



Working with the Card Sorting Method

<http://www.slideshare.net/roth/working-with-the-card-sorting-method>

Overview *organization of module*

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Part 1: Background

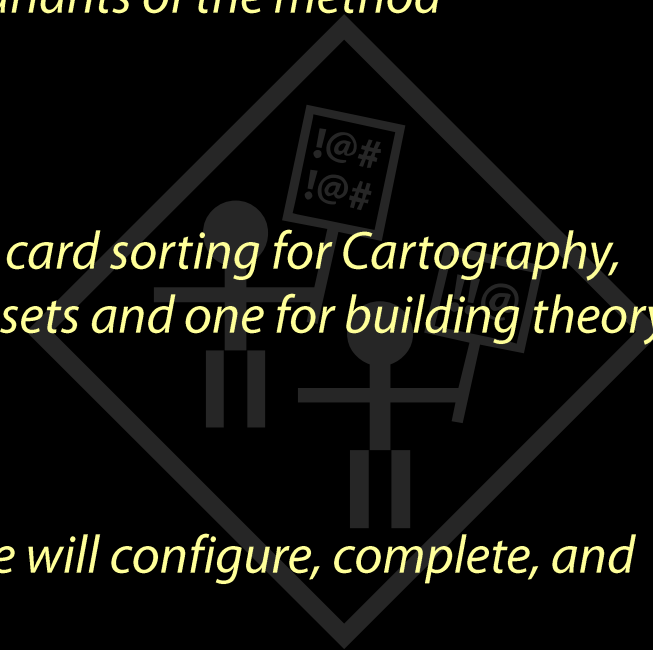
historical and conceptual background on the card sorting method, including a framework for organizing and applying variants of the method

Part 2: Case Studies

a review of three case studies implementing card sorting for Cartography, including two studies for improving symbol sets and one for building theory

Part 3: Exercise

an example card sorting activity in which we will configure, complete, and analyze a card sort



Overview *WebSort.net*

The screenshot displays the WebSort.net interface. At the top left, the logo and name 'WebSort.net' are visible, along with links for 'Instructions' and 'Leave a comment'. Below this, a sidebar on the left shows a list of 190 unsorted items. The items are represented by icons and text labels: 'pumping station', 'rail hijacking', 'emergency food distribution', 'petroleum facilities' (highlighted in yellow), and 'telecommunications'. The main area on the right contains five category panels: 'Incidents' (civil disturbance incident), 'Natural Events' (bird infestation, tornado), 'Operations' (law enforcement operation, FBI, DEA), 'Infrastructures' (petroleum facilities, highlighted in yellow), and 'Other' (unexploded ordnance). A green checkmark and the text 'I'm Done!' are located in the bottom right corner.

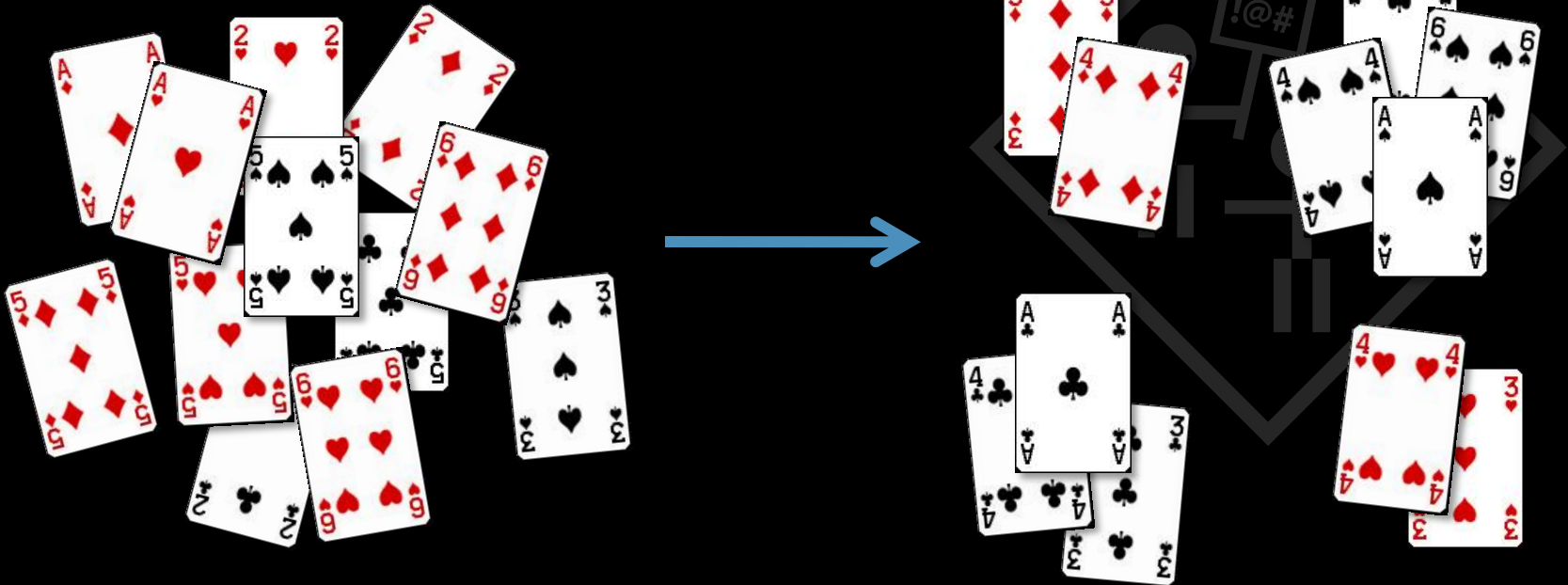


Part 1: Background

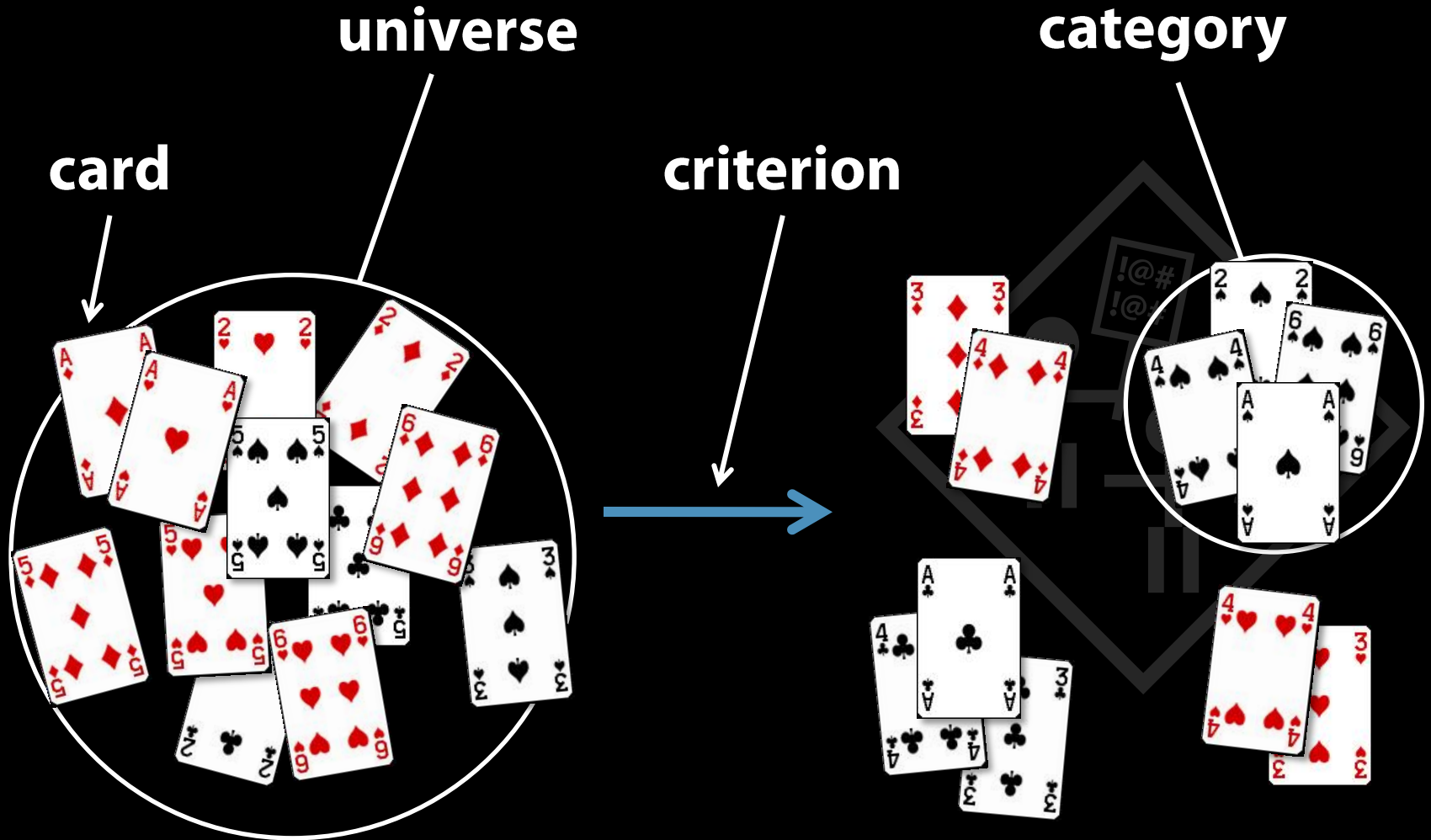
Background *introduction*

Card Sorting:

*a knowledge elicitation technique for investigating the broader conceptual structures—or **mental categorizations**—of a set of items from a targeted group of individuals*

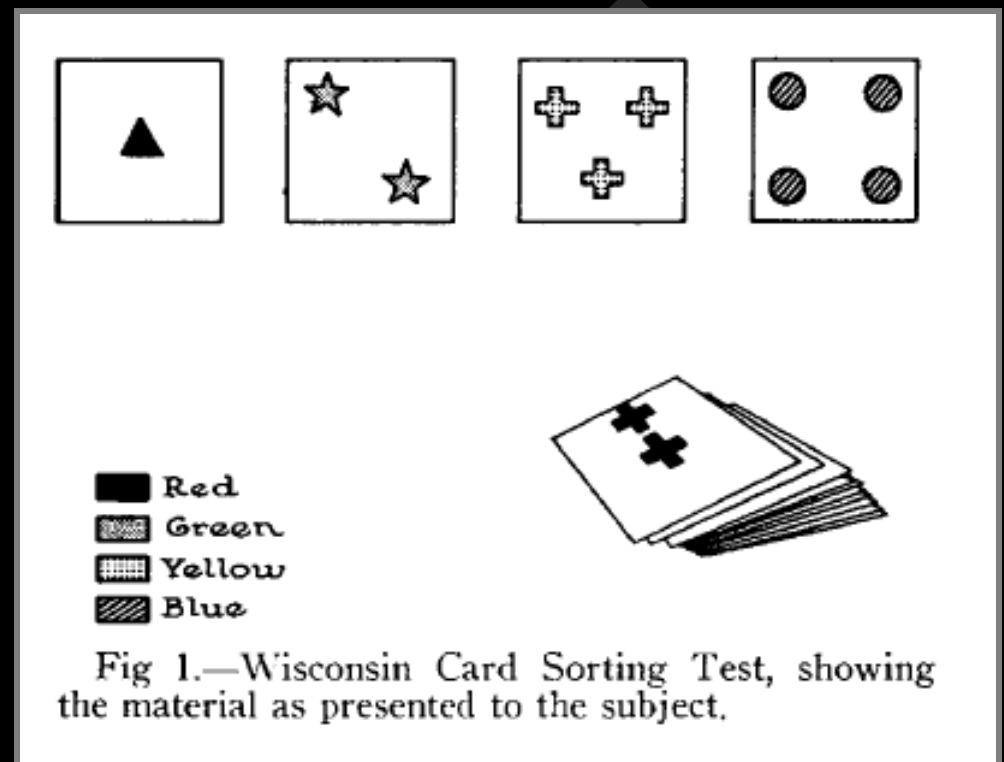


Background *terminology*



Wisconsin Card Sorting Test:

a clinical tool for diagnosing traumatic brain injuries in which patients are asked to sort the same set of cards multiple times, using a different criterion with each sort



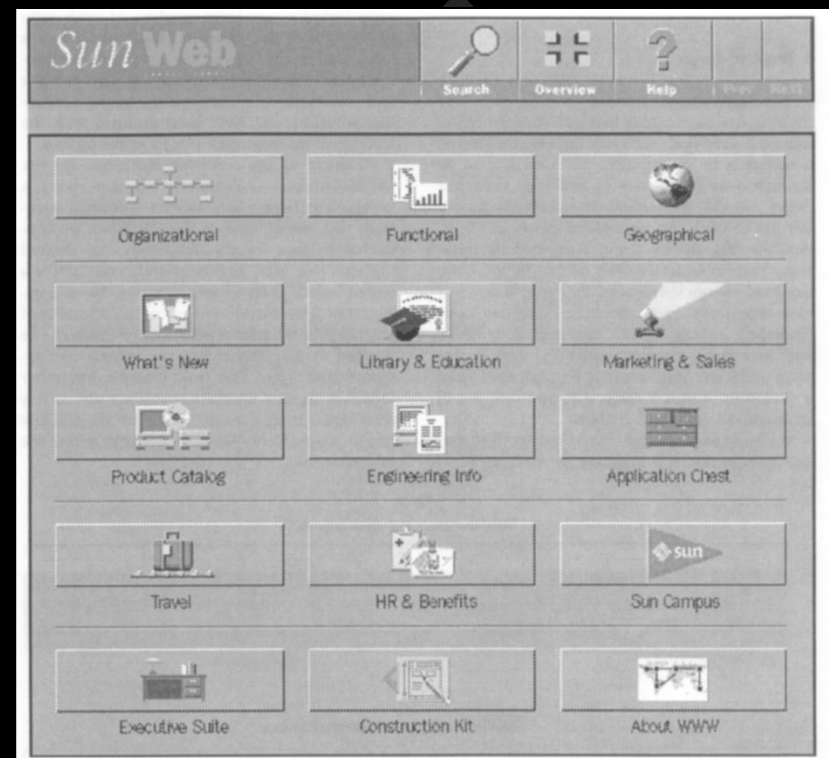
after Berg (1946, 1948)

Usability Engineering & User-Centered Design:

transition in focus from evaluating the abilities of patients to eliciting knowledge from targeted participants

card sorting is an effective UCD method for ensuring a
“coherent design”

after Nielsen & Sano (1995)



after Lloyd, Dykes,
& Radburn (2008)

Structural
graphics

Density maps

Dorling cartograms

Thematic maps

Map algebra

Simplified maps

Continuous cartograms

Multiple maps

Spider maps

Thiessen polygons

Line graphs

Histograms

Box plots

Scatterplot matrix

Scatterplots

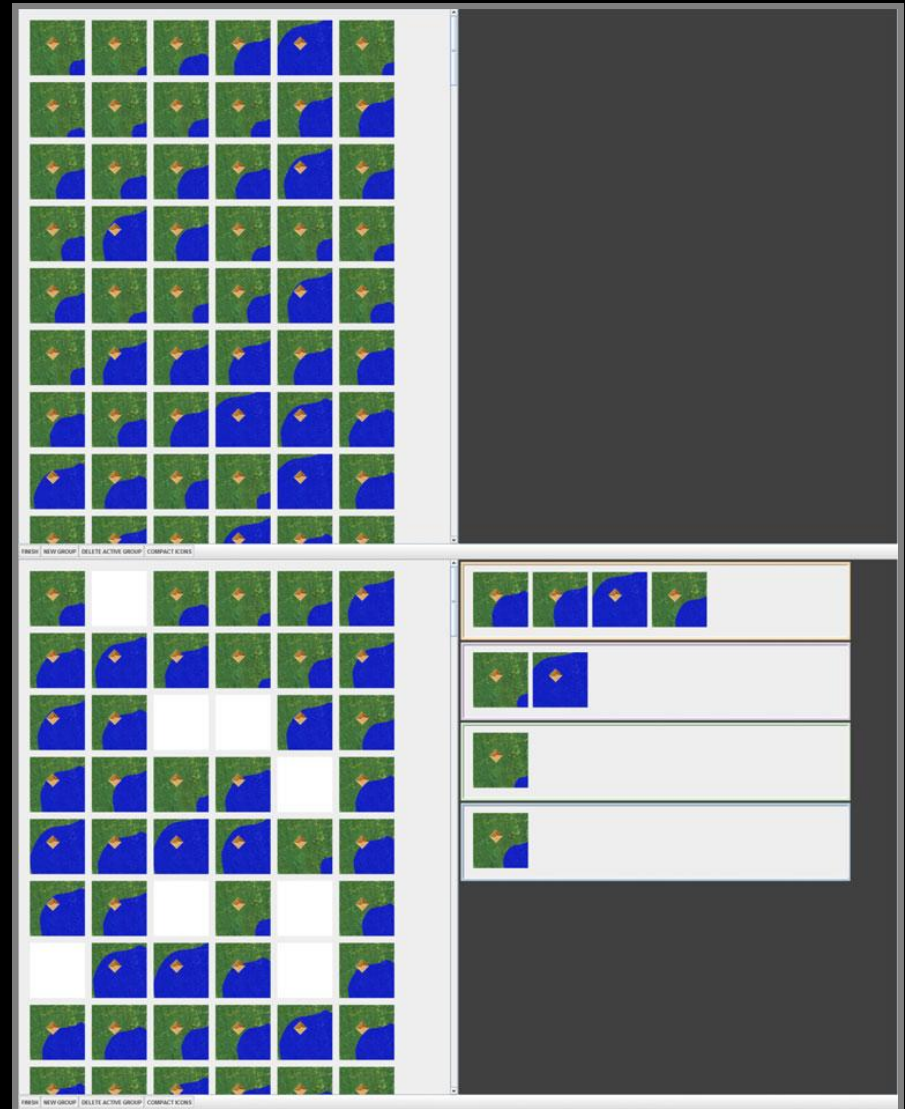
Table lens

Background *card sorting* for GIScience

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Spatial Cognition:

