Preliminary Analysis of the Concept Concept Inventory with some Theoretical and Methodological Background

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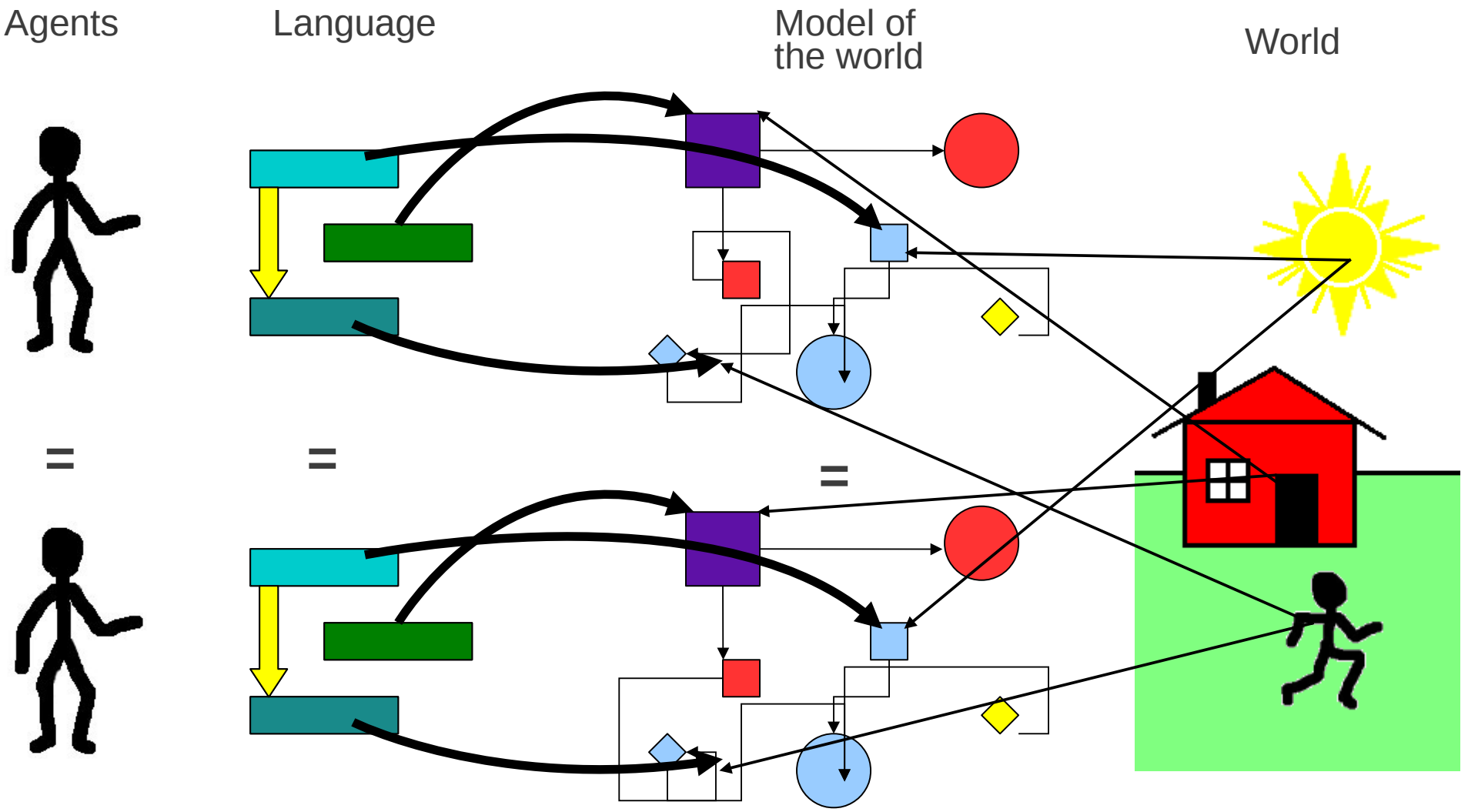
ConChaMo

Conceptual Change Research workshop
Hanasaari, Helsinki, Finland
22nd of August, 2012

