Interaction is a complex system

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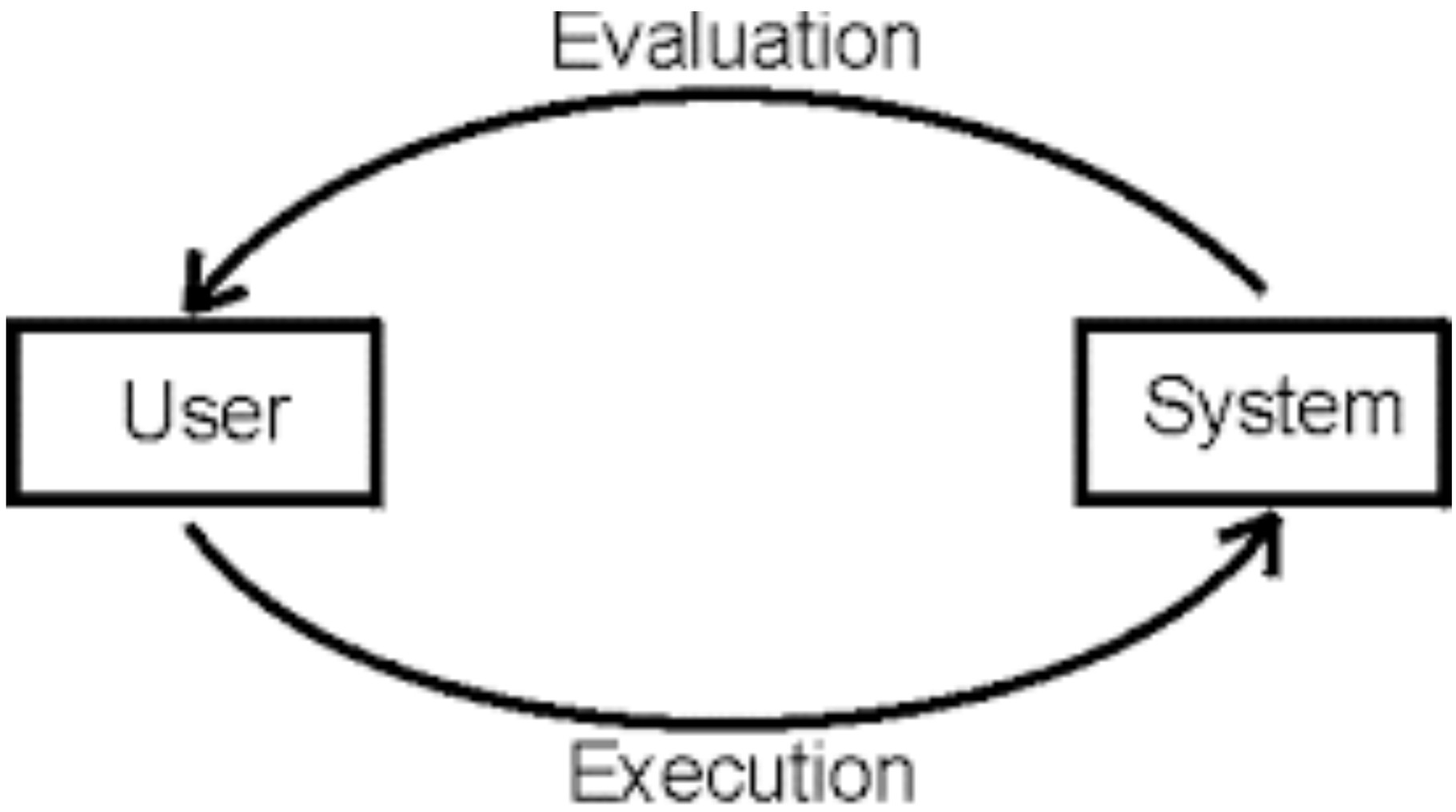
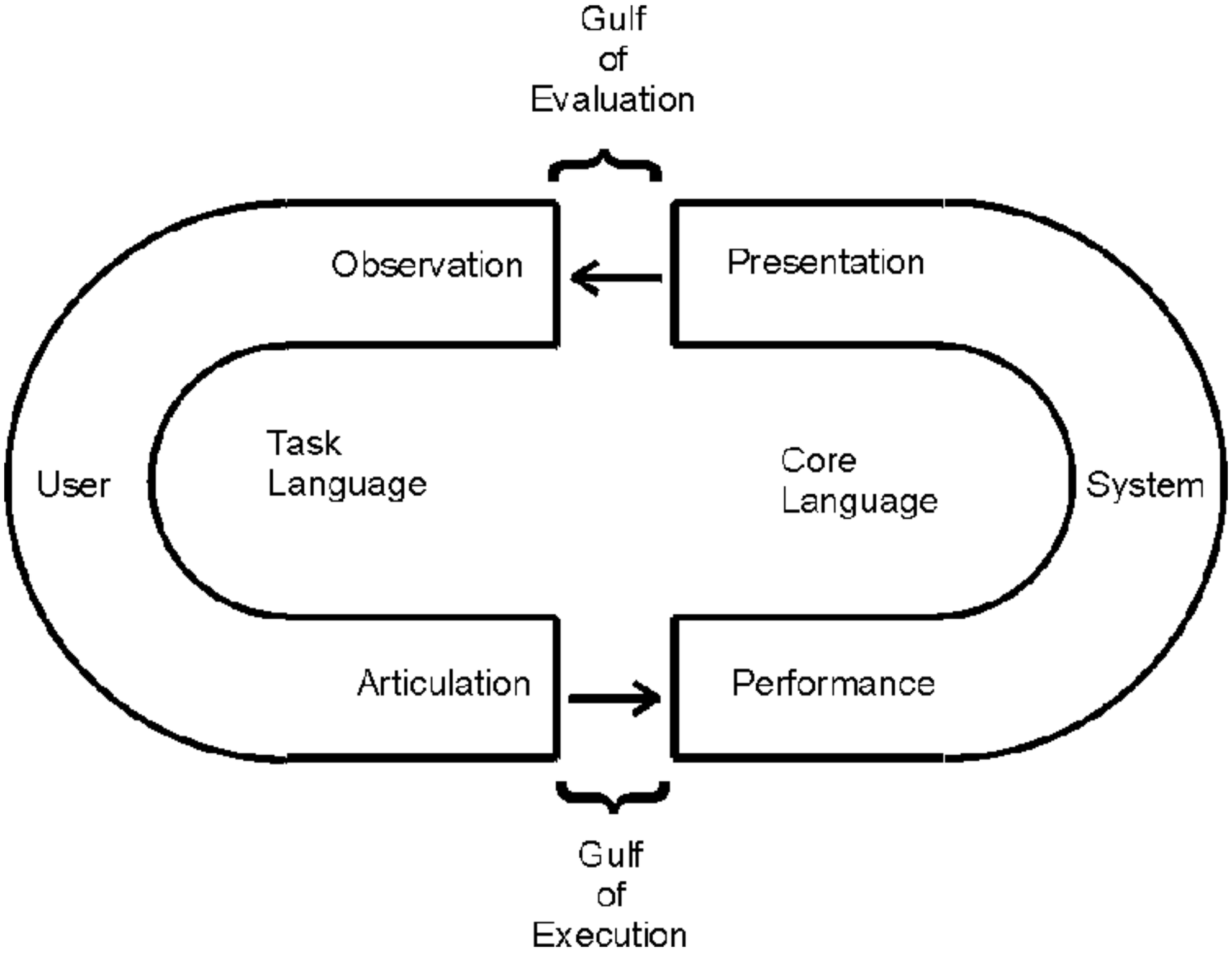
Emergent Interaction: Complexity, Dynamics, and Enaction in HCI