*formalizing qualitatively
equivalent knowledge schema
that structure spatial cognition*

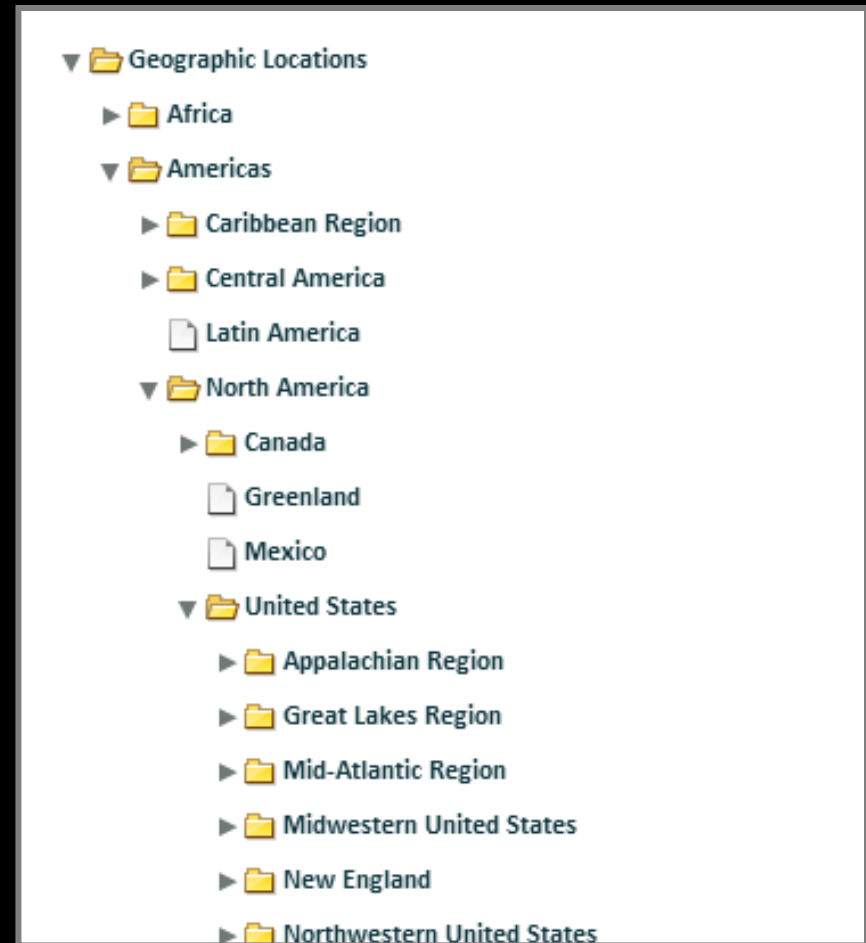


**Klippel & colleagues
(2009, 2011, 2012)**

Geographic Ontologies

*semantic similarities in
geographic concepts and
relationships across domains*

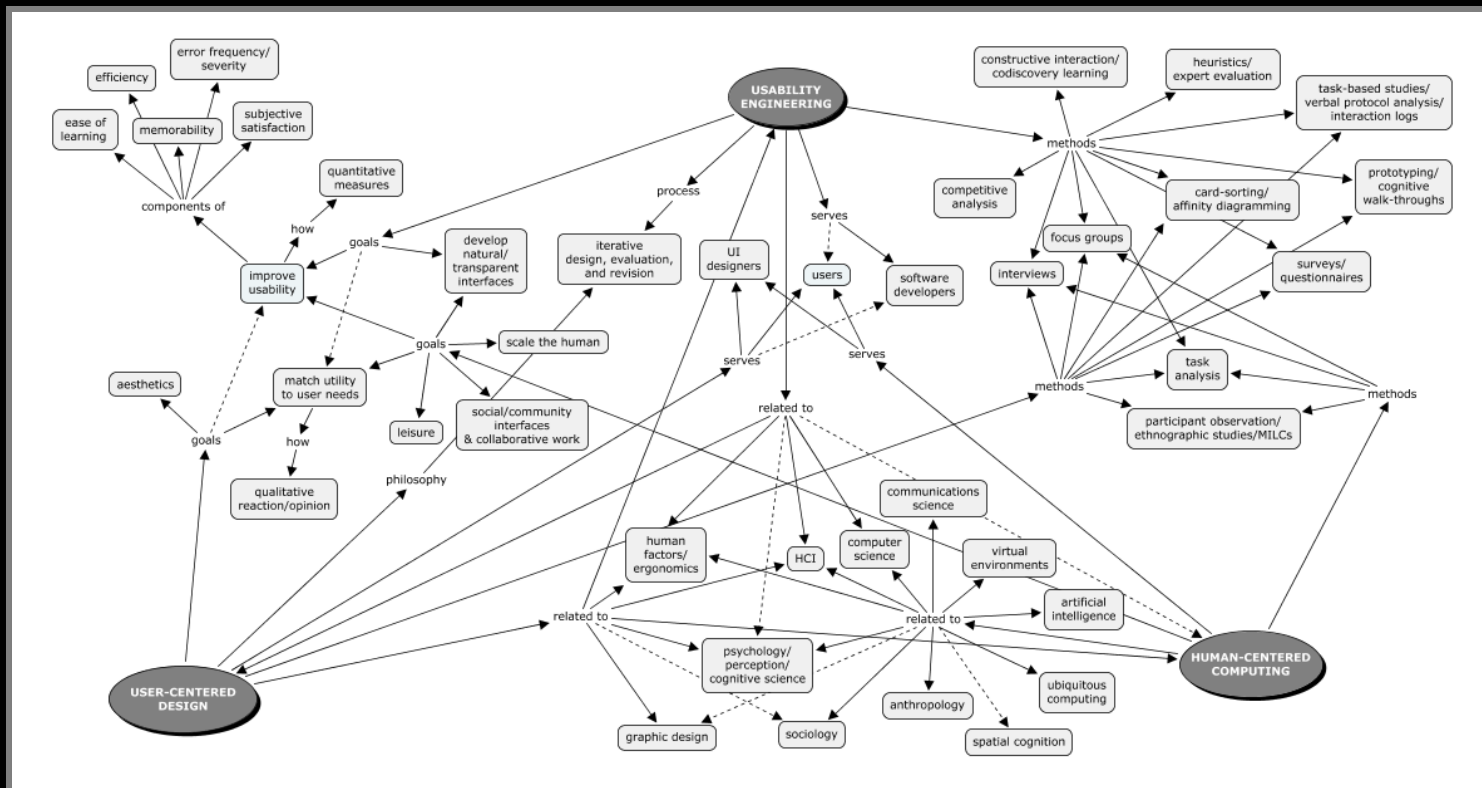
**Medical Subject Headings
(MeSH), Geographic Ontology**



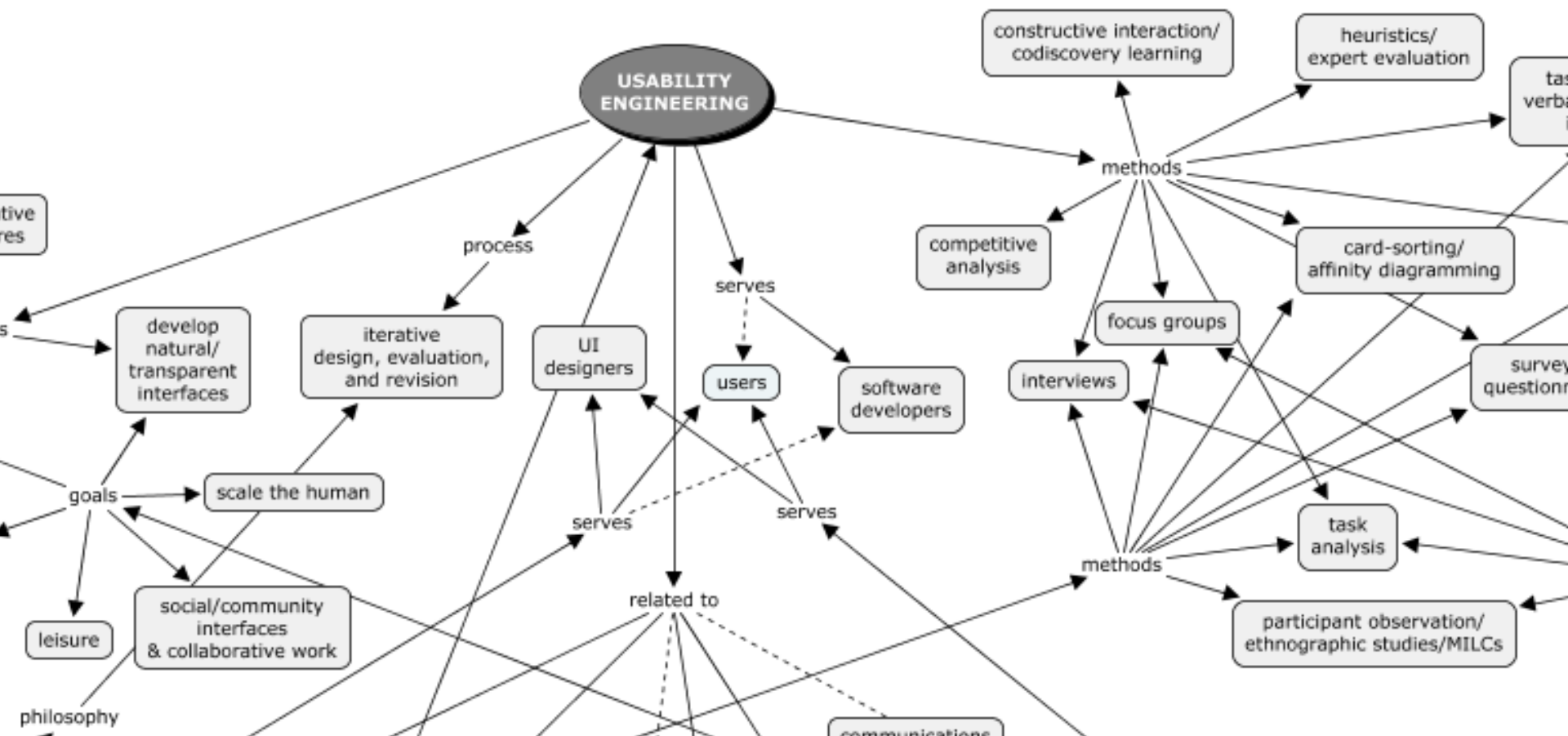
	Method	Similar or Related Methods
Expert-based	heuristic evaluation	<i>rules of thumb</i>
	conformity inspection	<i>feature inspection, consistency inspection, standards inspection, guideline checklist</i>
	cognitive walkthroughs	<i>pluralistic walkthroughs, prototyping, storyboarding, Wizard of Oz</i>
Theory-based	scenario-based design	<i>personas, scenarios of use, use case, context of use, theatre</i>
	secondary sources	<i>content analysis, competitive analysis</i>
	automated evaluation	<i>automated interaction logs, unmoderated user-based methods</i>
User-based	participant observation	<i>ethnographies, field observation, MILCs, journal/diary sessions, screenshot captures</i>
	surveys	<i>questionnaires, entry/exit surveys, blind voting, cognitive workload assessment</i>
	interviews	<i>structured interviews, semi-structured interviews, unstructured interviews, contextual inquiry</i>
	focus groups	<i>supportive evaluation</i>
	Delphi	
	card sorting	<i>Q methodology, concept mapping, affinity diagramming, paired/triad comparison</i>
	talk/think aloud	<i>verbal protocol analysis, co-discovery study</i>
	interaction study	<i>performance measurement, controlled experiments</i>

Concept Mapping/Affinity Diagramming

a knowledge elicitation technique for revealing relationships among concepts



Concept Mapping/Affinity Diagramming



Background *similar methods*

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Pair or Triad Comparison

individual ratings on similarity between/among only 2-3 cards at a time

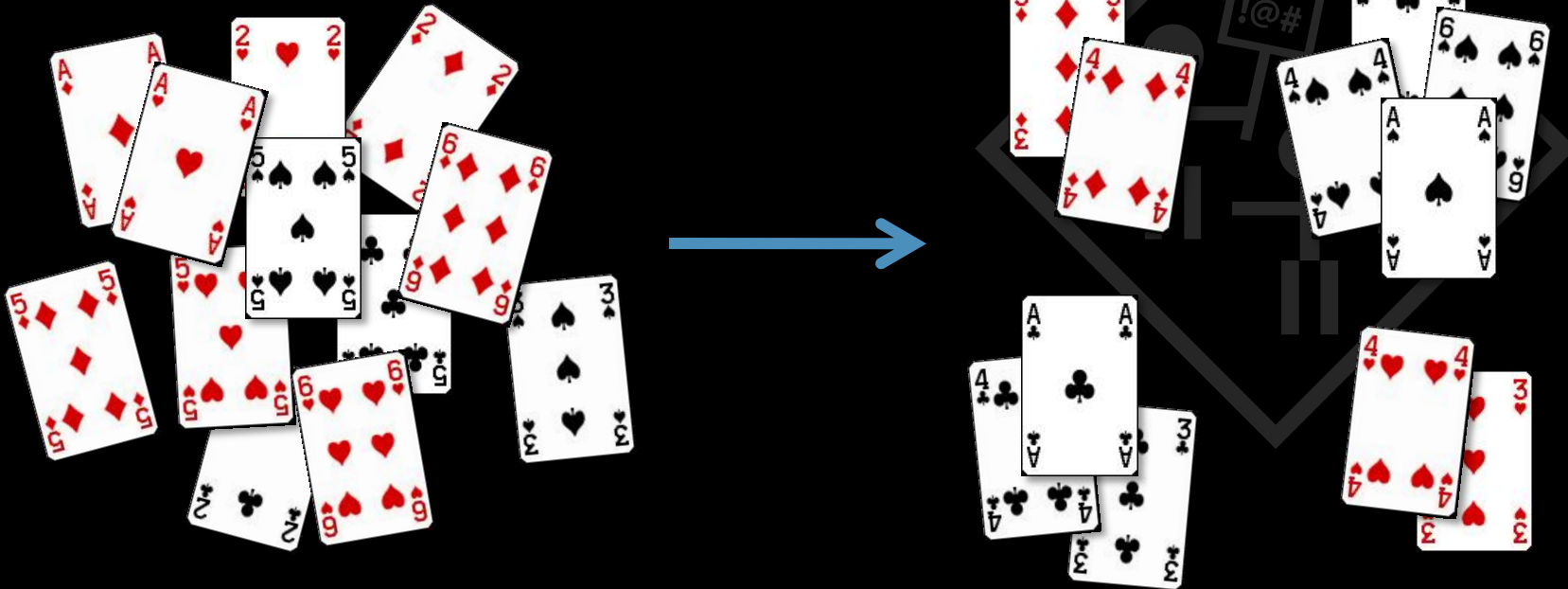


Sesame Street: *One of these things is not like the other...*

Background *introduction*

Card Sorting:

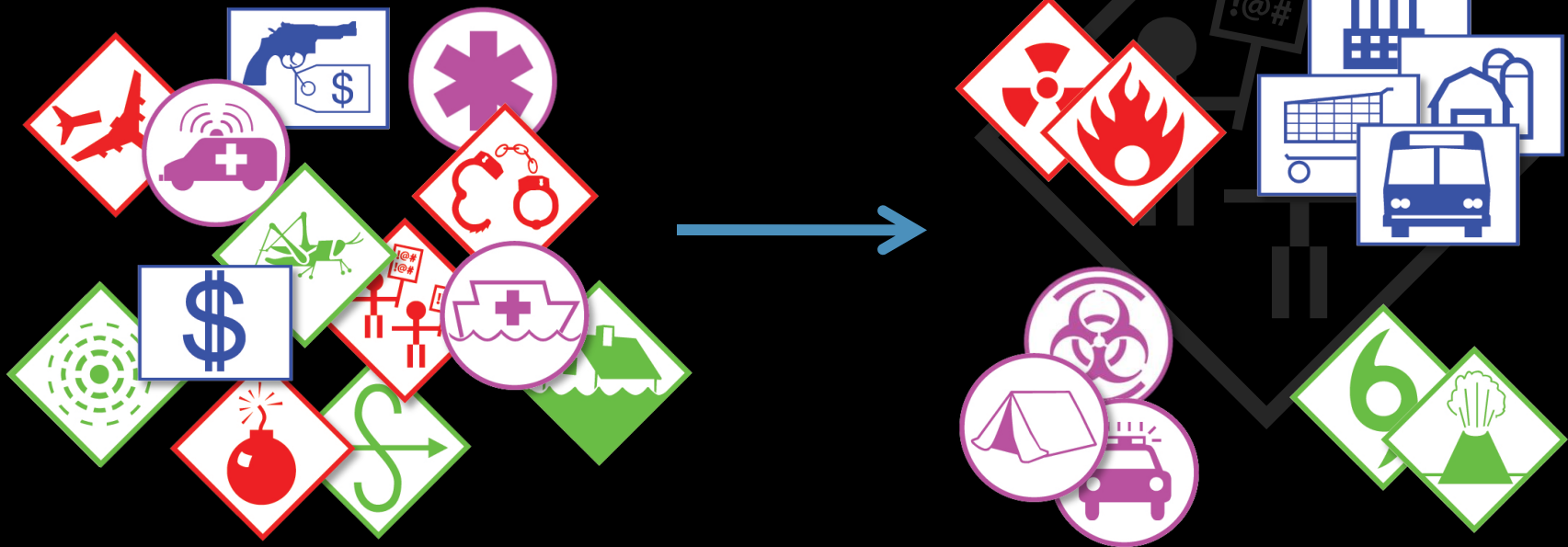
*a knowledge elicitation technique for investigating the broader conceptual structures—or **mental categorizations**—of a set of items from a targeted group of individuals*



