

# Opening the Black Box of Interaction in Visualization

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VIS Tutorial 2014



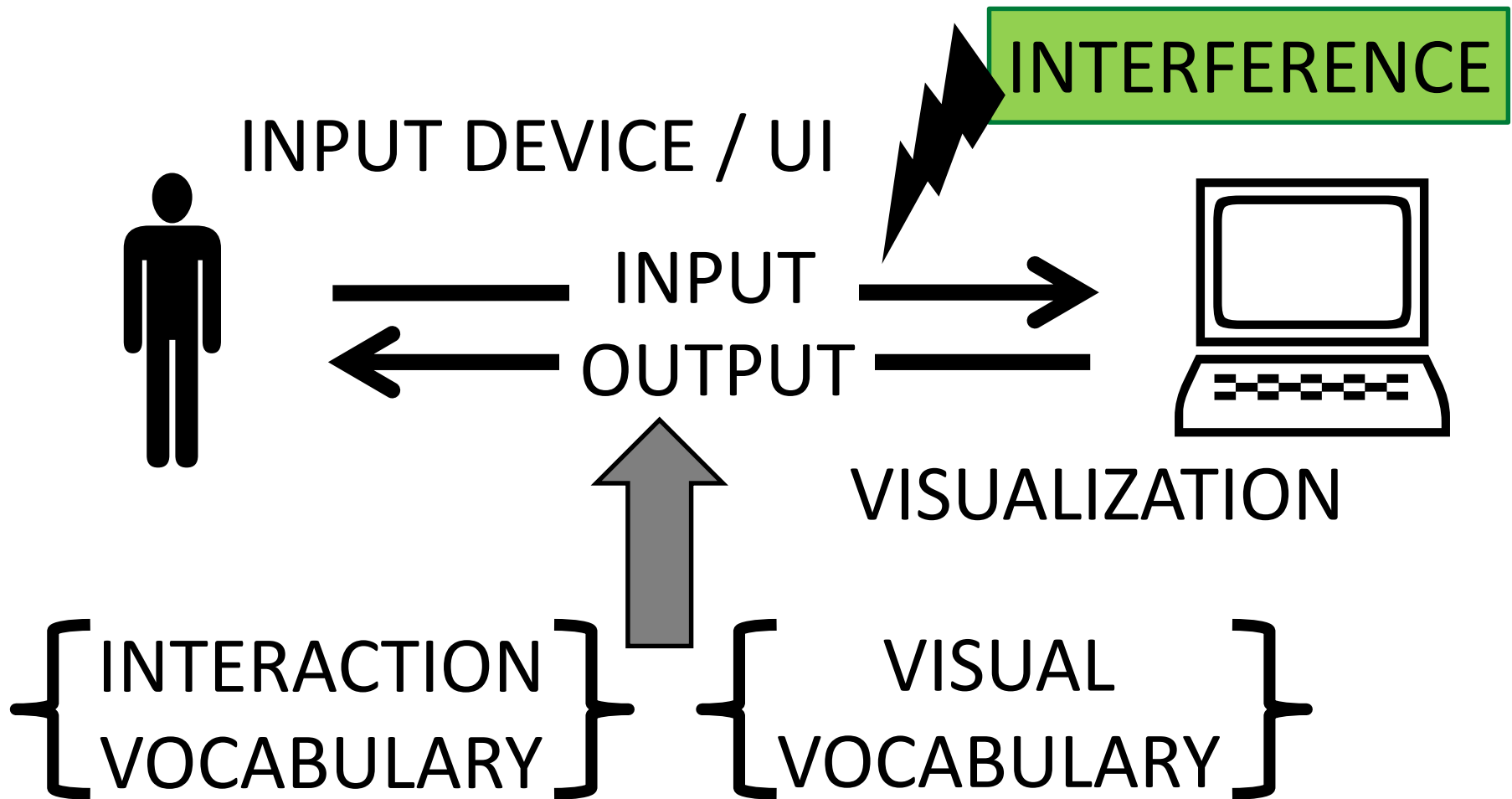
TECHNISCHE  
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# SUMMARY AND OPEN CHALLENGES

# Interaction as Communication



# Open Challenge #1: Interference

Signals coming too fast: Interruption

- Interruption management techniques for Visual Analysis are currently unexplored (possible Interruptions, Responses, Strategies)

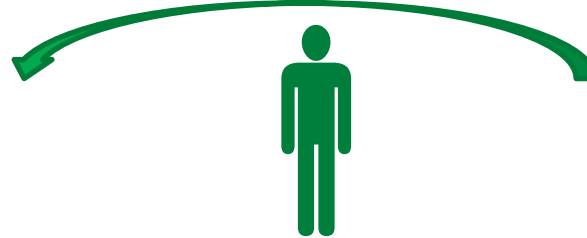
Signals coming too slow: Delay

- Progressive Visualization/Visual Analytics

No signals coming at all: Deadlock? -> Timeout?

