime
 - **formulate** finding: financial impact of upper-class crime >> lower-class crime (Karakatsanis 2019)
- illustration of Iceberg model's descriptive and prescriptive power
 - describes what goes wrong: unquestioned acceptance of explicit schema of criminality
 - prescribes how to avoid: articulate tacit schema to reframe

1. Add

Acquire Datasets

Incorporate Explicit Schemas

Absorb Tacit Schemas

2. Check

Interpret Datasets

Evaluate Schemas

3. Refine

Consider Power

Articulate Tacit Schemas

Update Datasets

Formulate Findings

Scenario: Measuring With Sensors (Water)

- following model illustrates when interpretivist sensemaking is necessary
 - **Add:** **acquire** water quality dataset from Flint Michigan, **incorporate** & **absorb** schemas
 - **Check:**
 - **interpret** dataset: water quality looks good
 - **evaluate** schema: know that residents drink bottled water
 - **Refine:**
 - **consider** power: water system infrastructure differs across neighborhoods
 - **articulate** explicit schema: all system segments should be sampled
 - **Add:** **acquire** new data from both rich and poor neighbourhoods
 - **Refine:** journalists **formulate** findings reflecting previously unreported water hazards
- following model can also lead to positivist sensemaking
 - **Add:** **acquire** data from rainwater sensors, **incorporate** & **absorb** schemas from standard measurement methodology
 - **Check:** **interpret** dataset & **evaluate** schemas against given data
 - **Refine:** **consider** power, conclude that methods and measurements are sound, **formulate** findings as usual
- illustration of Iceberg model's epistemic pluralism
 - sometimes data gathering does not present messy problems, positivist methods suffice

1. Add

Acquire Datasets
Incorporate Explicit Schemas
Absorb Tacit Schemas

2. Check

Interpret Datasets
Evaluate Schemas

3. Refine

Consider Power
Articulate Tacit Schemas
Update Datasets
Formulate Findings

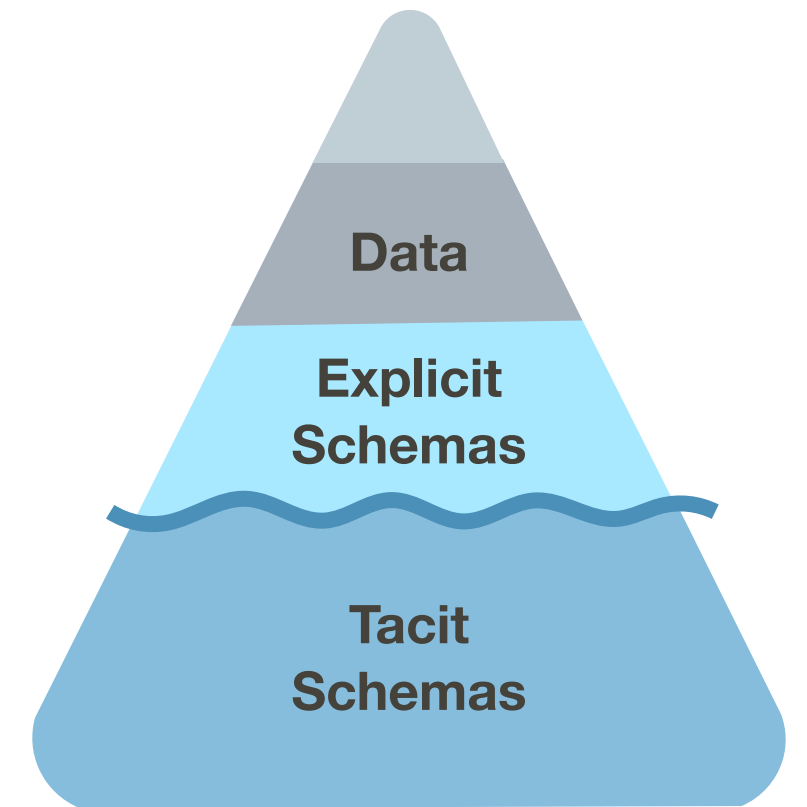
Discussion & conclusion

- virtue of epistemic humility
 - our approach to sensemaking offers room for both positivism and interpretivism
 - as long as this methodological decision is actively considered and justified
 - be wary of the sin of positivism:
overconfidence in science, as a source of objective knowledge
 - also be wary of the sin of interpretivism:
underconfidence in science, still best way to check limits of subjective inference
- Iceberg Model
 - describes how it's easy to be misled in the sensemaking process
 - prescribes critical approaches to checking for alternative explanations

Iceberg Sensemaking: A Process Model for Critical Data Analysis

IEEE TVCG 31(9): 6067-6084, 2025

[doi: 10.1109/TVCG.2024.3486613](https://doi.org/10.1109/TVCG.2024.3486613) arxiv.org/pdf/2204.04758



Charles Berret

University of British Columbia
Linköping University
Enigma Technologies



Tamara Munzner

University of British Columbia



IEEE VIS 2025 Talk, 7 Nov 2025, Vienna Austria

<http://www.cs.ubc.ca/~tmm/talks.html#iceberg25>

 **@tamara@cosocial.ca**