Background *card sorting* for *Cartography*

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- identify logical symbol categories
- support collaborative design
- integrate expert knowledge into automated systems
- critique symbol designs
- identify unclear feature definitions
- identify ambiguous symbols
- identify missing symbols



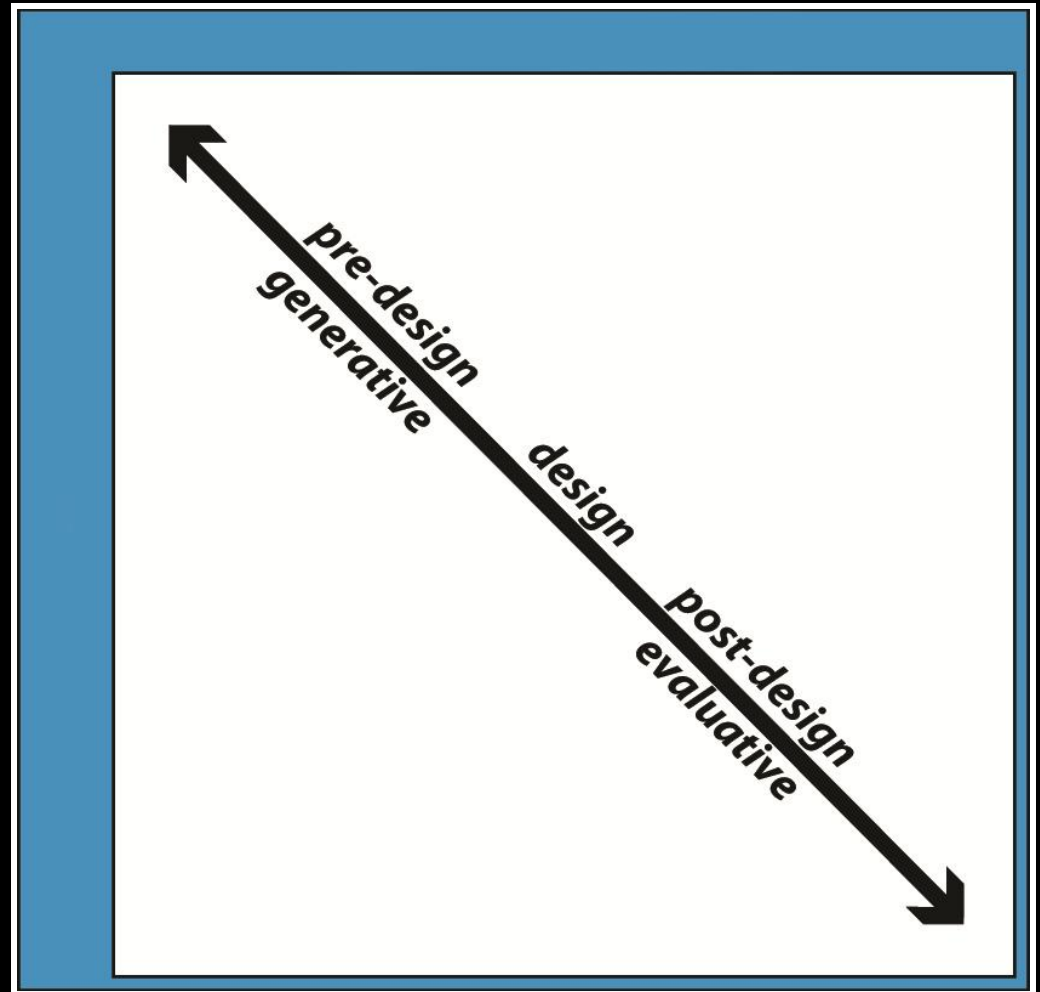
Background *card sorting* for Cartography

generative (pre-design):

the designers wish to collect information that will inform the design of a symbol set

evaluative (post-design):

the designers have an existing symbol set & wish to evaluate it



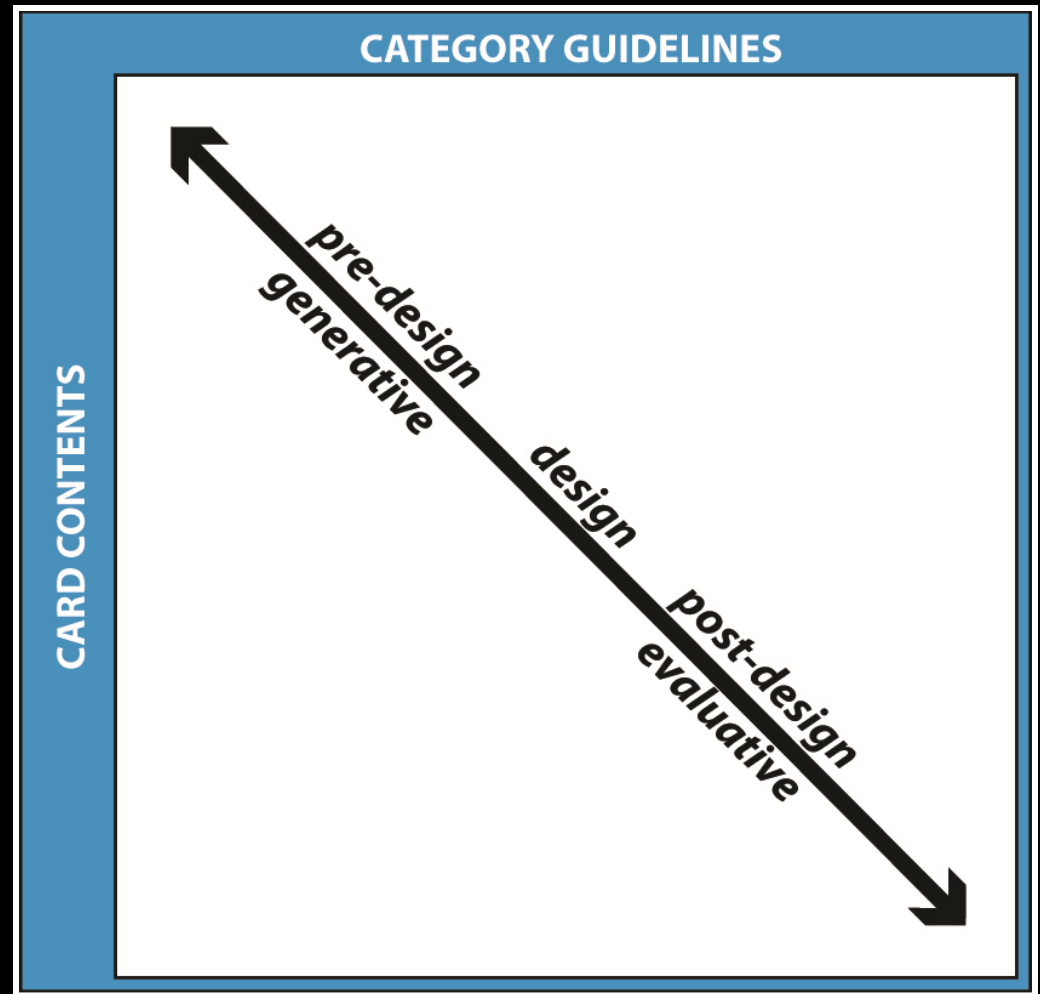
Background *card sorting for Cartography*

categories:

the categorization guidelines given to participants during the sort

cards

the content of the cards themselves



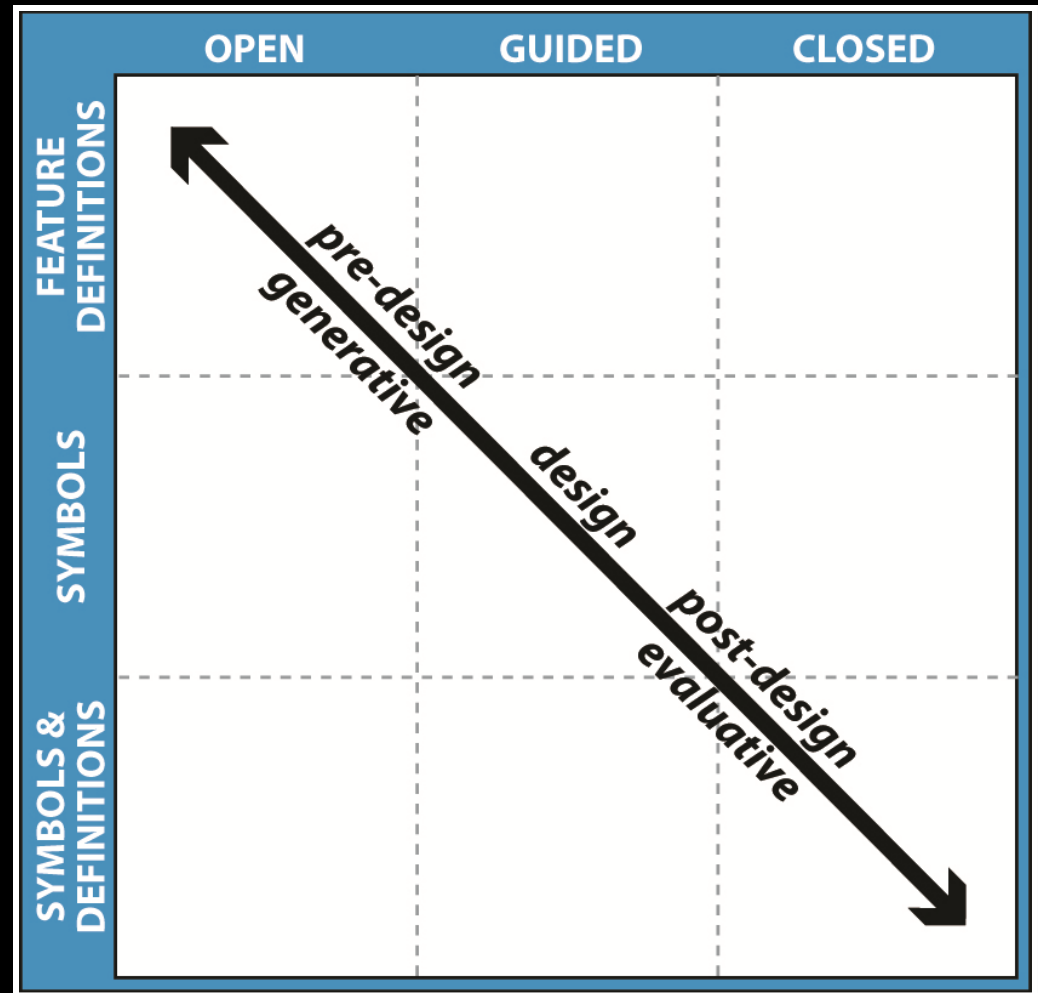
Background *card sorting for Cartography*

category guidelines:

open: *participants identify both the sorting criterion and the categories*

guided: *participants identify the set of categories, but are given the sorting criterion*

closed: *participants are given both the sorting criterion and the set of categories*



Background *card sorting for Cartography*

card contents:

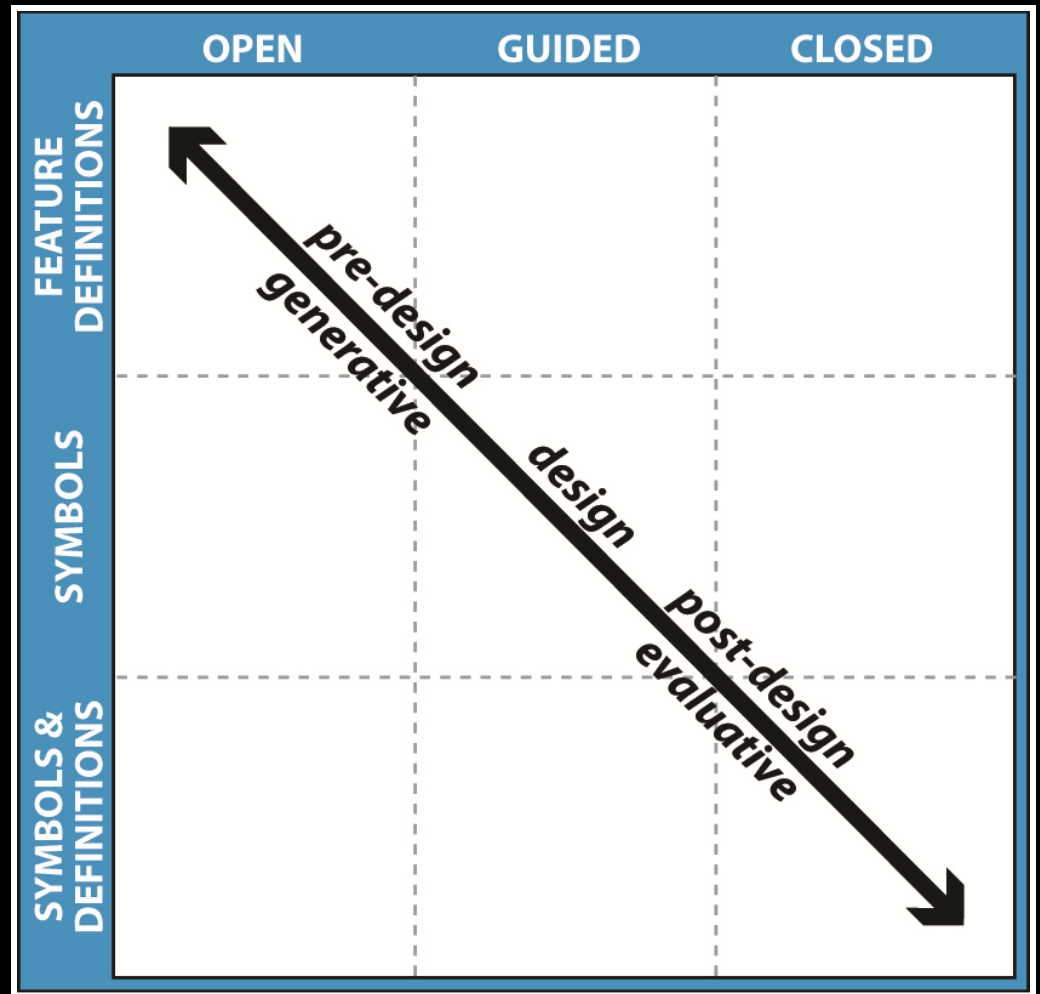
feature definitions:

“Hotspot: An area of intensified fire activity and increased heat.”