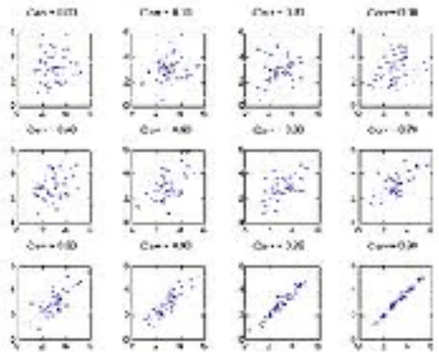
Norman's Interaction Cycle


Gulf
of
Evaluation
Observation
Presentation
User
Task
Language
Core
Language
System
Articulation
Performance
Gulf
of
Execution

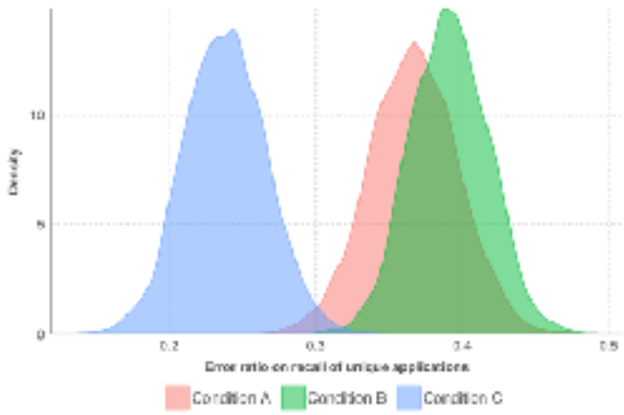
Measurement

Phenomena

Sample data



Analysis/Statistics



Assumption: causal relationships

So far: 3 approaches

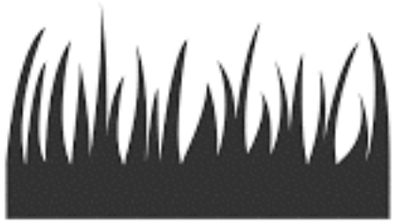
- Controlled studies
  - the researcher intervenes in the reality of participants
- Observational studies
  - the researcher does not intervene in the reality of the participants
  - models use regressions regressions
- Qualitative methods
  - descriptions of activities & experiences to understand dynamic interactions => Hypothesis generation