# Norman's Model of Interaction

8. Take further action  
(compare outcome with goal)



## EXECUTION

1. Establish a goal  
(Why?)
2. Form intention/identify task  
(What?)
3. Specify action sequence  
(How?)

Execution/  
Evaluation loop



4. Execute action

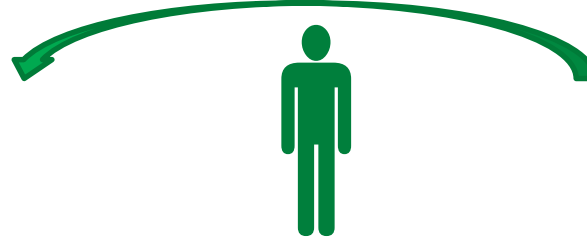
## EVALUATION

7. Evaluate the outcome  
(Why?)
6. Interpret the system's state  
(What?)
5. Perceive the state of the system  
(How?)

[Norman88]

# Norman's Model of Interaction

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## EXECUTION

1. Establish a goal  
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## EVALUATION

7. Evaluate the outcome  
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Execution/  
Evaluation loop

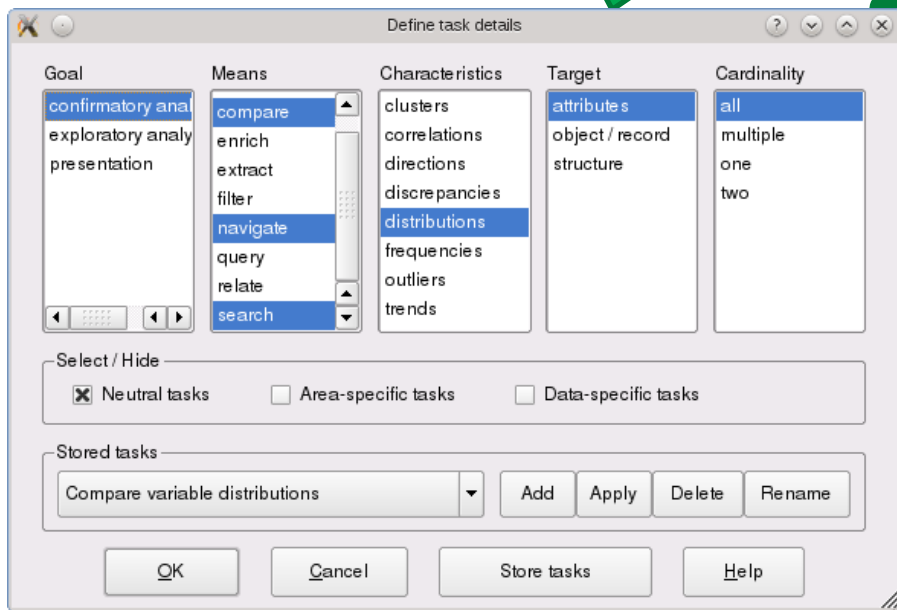


# Norman's Model of Interaction

8. Take further action  
(compare outcome with goal)

**EXECUTION**

**EVALUATION**

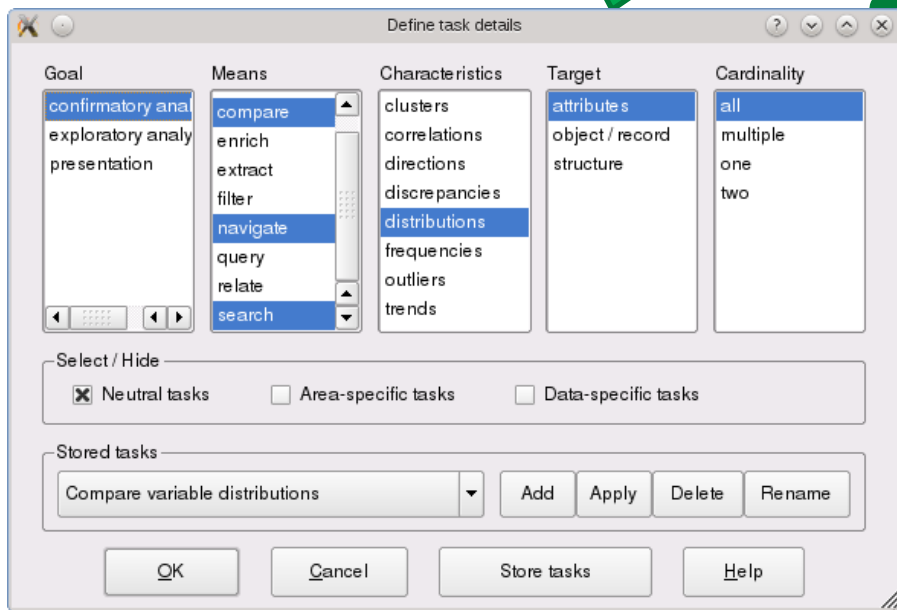


7. Evaluate the outcome (Why?)
6. Interpret the system's state (What?)
5. Perceive the state of the system (How?)



# Open Challenge #2: Supporting the Evaluation Side of a Visualization

EXECUTION



EVALUATION

7. Evaluate the outcome (What?)
6. Interpret the system's state (What?)
5. Perceive the state of the system (How?)

VISUALIZATION PIPELINE



# Types of Interaction Models

What is modeled?