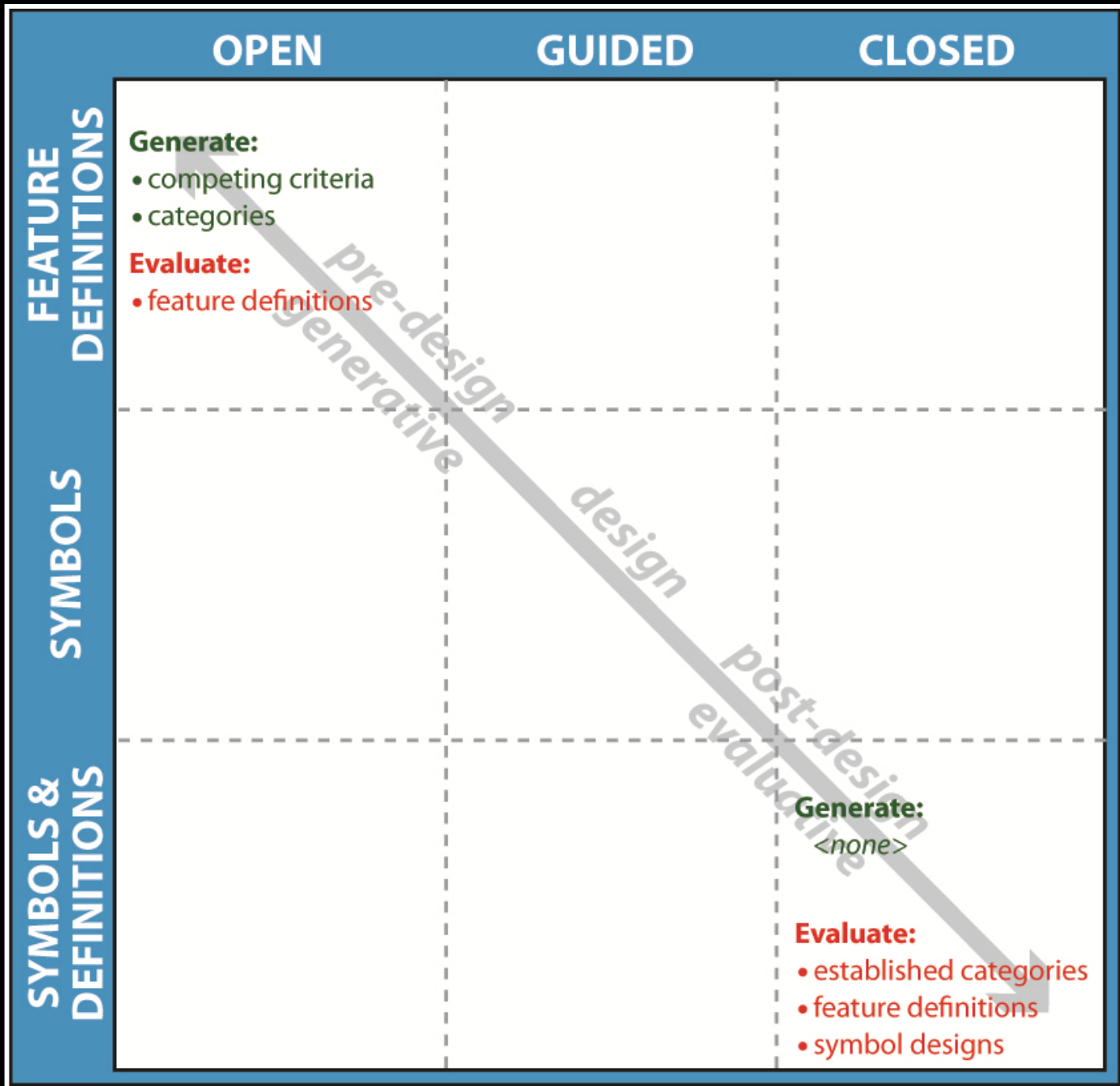
symbols:



**most authors recommend restricting the card universe to 30-200 cards*

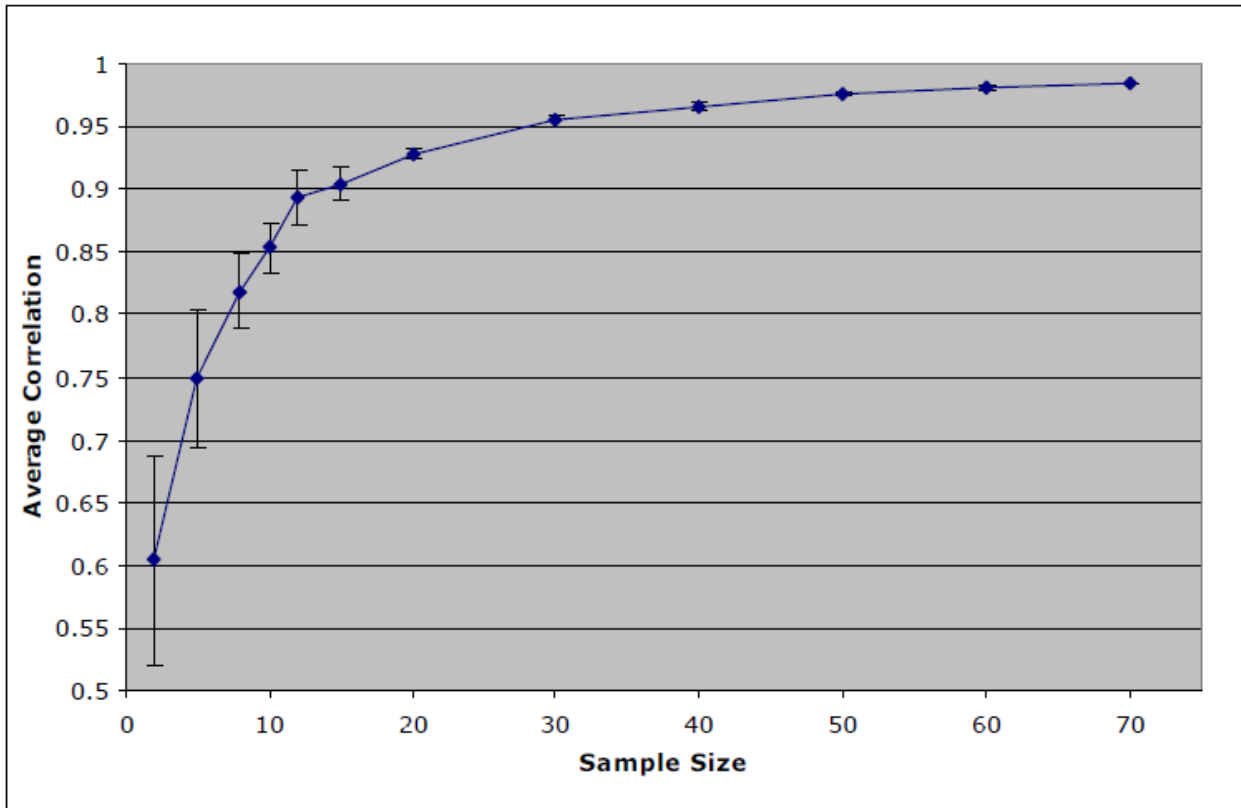


Roth et al.
(2011)



	OPEN	GUIDED	CLOSED
FEATURE DEFINITIONS	<p>Generate:</p> <ul style="list-style-type: none"> • competing criteria • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • feature definitions 	<p>Generate:</p> <ul style="list-style-type: none"> • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • <i>a priori</i> criterion • feature definitions 	<p>Generate:</p> <p><none></p> <p>Evaluate:</p> <ul style="list-style-type: none"> • <i>a priori</i> categories • feature definitions
SYMBOLS	<p>Generate:</p> <ul style="list-style-type: none"> • competing criteria • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • symbol designs 	<p>Generate:</p> <ul style="list-style-type: none"> • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • sorting criterion • symbol designs 	<p>Generate:</p> <p><none></p> <p>Evaluate:</p> <ul style="list-style-type: none"> • established categories • symbol designs
SYMBOLS & DEFINITIONS	<p>Generate:</p> <ul style="list-style-type: none"> • competing criteria • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • feature definitions • symbol designs 	<p>Generate:</p> <ul style="list-style-type: none"> • categories <p>Evaluate:</p> <ul style="list-style-type: none"> • sorting criterion • feature definitions • symbol designs 	<p>Generate:</p> <p><none></p> <p>Evaluate:</p> <ul style="list-style-type: none"> • established categories • feature definitions • symbol designs

Background *sample size*



90%: n=15

92%: n=20

95%: n=30

Figure 1. Correlation coefficients for various sample sizes, with error bars.

**Tullis & Wood
(2004)**

Agreement:

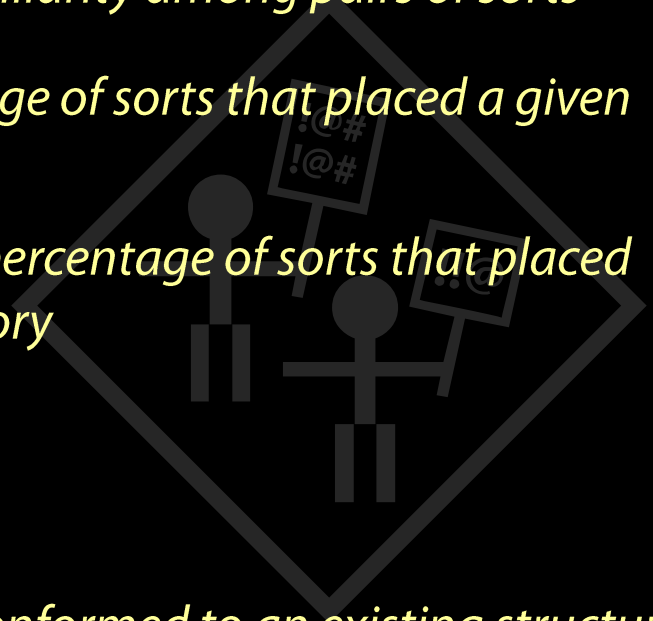
the degree to which the participants' sorts are similar

- 1. overall agreement:** *the average similarity among pairs of sorts*
- 2. card versus category:** *the percentage of sorts that placed a given card into a given category*
- 3. card versus card agreement:** *the percentage of sorts that placed two given symbols into the same category*

Accuracy:

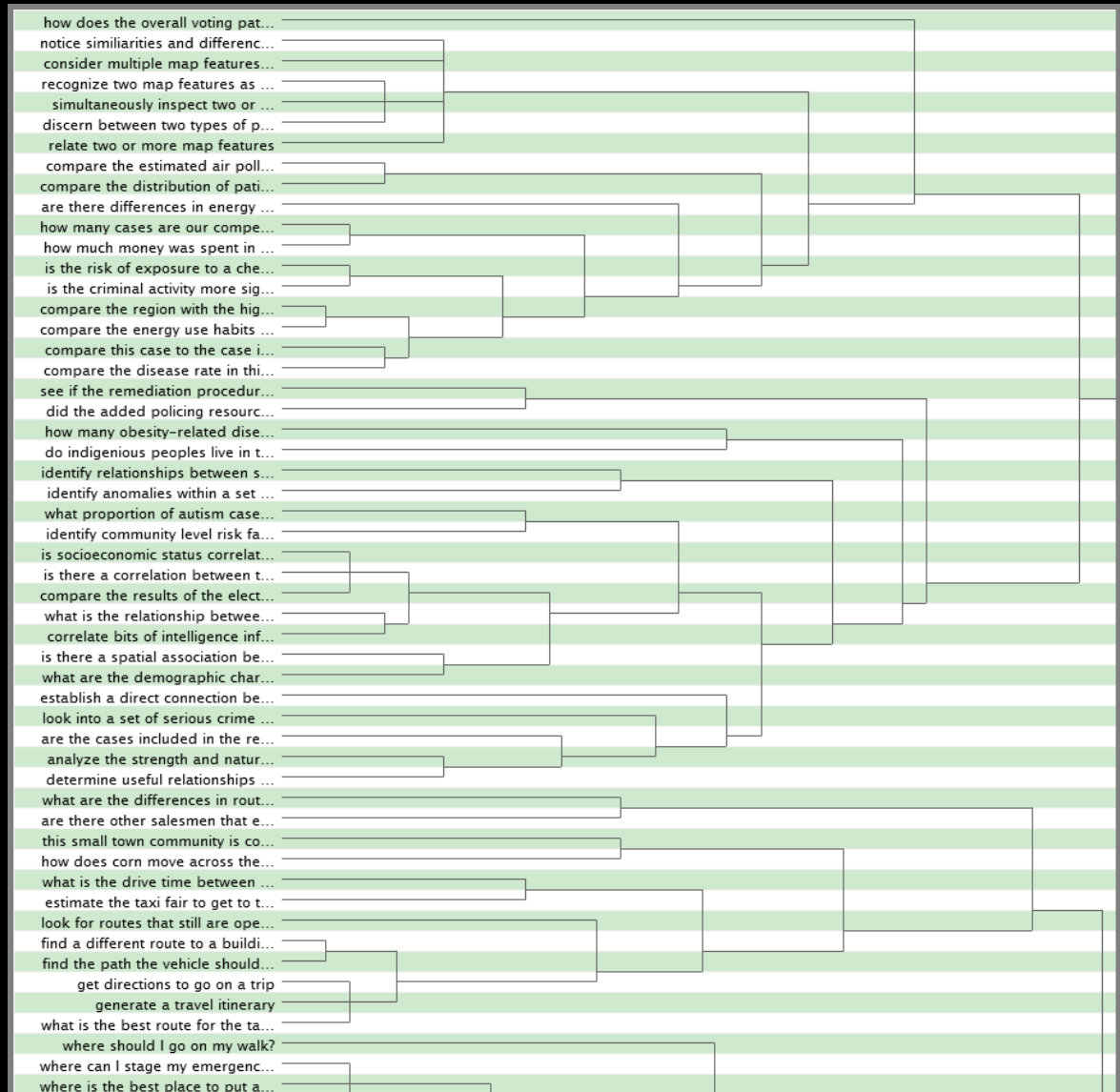
the degree to which the participants' sorts conformed to an existing structure

- *for closed sorting only*



Clustering & Dendograms:

card-by-card agreement



Background *reliability*

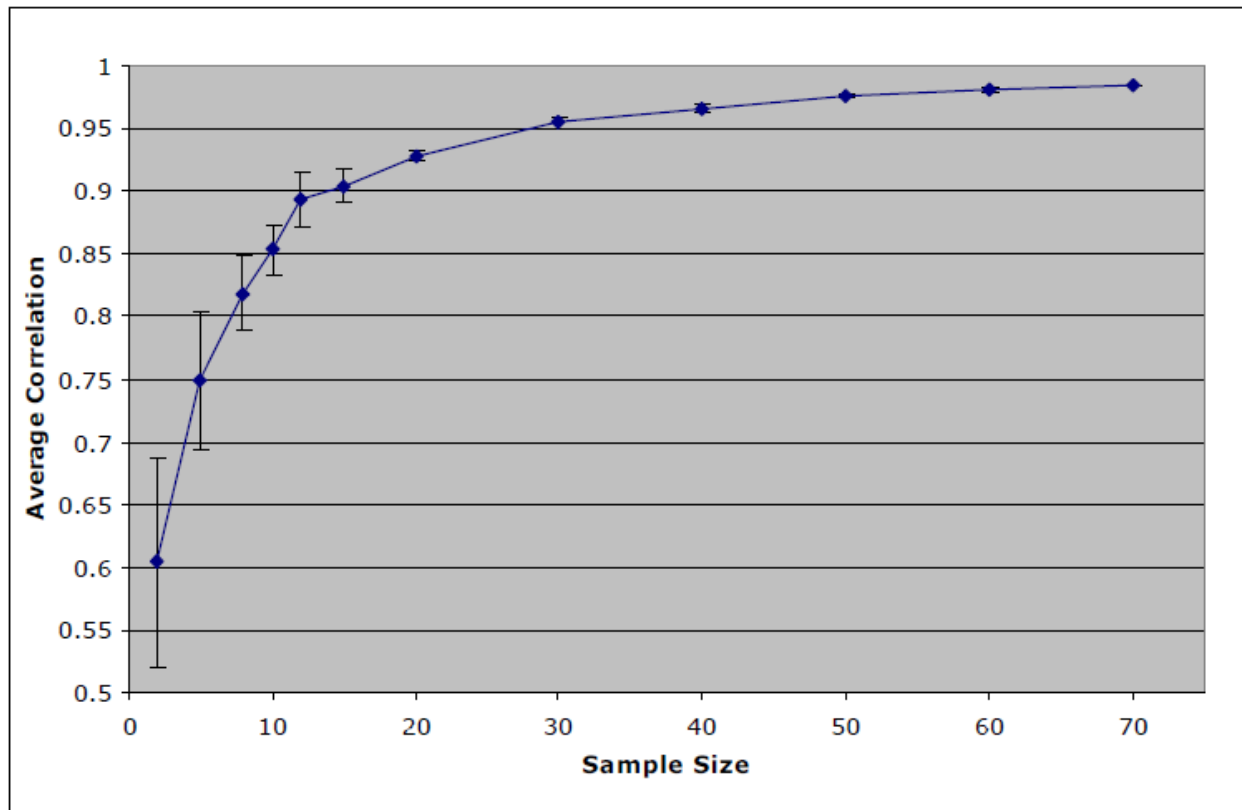


Figure 1. Correlation coefficients for various sample sizes, with error bars.