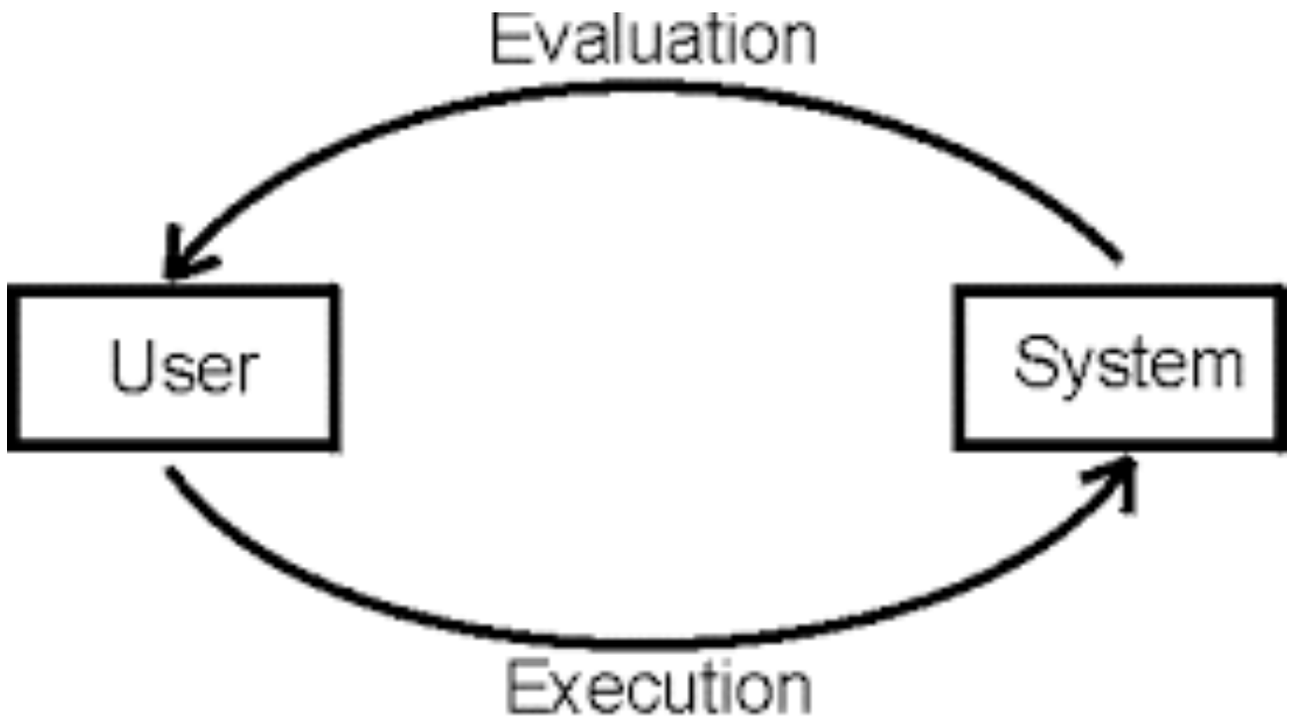
Limitation:
how to run studies in-the-wild?

Rethink causal relationships

The number of wolves affects sheep

The number of sheep affects wolves





Norman's Interaction Cycle

To analyse interaction data:

use methods from complex dynamic systems

Objective

- In naturalistic settings
- Distinguish between
  - naturally occurring correlations
  - causal relationships
- Without intervention from researcher

1-slide intro to Complex Dynamic Systems

- Multiple actors/component/variables interacting
- Interaction evolves over time (chaos theory)
  - Correlation can occur without causality
  - Causality can exist without correlation
- Taken's theorem: the complete behaviour of a complex system can be reconstructed by analysing any single variable that is associated with the system.
- Convergent Cross Mapping (*Science* 2012): identify causality in time-series pairs of variables
  - Variables can affect each other simultaneously

Used to study ecosystems

- Do sheep affect wolves, or vice versa?
- Does rain affect tree growth?
- Does plankton affect fish growth?