- Extent: Single Action or whole Workflow
- Granularity: Concrete Events or General Task

How is it modeled?

- Diagrammatically: Sequence/Activity Diagram
- Symbolically: Notations

# Open Challenge #3: How to Model Undirected, Explorative Processes?

Shown approaches work well for rather linear, streamlined processes.

-> the more flexibility is incorporated, the more effort is required and the less expressive it becomes

**Possible solution: Declarative approaches** that do not define permissible actions, but permissible states through constraints & artifacts

-> see [Pesic et al. 2007]

– DECLARE: Full Support for Loosely-Structured Processes

or [v.d.Aalst et al. 2009]

– Declarative workflows: Balancing between flexibility and support

# History Management

Three aspects:

1. Recording history (*logging*)
2. Utilizing the current history (*undo/redo*)
3. Utilizing a collection of histories (*guidance*)

Principal problem: no agreed-upon way to store and share histories/provenance information!

# Open Challenge #4: Storing Histories

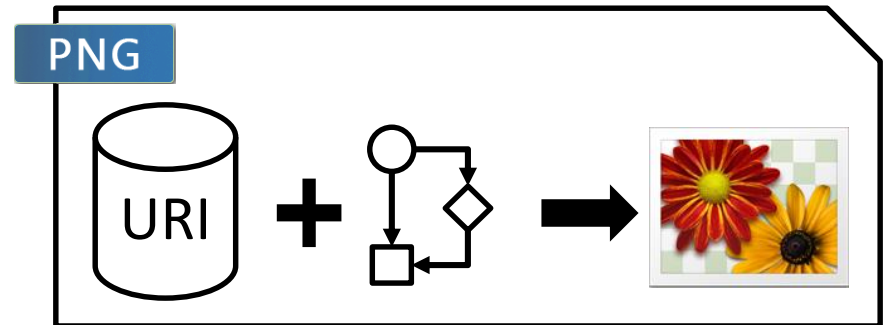
## Possible Solution: Embedding History in Visual Result

- The PNG standard allows for defining and including custom data chunks. -> Make each exported screenshot from a “provenance-enabled” vis tool include its visualization history.



what your OS, browser, and image processing app sees

VS.