90%: n=15

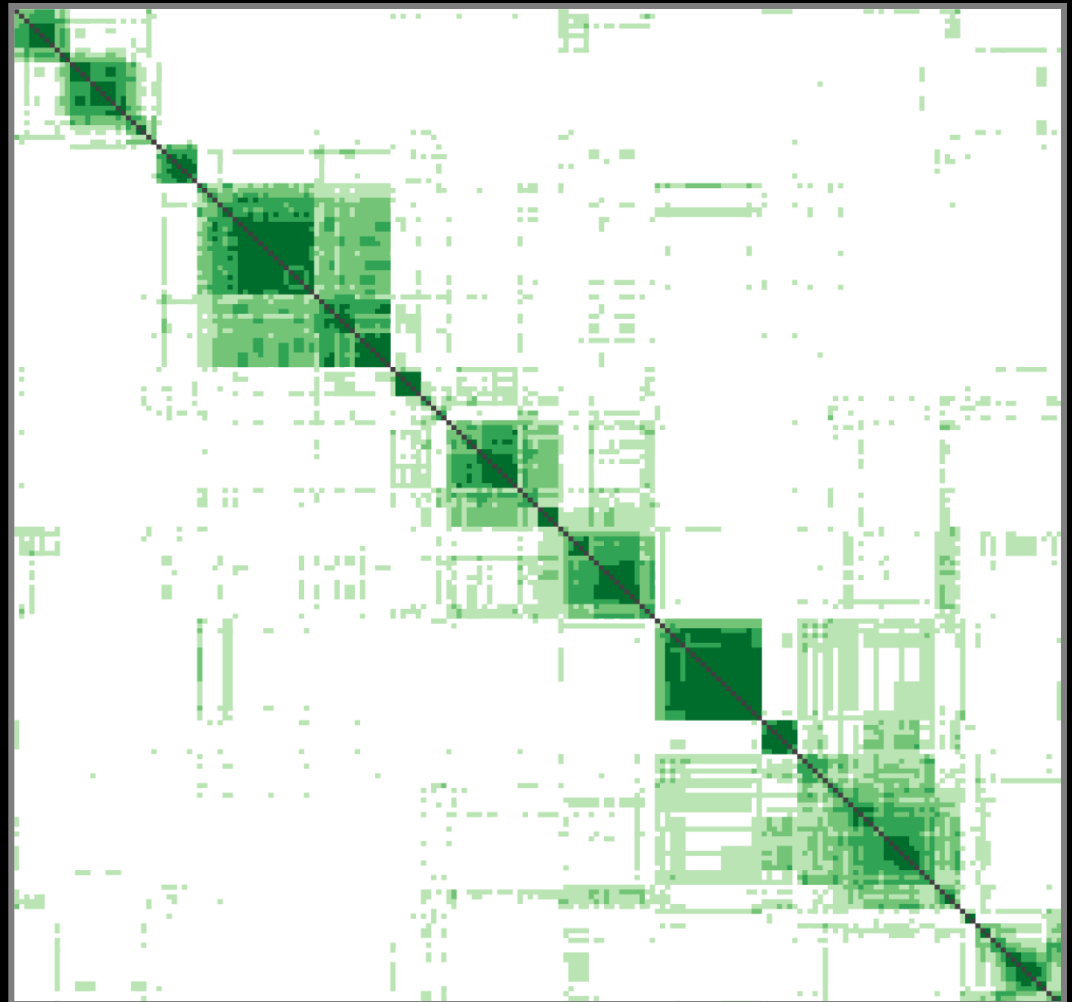
92%: n=20

95%: n=30

**Tullis & Wood
(2004)**

Agreement Matrix:

card-by-card agreement



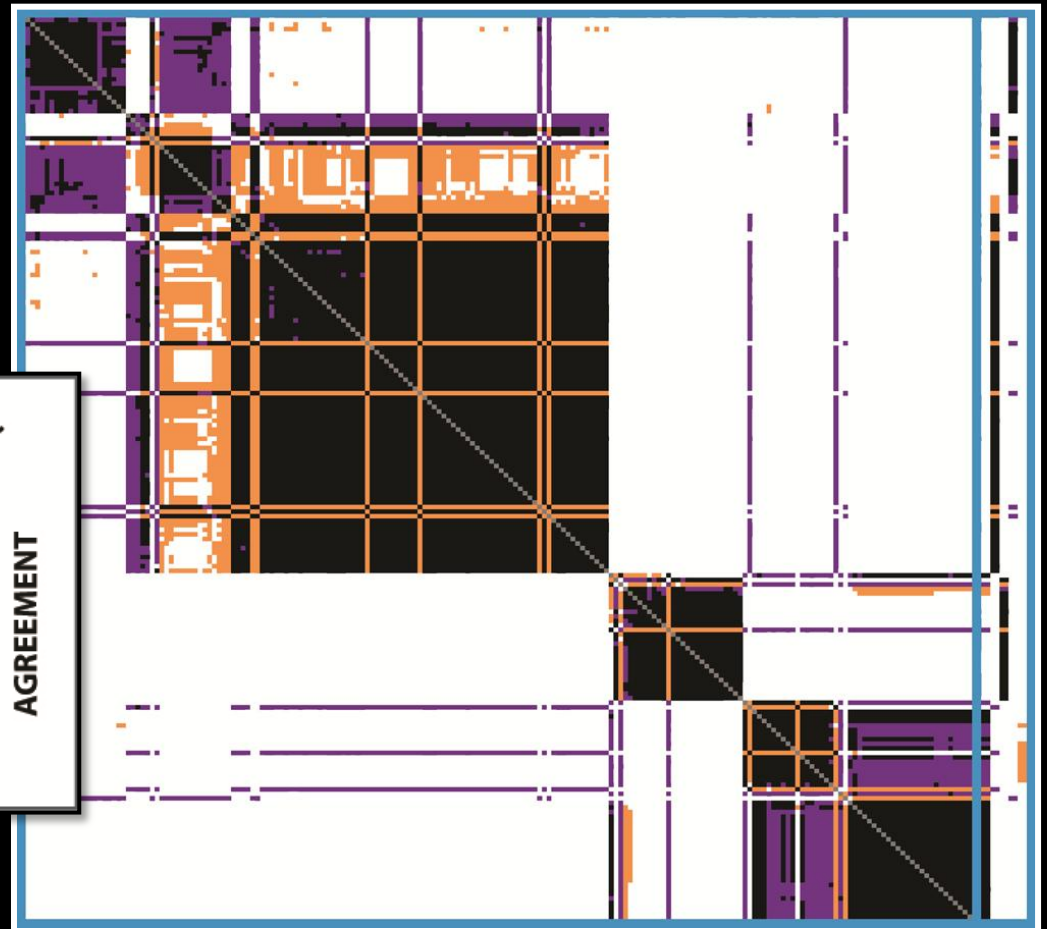
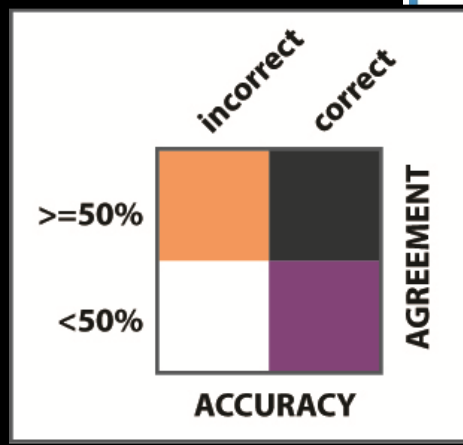
Accuracy Matrix:

contingency table

		ANSI STANDARD				
		INCIDENTS	INFRA-STRUCTURES	NATURAL EVENTS	OPERATIONS	TOTAL
SORT RESULTS (based on 50% agreement)	INCIDENTS	31	1	1	1	34
	INFRASTRUCTURES	0	75	0	12	87
	NATURAL EVENTS	2	0	24	0	26
	OPERATIONS	0	1	0	28	29
	OTHER	7	0	0	0	7
	NO MAJORITY	7	4	1	3	15
	TOTAL	47	81	26	44	198
	% CORRECT	66.0%	92.6%	92.3%	63.6%	79.8%

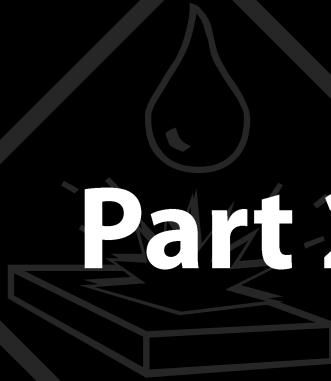
Bivariate Matrices:

accuracy by agreement













Part 2: Case Studies



ANSI INCITS 415 point symbology standard for emergency mapping - Federal Geographic Data Committee Homeland Security Working Group

INCIDENTS		NATURAL EVENTS		OPERATIONS		INFRASTRUCTURE	
	Civil disturbance		Removable gas		Emergency medical operation		Fast mail
	Civil demonstration		Removable liquid		EAT station locations		grain storage
	Civil displaced population		Removable solid		ambulance		banking finance & insurance
	Civil rioting		non-removable gas		medical evacuation helicopter station		ATMs
	Civilian activity incident		organic particles		health department facility		banks
	Corrosive threat		radiation		hospital		bulk storage
	Corrosive material		volcanic eruption		hospital ship		Federal reserve banks
	Corrosive explosion		volcanic threat		medical facilities not patient		financial exchanges
	Cracking		drought		pharmacy		financial services other
	Drowning		flood		pharmacy		Government structure
	Explosion		fog		stage		Chemical plant
	Fire		fuel		Emergency operation		Beam manufacturers
	Fire spill		invasion		Emergency collection processing center		Beam refiners
	Fire residential fire		rain		Emergency incident command center		Biocorrosive material production
	Fire single		landslide		Emergency operations center		Biocorrosive material storage
	Fire residential fire		landslide		Emergency public information center		Industrial site
	Fire school fire		landslide		Emergency shelters		Infectious
	Fire smoke		landslide		Emergency staging area		Pharmaceutical manufacturer
	Fire special needs fire		landslide		Emergency teams		Superfund sites EPA
	Fire wild fire		landslide		Emergency water distribution center		Toxic release inventory
	Hazardous material incident		landslide		Emergency food distribution center		educational facilities
	Hazardous material		landslide		Fire suppression operation		college university
	Hazardous material		landslide		Fire hydrant		schools
	Hazardous material		landslide		Other water supply location		Energy facilities infrastructure
	Hazardous material		landslide		Fire station		generation stations
	Hazardous material		landslide		Fire station		natural gas facilities
	Hazardous material		landslide		Fire station		nuclear facilities
	Hazardous material		landslide		Fire station		petroleum facilities
	Hazardous material		landslide		Fire station		propane facilities
	Hazardous material		landslide		Fire station		government site infrastructure
	Hazardous material		landslide		Fire station		military infrastructure
	Hazardous material		landslide		Fire station		military armory
	Hazardous material		landslide		Fire station		military base
	Hazardous material		landslide		Fire station		postal service infrastructure
	Hazardous material		landslide		Fire station		postal distribution center
	Hazardous material		landslide		Fire station		post office
	Hazardous material		landslide		Fire station		public venue infrastructure
	Hazardous material		landslide		Fire station		enclosed facility
	Hazardous material		landslide		Fire station		open facility
	Hazardous material		landslide		Fire station		recreational area
	Hazardous material		landslide		Fire station		religious institution
	Hazardous material		landslide		Fire station		special needs infrastructure
	Hazardous material		landslide		Fire station		adult day care
	Hazardous material		landslide		Fire station		child day care
	Hazardous material		landslide		Fire station		elder care
	Hazardous material		landslide		Fire station		telecommunications infrastructure
	Hazardous material		landslide		Fire station		telecommunications facility
	Hazardous material		landslide		Fire station		telecommunications tower
	Hazardous material		landslide		Fire station		transportation infrastructure
	Hazardous material		landslide		Fire station		air traffic control facility
	Hazardous material		landslide		Fire station		airport
	Hazardous material		landslide		Fire station		bridge
	Hazardous material		landslide		Fire station		bus station
	Hazardous material		landslide		Fire station		ferry terminal
	Hazardous material		landslide		Fire station		helicopter landing site
	Hazardous material		landslide		Fire station		dock
	Hazardous material		landslide		Fire station		maintenance facility
	Hazardous material		landslide		Fire station		port
	Hazardous material		landslide		Fire station		rail station
	Hazardous material		landslide		Fire station		rest stop
	Hazardous material		landslide		Fire station		ship anchorage
	Hazardous material		landslide		Fire station		toll facility
	Hazardous material		landslide		Fire station		traffic control point
	Hazardous material		landslide		Fire station		traffic inspection facility
	Hazardous material		landslide		Fire station		tunnel
	Hazardous material		landslide		Fire station		water supply infrastructure
	Hazardous material		landslide		Fire station		waste facility
	Hazardous material		landslide		Fire station		dam
	Hazardous material		landslide		Fire station		discharge duct
	Hazardous material		landslide		Fire station		ground well
	Hazardous material		landslide		Fire station		pumping station
	Hazardous material		landslide		Fire station		reservoir
	Hazardous material		landslide		Fire station		storage tank
	Hazardous material		landslide		Fire station		surface water intake
	Hazardous material		landslide		Fire station		water treatment facility

Case Study #1 ANSI INCITS 415-2006

	SYMBOL	NAME/DEFINITION
INCIDENTS		residential fire: a fire affecting a home or housing complex, resulting in partial or total destruction of the structure and/or bodily injury, smoke inhalation or death
		marine accident: a sudden, unexpected event involving a boat or ship resulting in vessel submerging, damage, bodily injury, death and/or the disruption of transportation service
NATURAL EVENTS		drizzle: some time called mist; very small, numerous, and uniformly dispersed water droplets that appear to float while following air currents; unlike fog droplets, drizzle fall to the ground
		landslide: a general term for a wide variety of processes and landforms involving the down slope movement under the force of gravity of masses of soil and rock material
OPERATIONS		medical evacuation helicopter station: the locus of an emergency helicopter landing pad, utilized to transport severely injured persons
		emergency water distribution center: a place where potable water is distributed to displaced persons or victims of war or disaster
INFRA-STRUCTURES		toxic release inventory: the location according to a publicly available database of chemical and other toxic waste releases
		traffic control point: the location of absolute signals controlled by an operator to regulate and maintain transportation flow

Case Study #1 ANSI INCITS 415-2006

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category guidelines: closed sort

1. incidents
2. natural events
3. infrastructure
4. operations
5. other

card contents: symbols + definitions (198 total)

sample size: n=20, Penn State undergraduate students; average time to completion ~25 minutes

	OPEN	GUIDED	CLOSED
FEATURE DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• a priori criterion• feature definitions	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• a priori categories• feature definitions
SYMBOLS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• symbol designs
SYMBOLS & DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• feature definitions• symbol designs

pre-design generative design post-design evaluation

Roth et al. (2011)

Case Study #1 *ANSI INCITS 415-2006*

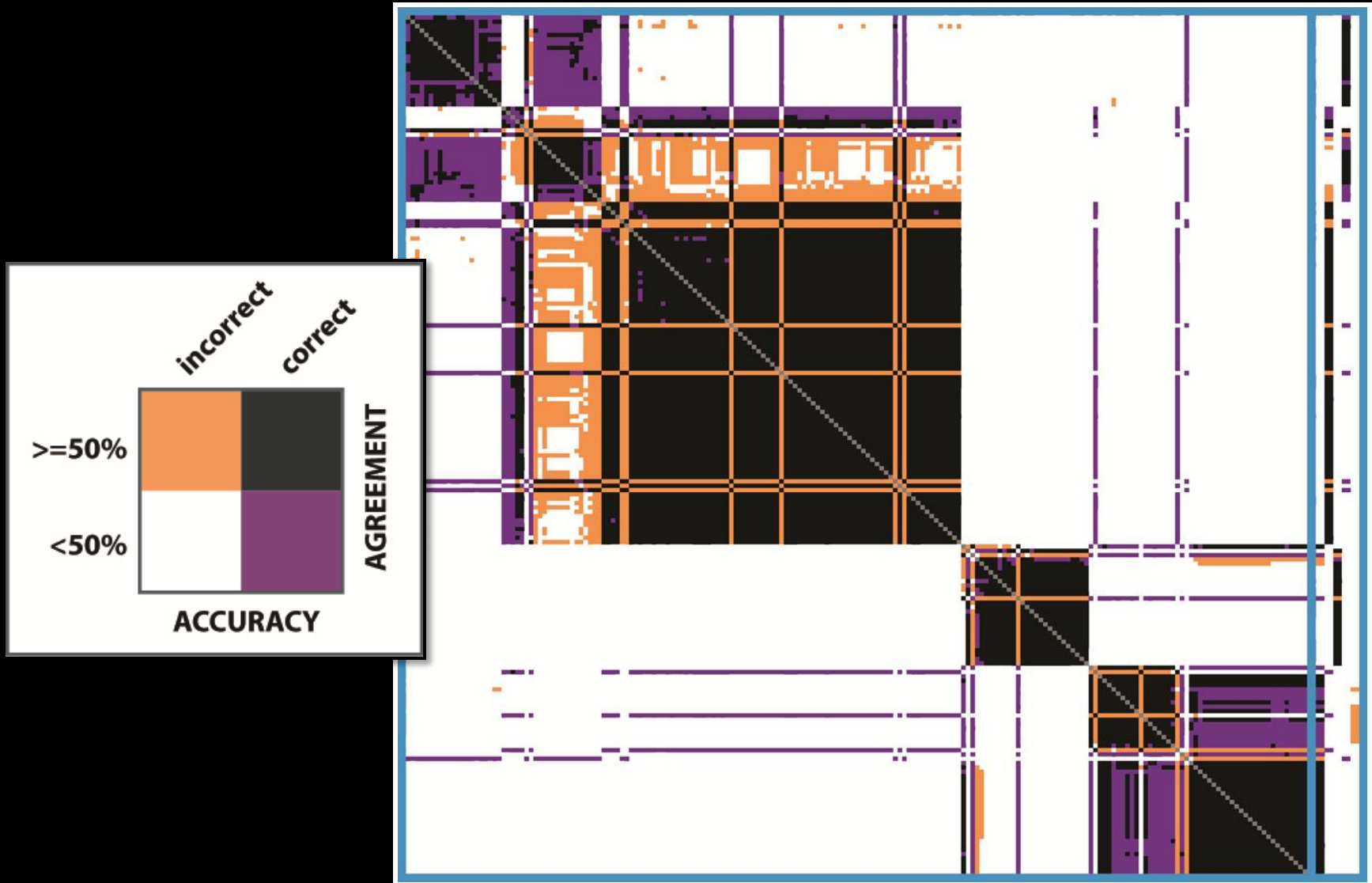
	AVG # PER CATEGORY	ACTUAL # IN CATEGORY	UNIQUE ITEMS	AGREEMENT
INCIDENTS	41.9	47	95	44%
INFRASTRUCTURES	77.1	81	126	61%
NATURAL EVENTS	23.0	26	41	56%
OPERATIONS	34.6	44	129	27%
OTHER	17.2	0	83	21%

agreement

accuracy

		ANSI STANDARD				
		INCIDENTS	INFRA-STRUCTURES	NATURAL EVENTS	OPERATIONS	TOTAL
SORT RESULTS (based on 50% agreement)	INCIDENTS	31	1	1	1	34
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Case Study #1 *ANSI INCITS 415-2006*