- Typically used to study (in depth) single ecosystems
- Typically used to identify causality

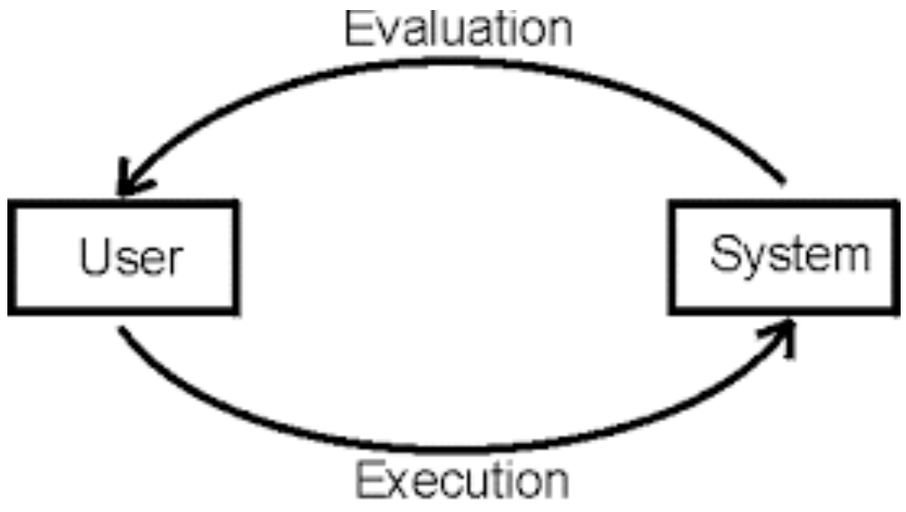
Our contribution:

Treat each participant as an ecosystem

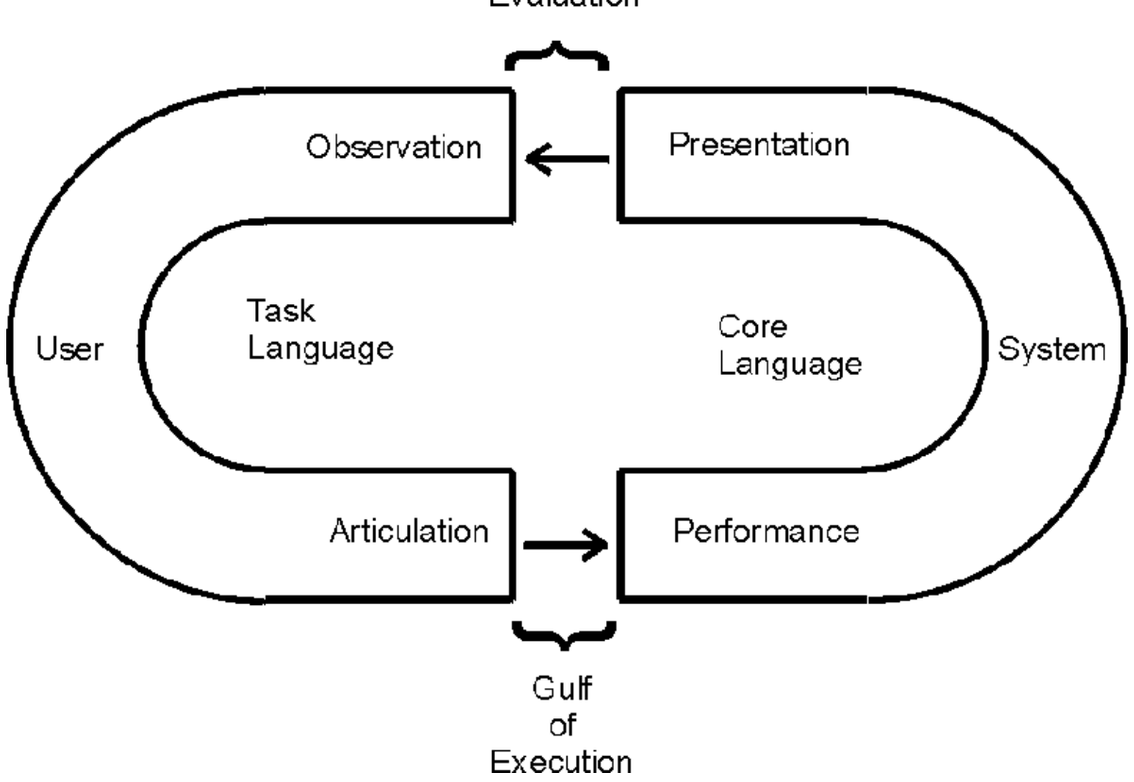
Summarise analyses from multiple participants (ecosystems)

Thoughts / Benefits

- No need to worry about confounding variables
  - Taken's Theorem
  - If any variable has an effect, its effect leaves a "footprint" in all affected variables.
- The technique works *spookily* well
  - We tried it on random data, or "fake" correlations, and it worked
  - We tried it on "impossible" scenarios, and it worked as expected
  - We tried it with confounding data, and it worked as expected



Norman's Interaction Cycle



The ~~end~~ beginning!

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