what “provenance-enabled” tools see

GOAL

Visual  
Representation /  
Encoding

Data  
Presentation  
Architecture

Interaction

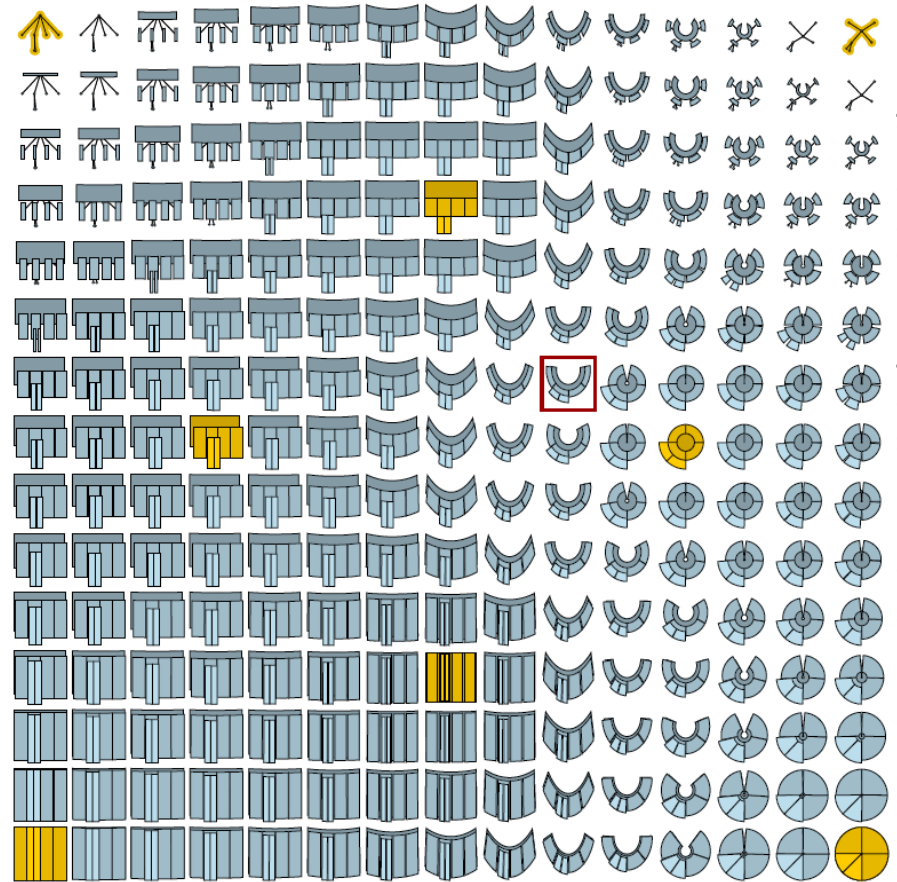
METAPHOR

# Open Challenge #5: Specific Metaphors for Interactive Visualization

Visualization-specific metaphors aside the rubber sheet



Image source:  
<http://www.pinotpalette.com>



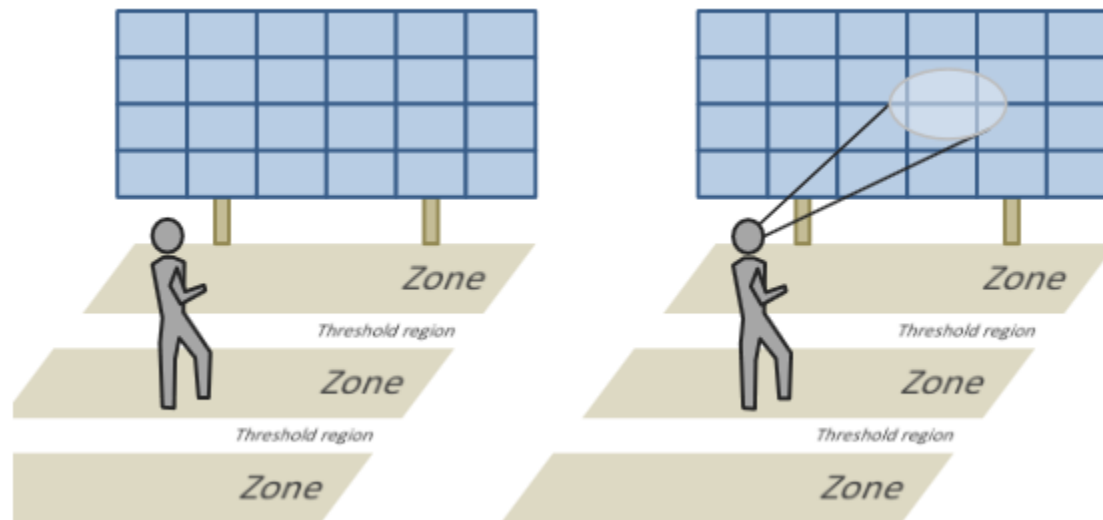
Source: Schulz+Hadlak (unpublished)

# Metaphors: Benefits & Caveats

- Pro:
  - clear entry point
  - solves problems of discoverability and orientation
- Con:
  - too strict adherence, lose benefits of digital medium
  - users expectations are created by metaphor

# Open Challenge #6: Interaction Vocabulary for new Devices

- What is the HOVER on touch devices?
- What happens when you PINCH a bar chart?
- Vocabulary for Physical Navigation?



Source: Lehmann et al. 2011



# Make sure to get the Tutorial Materials!

Download this Slide Deck + the Literature List @  
<http://tinyurl.com/tutorial2014>

Contact us in case of questions or further ideas!

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