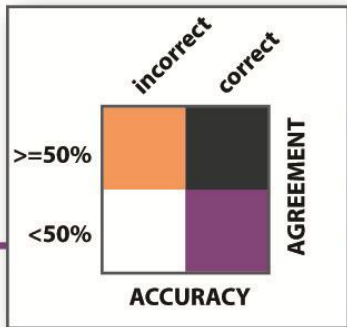


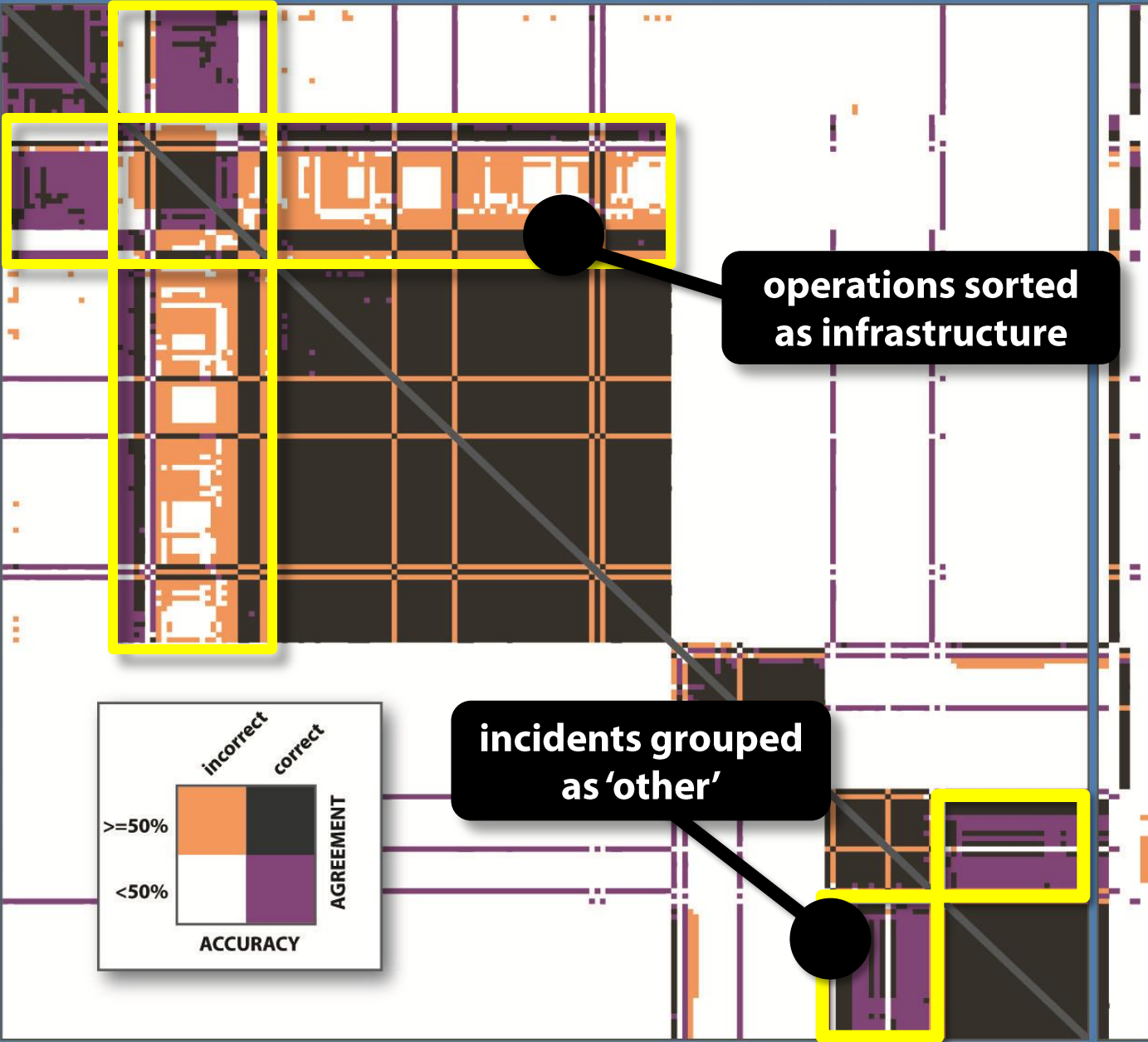
OPERATIONS

INFRASTRUCTURE

NATURAL EVENTS

INCIDENTS





Case Study #2 *e-Symbology Portal*

40

e-Symbology Portal

a web portal that facilitates the creation of asynchronous, round-based activities for interactive formalization and refinement of a symbol set

GeoVISTA: Symbol Standard Development Project

Kilo

- Forums
- My account
- Create content
- Feed aggregator
- Log out

Symbol Standard Development Activities

- Orientation
- Round #1: 2/8-2/14
 - Activity #1: Review Current Symbology
 - Activities #2-4: Discussion of Current Symbology
- Round #2: 2/15-2/21
- Round #3: 2/22-2/28

Outline Designer

Outline Designer Settings Usability Settings

Home

Round #1: 2/8-2/14

Submitted by roeth on Fri, 02/05/2010 - 14:32

The purpose of the first round is to complete an assessment of the CBP map symbolization needs. We are particularly interested in understanding what works well with the current symbol set (needs that are currently met), what does not currently work well (needs that are currently met, but poorly or incompletely), and what is missing (needs that currently are not met). The existing symbol set will be used as a prompt for discussing symbolization needs. The activities associated with this round can be viewed by selecting the appropriate bullet in the 'Symbol Standard Development Activities' panel in the left frame or by selecting one of the hyperlinks below this overview.

Round #1 includes four activities: one critical evaluation of a document and three asynchronous group discussion threads. Begin this round by completing Activity #1 (Review of Current Symbology); please complete this activity early in the round (either Monday 2/8 or Tuesday 2/9). The fourth activity also includes a follow-up voting/polling component that needs to be completed on Friday 2/12.

Once you have reviewed the symbology matrix provided, you can complete Activities #2-4 concurrently (a trio of asynchronous, group discussion threads). Because the first round is heavy on discussion, please log into the site at least once a day (more often is preferred) to read and contribute to the discussion.

A PDF including all Round #1 instructions with explanatory screenshots can be downloaded from the following link. This PDF was also included in the email announcing the opening of Round #1.

- Activity #1: Review Current Symbology
- Activities #2-4: Discussion of Current Symbology

[Activity #1: Review Current Symbology >](#)

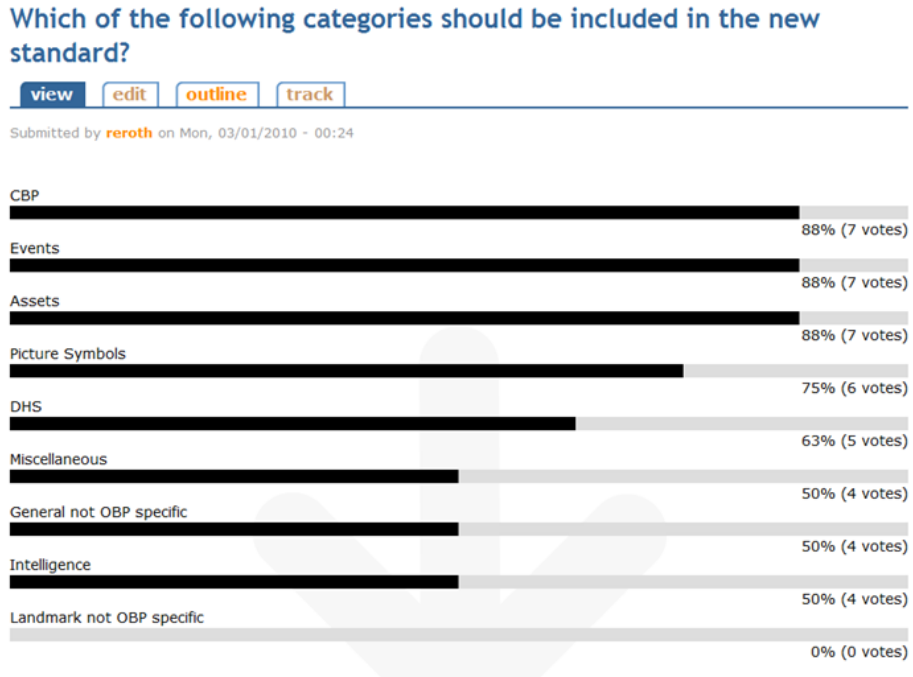
[Printer-friendly version](#) | [Add new comment](#)

<http://www.geovista.psu.edu/symbology/>

Case Study #2 e-Symbology Portal

Round 1 Discussion Topics

Forum	Topics	Posts	Last post
Activity #2: Problems With Existing Symbols	- reorth , Fri, 02/05/2010 - 12:48		
↳ Symbols that are never used	- jblanford , Thu, 02/18/2010 - 12:11		
↳ After reviewing the symbol	- Bravo , Fri, 02/19/2010 - 15:50		
↳ symbol usage	- Juliet , Thu, 02/18/2010 - 12:35		
↳ Problems with existing symbols	- jblanford , Wed, 02/17/2010 - 15:30		
↳ Aircraft crash	- Foxtrot , Thu, 02/18/2010 - 09:01		
↳ Aircraft crash	- Bravo , Fri, 02/19/2010 - 16:04		
↳ Similar symbols	- Foxtrot , Thu, 02/18/2010 - 08:43		
↳ Similar symbols	- Bravo , Fri, 02/19/2010 - 16:22		
↳ Symbol ?	- Juliet , Tue, 02/16/2010 - 10:19		
↳ Necessary Symbol Part II	- India , Wed, 02/17/2010 - 15:46		
↳ Infrequently-used (but still recurrent) symbols	- Foxtrot , Thu, 02/18/2010 - 08:35		
↳ I agree with this statement.	- Hotel , Thu, 02/25/2010 - 10:29		
↳ Other symbol is useless	- Charlie , Tue, 02/16/2010 - 14:47		
↳ Other symbol	- Foxtrot , Tue, 02/16/2010 - 13:29		
↳ other symbol	- Echo , Tue, 02/16/2010 - 16:44		
↳ Need better description	- Charlie , Wed, 02/17/2010 - 10:31		
↳ Symbology	- Juliet , Tue, 02/16/2010 - 10:16		
↳ Checkpoint Symbology	- Foxtrot , Tue, 02/16/2010 - 13:24		
↳ checkpoint symbology	- Echo , Tue, 02/16/2010 - 16:39		
↳ checkpoint symbology	- Juliet , Wed, 02/17/2010 - 08:40		
↳ I have only	- Hotel , Thu, 02/18/2010 - 12:14		
↳ Symbology	- Echo , Wed, 02/17/2010 - 12:14		
↳ at its Tuscan	- India , Wed, 02/17/2010 - 15:43		
↳ Symbology	- India , Wed, 02/17/2010 - 10:11		
↳ Symbology	- India , Wed, 02/17/2010 - 6:01		
↳ Symbology	- India , Thu, 02/18/2010 - 09:46		
↳ Symbology	- India , Thu, 02/17/2010 - 12:08		
↳ Symbology	- India , Tue, 02/16/2010 - 09:59		



- **CBP**
- **FEMA**
- **OIP**

CBP Map Symbology Template - Updated 04 February 2010

Case Study #2 *e-Symbology Portal*

43

category guidelines: one open sort and one closed sort (same universe)

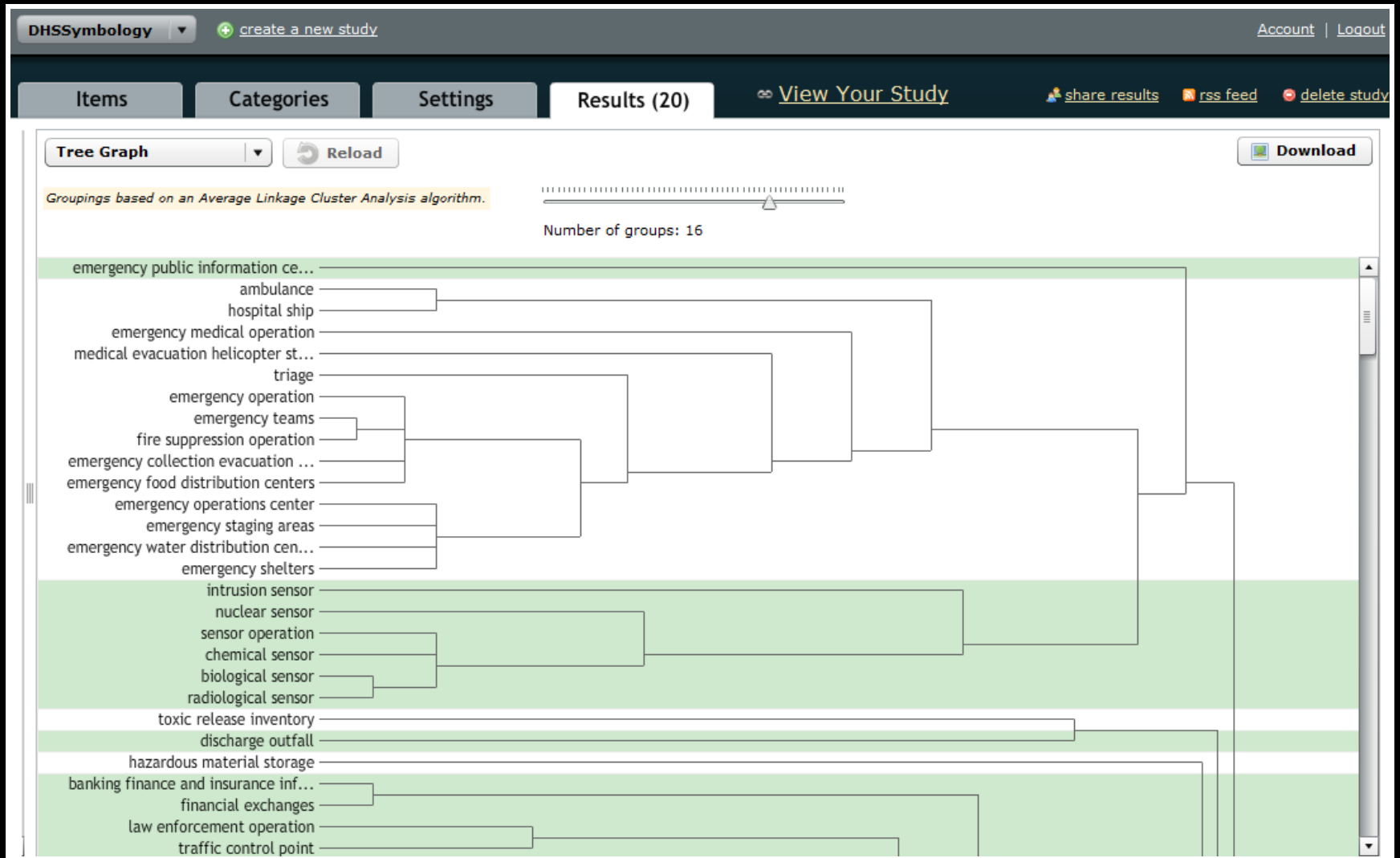
card contents: both sorts included symbols + definitions (168 & 172 cards per sort)

sample size: n=8, cartographers at Customs & Border Protection (CBP); completion time ~80 and ~35 minutes for open & closed, respectively

	OPEN	GUIDED	CLOSED
FEATURE DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• <i>a priori</i> criterion• feature definitions	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• <i>a priori</i> categories• feature definitions
SYMBOLS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• symbol designs
SYMBOLS & DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• feature definitions• symbol designs

Robinson et al. (forthcoming)

Case Study #2 e-Symbology Portal



Case Study #2 e-Symbology Portal

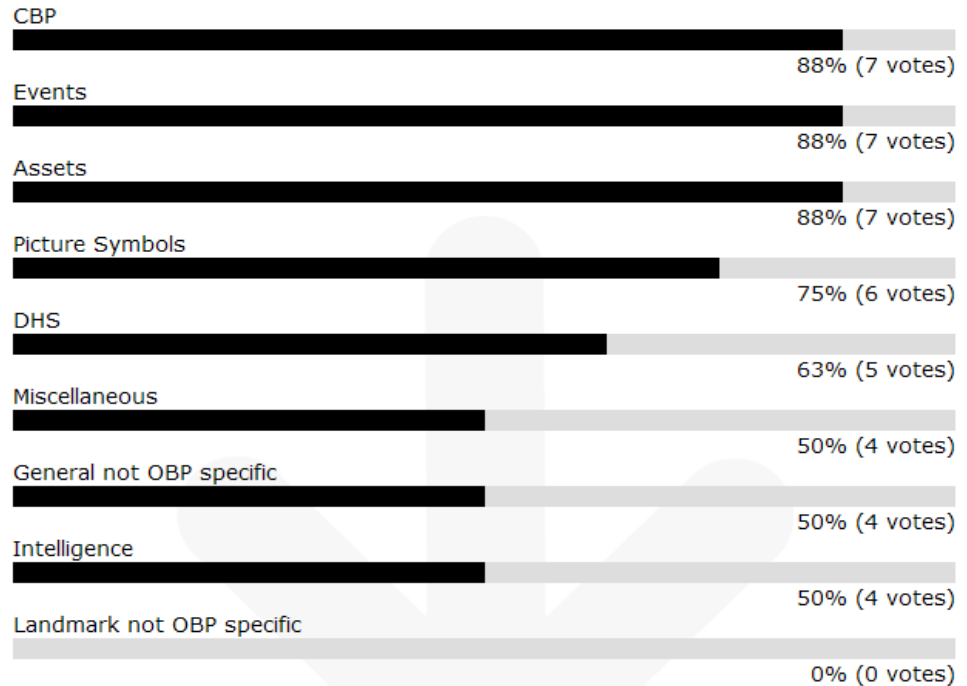
Round 1 Discussion Topics

Forum	Topics	Posts
Activity #2: Problems With Existing Symbols	- reeroth , Fri	
↳ Symbols that are never used	- jblanford , Thu, 02/18/2010 - 10:35	
↳ After reviewing the symbol	- Bravo , Fri, 02/19/2010 - 10:35	
↳ symbol usage	- Juliet , Thu, 02/18/2010 - 12:00	
↳ Problems with existing symbols	- jblanford , Wed, 02/17/2010 - 16:34	
↳ Aircraft crash	- Foxtrot , Thu, 02/18/2010 - 10:35	
↳ Aircraft crash	- Bravo , Fri, 02/19/2010 - 10:35	
↳ Similar symbols	- Foxtrot , Thu, 02/18/2010 - 10:35	
↳ Similar symbols	- Bravo , Fri, 02/19/2010 - 10:35	
↳ Necessary Symbol ?	- Juliet , Tue, 02/16/2010 - 10:16	
↳ Necessary Symbol Part II	- India , Wed, 02/17/2010 - 09:43	
↳ Infrequently-used (but still recurrent)	- Juliet , Thu, 02/18/2010 - 08:35	
↳ I agree with this statement	- Bravo , Fri, 02/19/2010 - 10:35	
↳ Other symbol is useless	- Charlie , Tue, 02/16/2010 - 10:16	
↳ "Other" symbol	- Foxtrot , Tue, 02/16/2010 - 10:16	
↳ other symbol	- Echo , Tue, 02/16/2010 - 10:16	
↳ Need better description	- Charlie , Tue, 02/16/2010 - 10:16	
↳ Same Symbology	- Juliet , Tue, 02/16/2010 - 10:16	
↳ Checkpoint Symbology	- Foxtrot , Tue, 02/16/2010 - 10:16	
↳ checkpoint symbology	- Echo , Tue, 02/16/2010 - 10:16	
↳ checkpoint symbology	- Juliet , Tue, 02/16/2010 - 10:16	
↳ I agree, we should use the symbol	- Juliet , Tue, 02/16/2010 - 09:43	
↳ checkpoint symbology	- Juliet , Tue, 02/16/2010 - 09:43	
↳ I believe that the symbol is not necessary	- Juliet , Tue, 02/17/2010 - 10:16	
↳ Symbols that are too complex	- Foxtrot , Tue, 02/17/2010 - 10:16	
↳ Too Complex	- Bravo , Fri, 02/19/2010 - 10:35	
↳ Also	- Charlie , Wed, 02/17/2010 - 10:34	
↳ Agreed - the actual symbol	- Hotel , Thu, 02/18/2010 - 10:35	
↳ Could you provide a	- Echo , Wed, 02/17/2010 - 10:34	
↳ Symbols that are difficult to interpret	- Foxtrot , Tue, 02/17/2010 - 10:16	

Which of the following categories should be included in the new standard?

[view](#) [edit](#) [outline](#) [track](#)

Submitted by **reeroth** on Mon, 03/01/2010 - 00:24

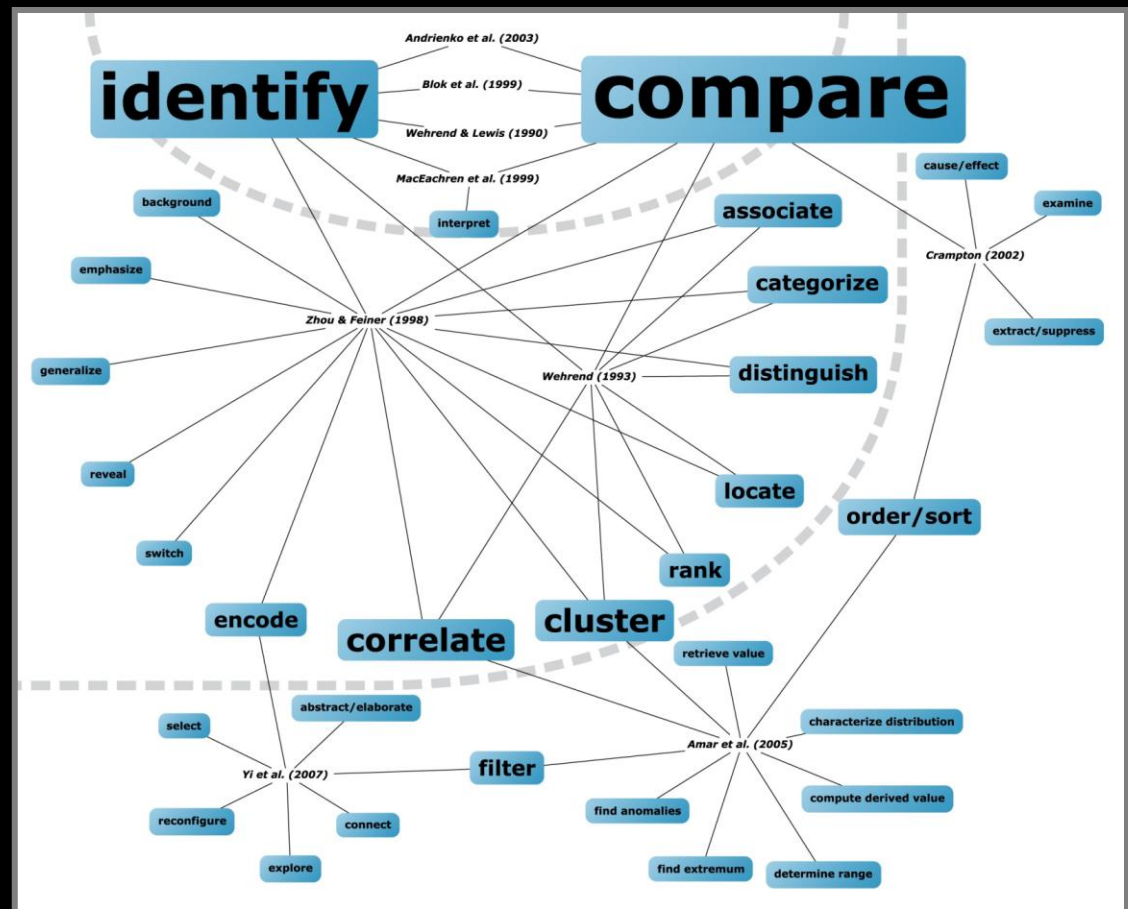


Total voters: 8

» [Add new comment](#)

Objectives:

the task that the user wants to complete with the interactive map



Roth
(forthcoming)

Case Study #3 *Interactive Maps*

Interview Pre-Stage:

n=21, interactive map users working in government & industry; included a question section in which they demonstrated how they use their tools

ID	Objective Card
1	what explosives materials are known to be inside a building that is on fire?
2	how fast is the fire truck going?
3	how big is the building that is on fire?
4	are there buildings nearby that are at risk of catching fire?
5	locate the building that is on fire on a map
6	find a different route to a building that is on fire if one way is closed
7	detect the location of a crime series within the city
...

ID	Operator Card
1	click on a shipwreck to get metadata and other rich information about the shipwreck
2	draw a red line to mark something of interest on the map
3	resymbolize map features using a different attribute
4	switch the basemap
5	use the lasso to zoom into a country
6	turn on a building reference layer
...

Case Study #3 *Interactive Maps*

49

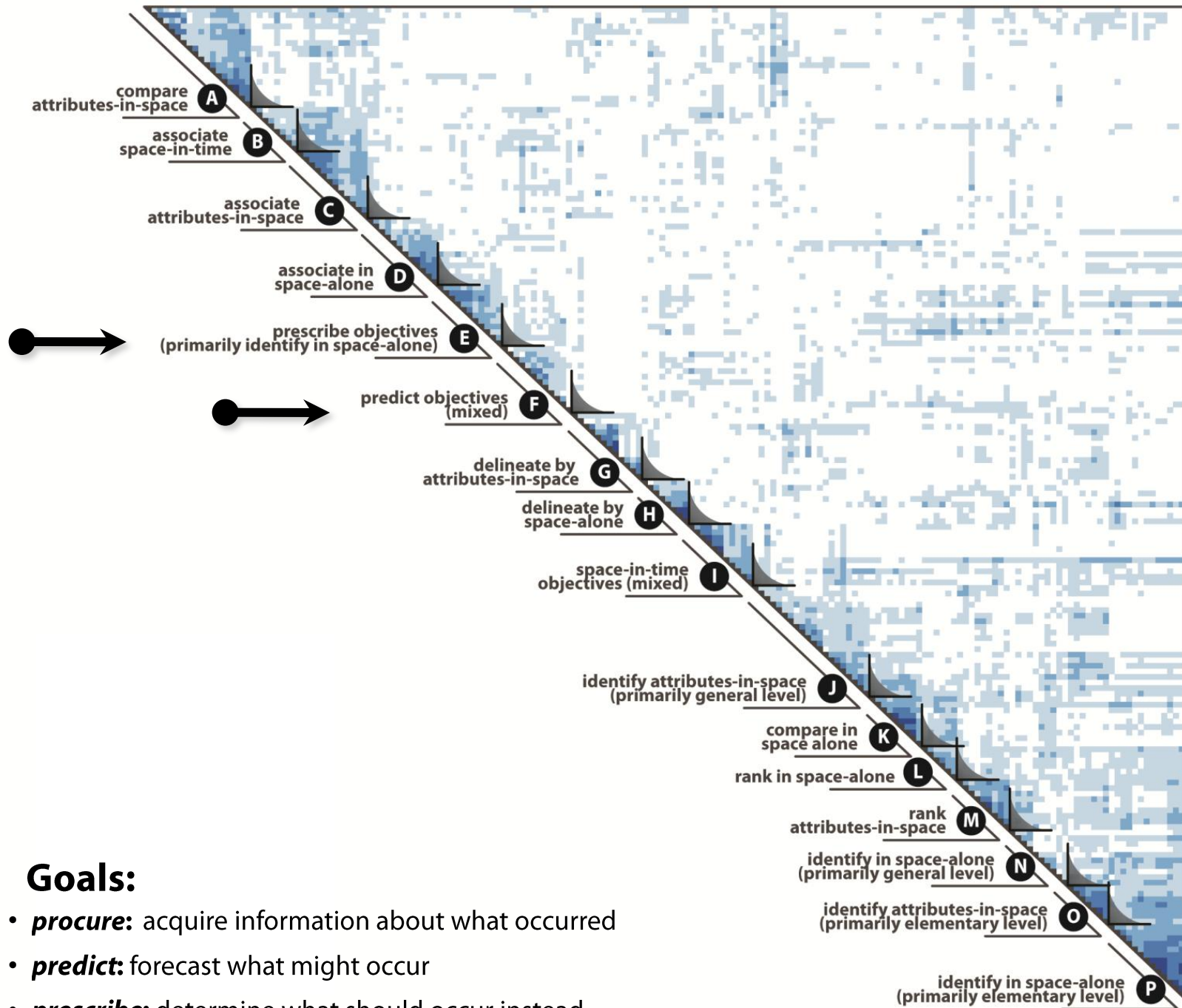
category guidelines: two guided sorts
(different universes)

card contents: both sorts included phrases
coded as representative of an objective
(n=178) or operator (n=206) from the
interviews

	OPEN	GUIDED	CLOSED
FEATURE DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• <i>a priori</i> criterion• feature definitions	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• <i>a priori</i> categories• feature definitions
SYMBOLS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• symbol designs
SYMBOLS & DEFINITIONS	Generate: <ul style="list-style-type: none">• competing criteria• categories Evaluate: <ul style="list-style-type: none">• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• categories Evaluate: <ul style="list-style-type: none">• sorting criterion• feature definitions• symbol designs	Generate: <ul style="list-style-type: none">• <none> Evaluate: <ul style="list-style-type: none">• established categories• feature definitions• symbol designs

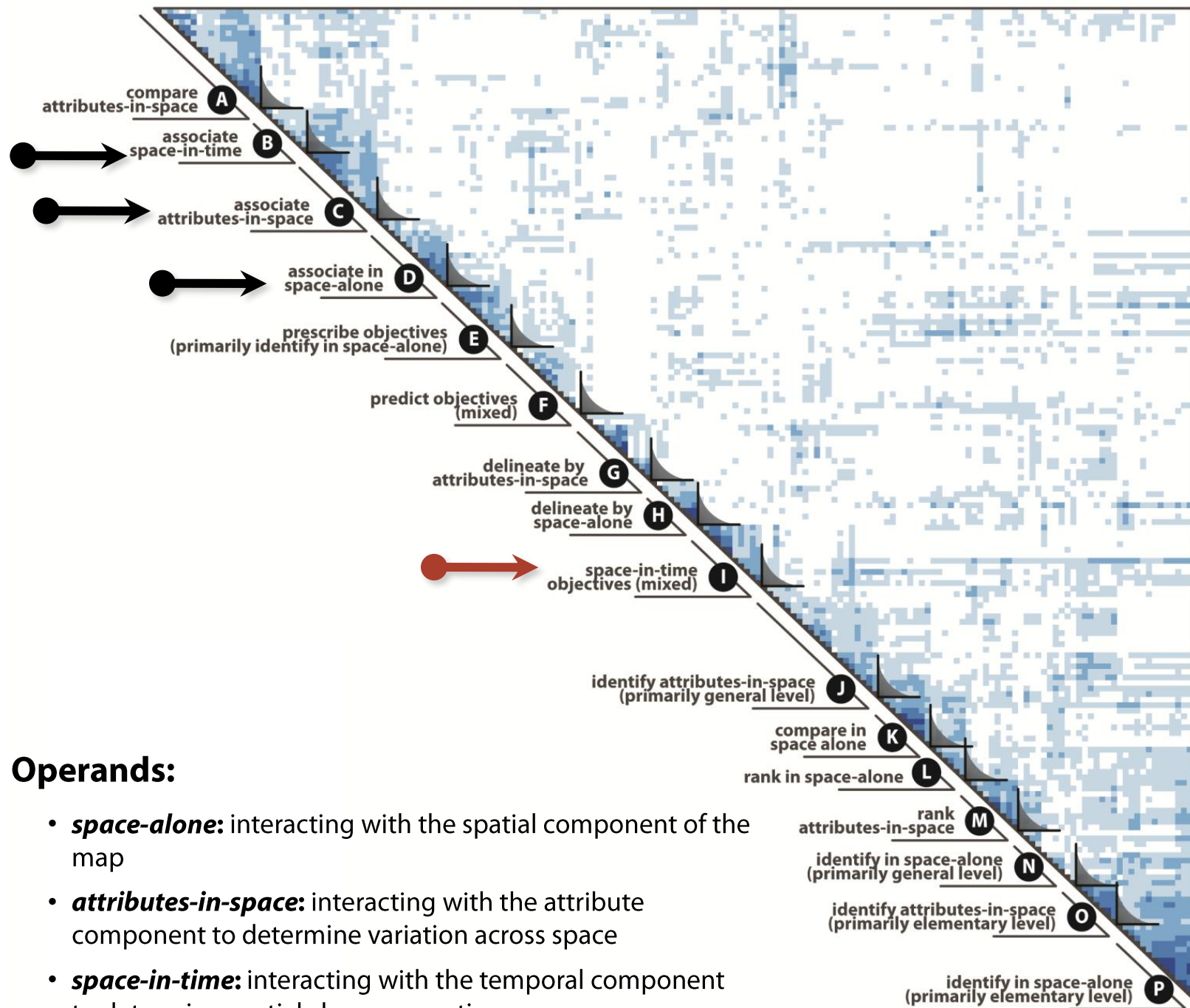
Roth (2012)

sample size: n=15, interactive map designers/developers working in
government & industry; completion time ~150 minutes for both sorts



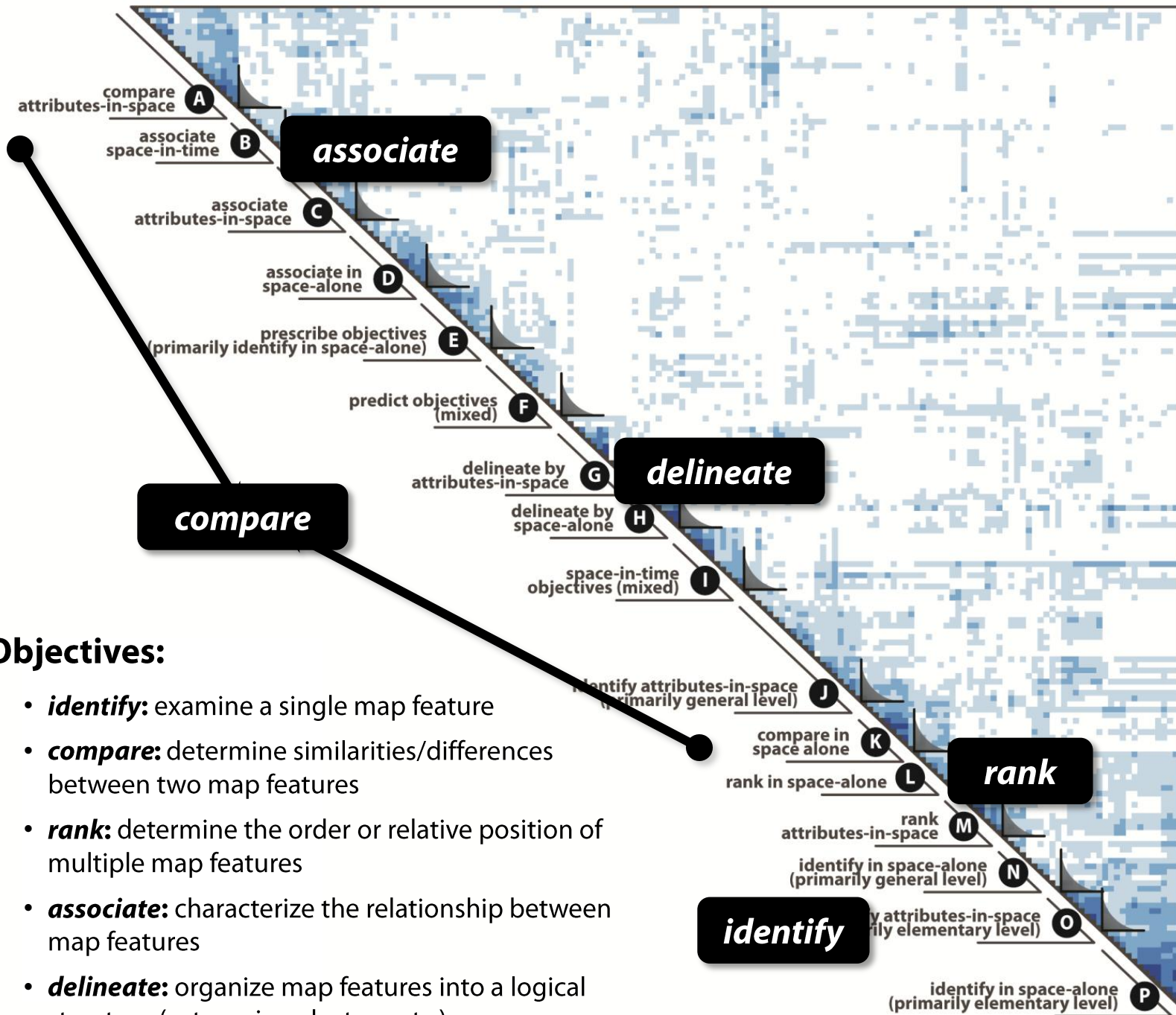
Goals:

- **procure:** acquire information about what occurred
- **predict:** forecast what might occur
- **prescribe:** determine what should occur instead



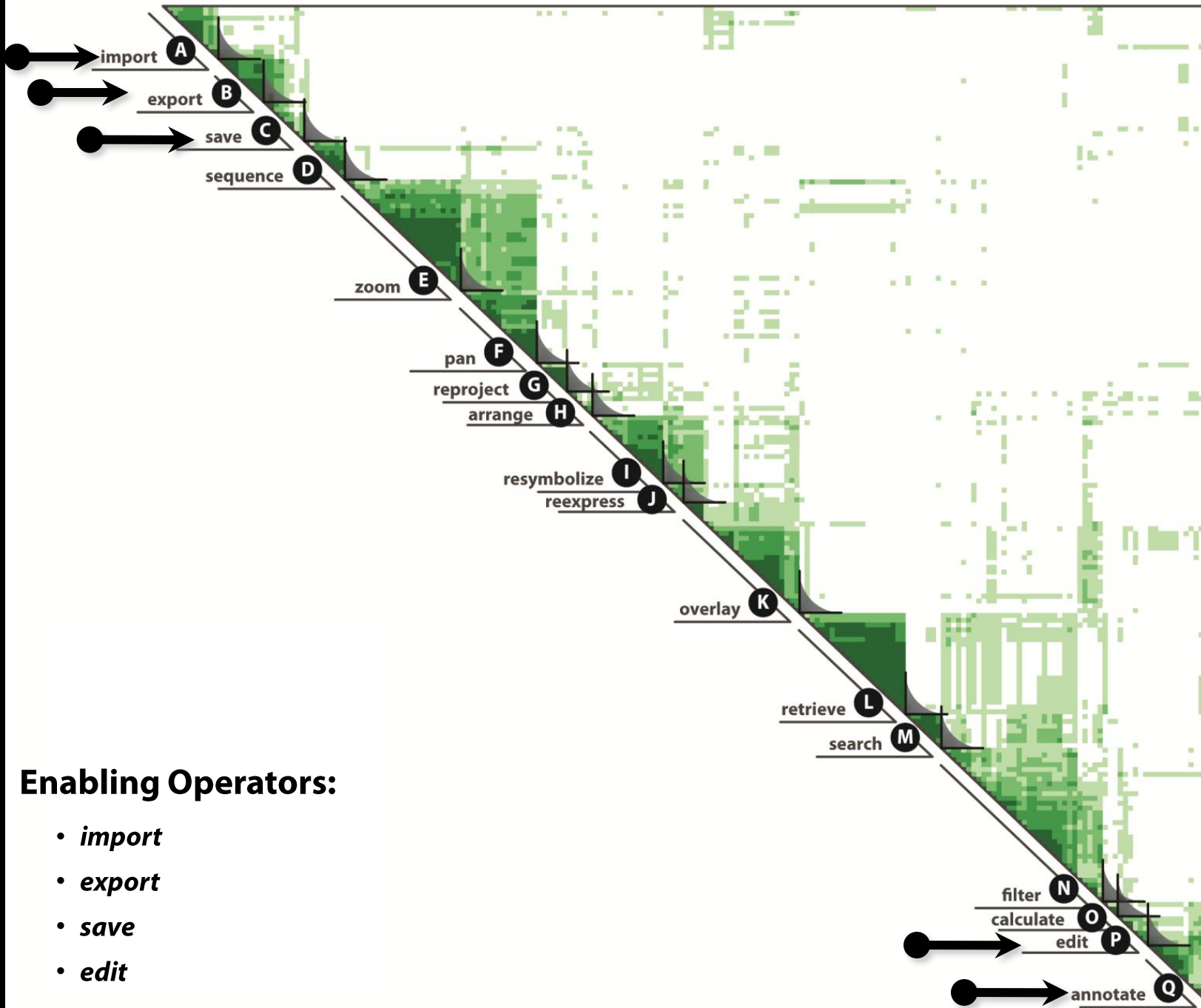
Operands:

- **space-alone**: interacting with the spatial component of the map
- **attributes-in-space**: interacting with the attribute component to determine variation across space
- **space-in-time**: interacting with the temporal component to determine spatial change over time



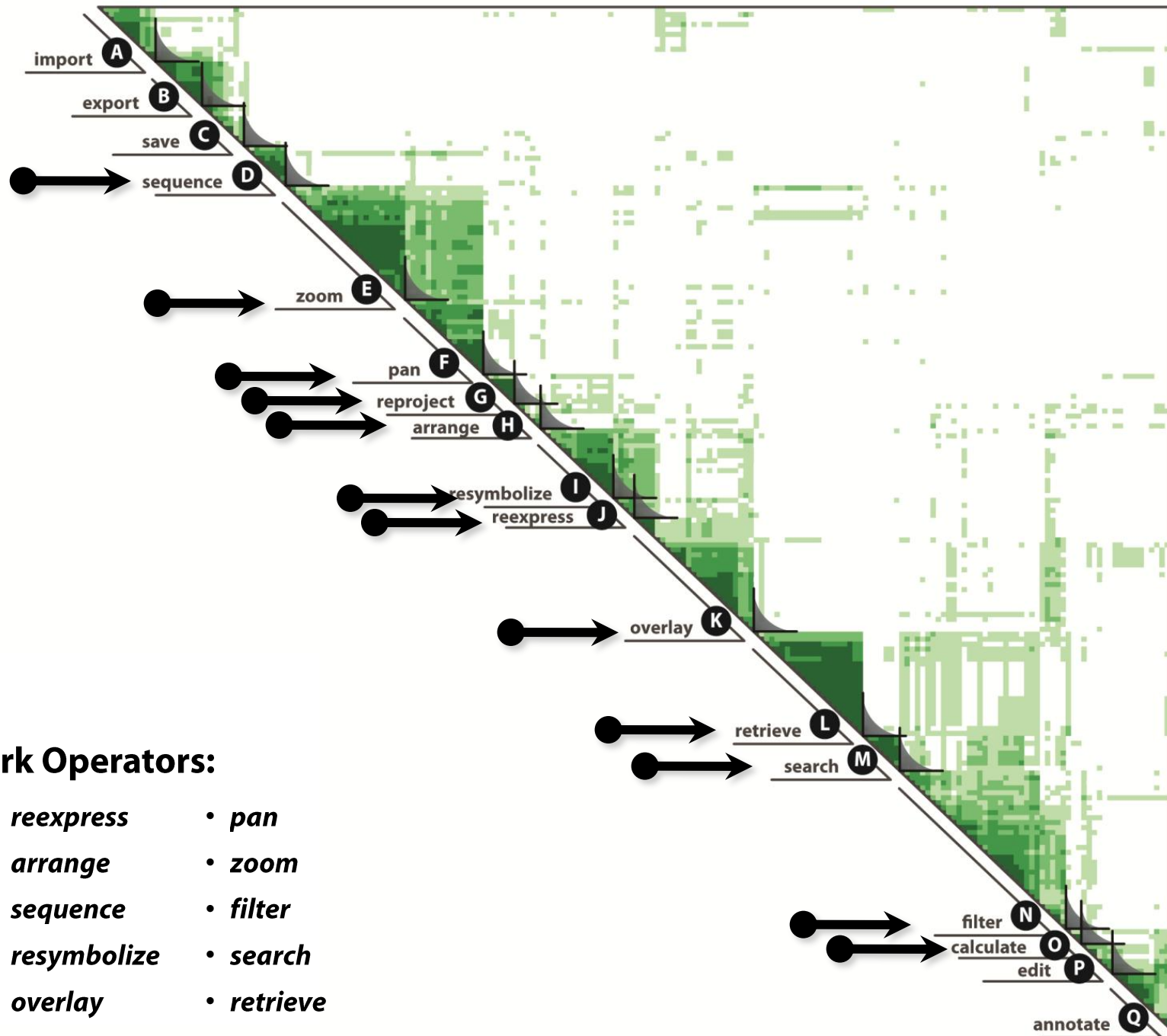
Objectives:

- **identify**: examine a single map feature
- **compare**: determine similarities/differences between two map features
- **rank**: determine the order or relative position of multiple map features
- **associate**: characterize the relationship between map features
- **delineate**: organize map features into a logical structure (categories, clusters, etc.)



Enabling Operators:

- *import*
- *export*
- *save*
- *edit*
- *annotate*



Work Operators:

- *reexpress*
- *arrange*
- *sequence*
- *resymbolize*
- *overlay*
- *reproject*
- *pan*
- *zoom*
- *filter*
- *search*
- *retrieve*
- *calculate*



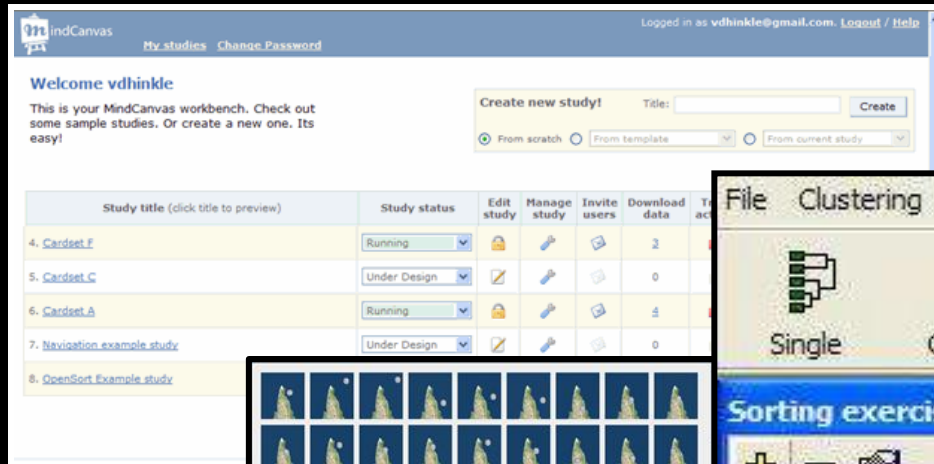
Part 3: Exercise



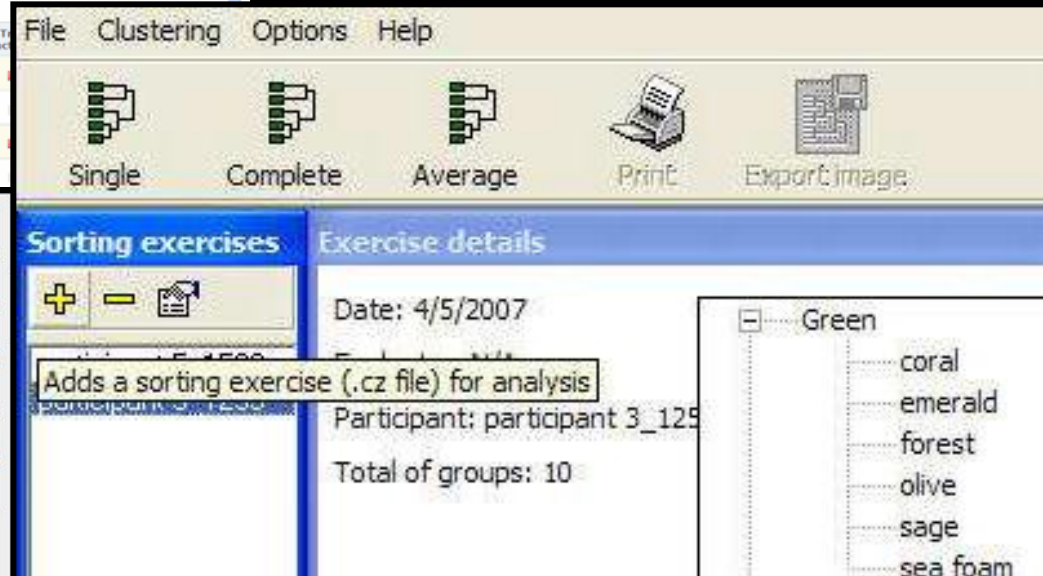
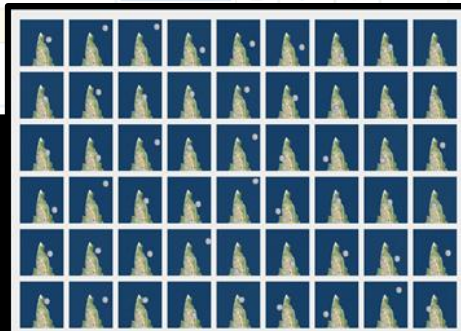
Exercise *Card Sorting Technologies*

Chaparro (2008)

OpenSort



CardZort



CatScan

Exercise *WebSort.net*

58

WebSort.net [Instructions](#) | [Leave a comment](#)

190 unsorted items

Incidents

- civil disturbance incident

Natural Events

- bird infestation
- tornado

Operations

- law enforcement operation
- FBI
- FBI
- DEA
- DEA

Infrastructures

- petroleum facilities

Other

- unexploded ordnance

petroleum facilities

telecommunications

I'm Done!

<http://websort.net/s/A9E7D9/>



Thanks for your attention!

<http://www.slideshare.net/reroth/working-with-the-card-sorting-method>

case study references

Roth RE, BG Finch, JI Blanford, A Klippel, AC Robinson, and AM MacEachren. 2011. Card sorting for cartographic research and practice. *Cartography and Geographic Information Science* 38(2): 89-99.

Roth RE. 2012. An empirically derived taxonomy of cartographic interaction primitives. In: *Proceedings of GIScience 2012*. Columbus, Ohio: September 21.

Roth RE. (forthcoming). Cartographic Interaction Primitives: Framework and Synthesis. *The Cartographic Journal*. 49(4).

Robinson AC, RE Roth, J Blanford, S Pezanowski, and AM MacEachren. (forthcoming) Developing map symbol standards through an iterative collaboration process. *Environment and Planning B*.