Background 1:

Artificial Intelligence Paradigms and Underlying Epistemological Assumptions

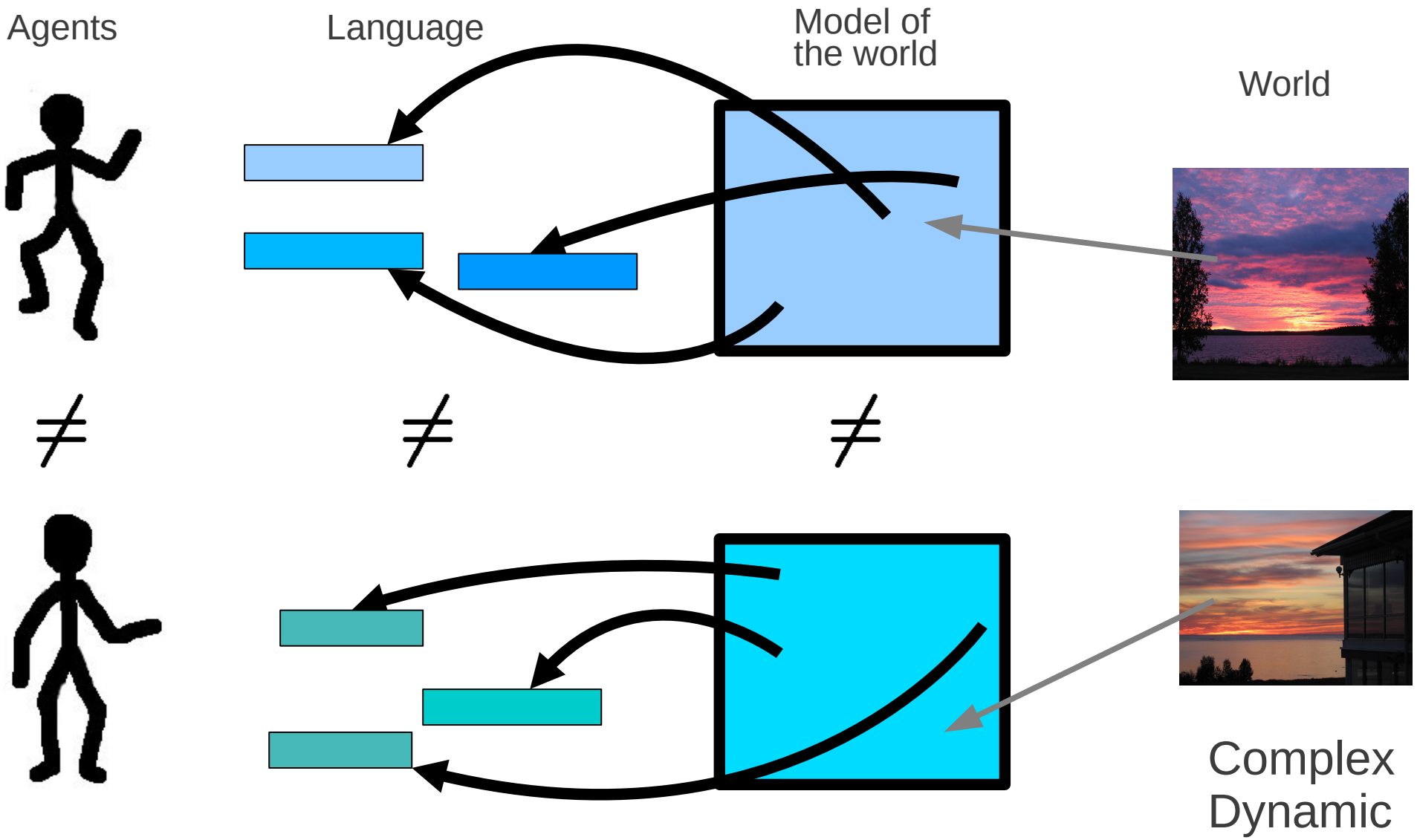
Traditional AI viewpoint



“...the World as Earthquake...”
Stellan Ohlsson, 22.8.2012

Emergentist viewpoint

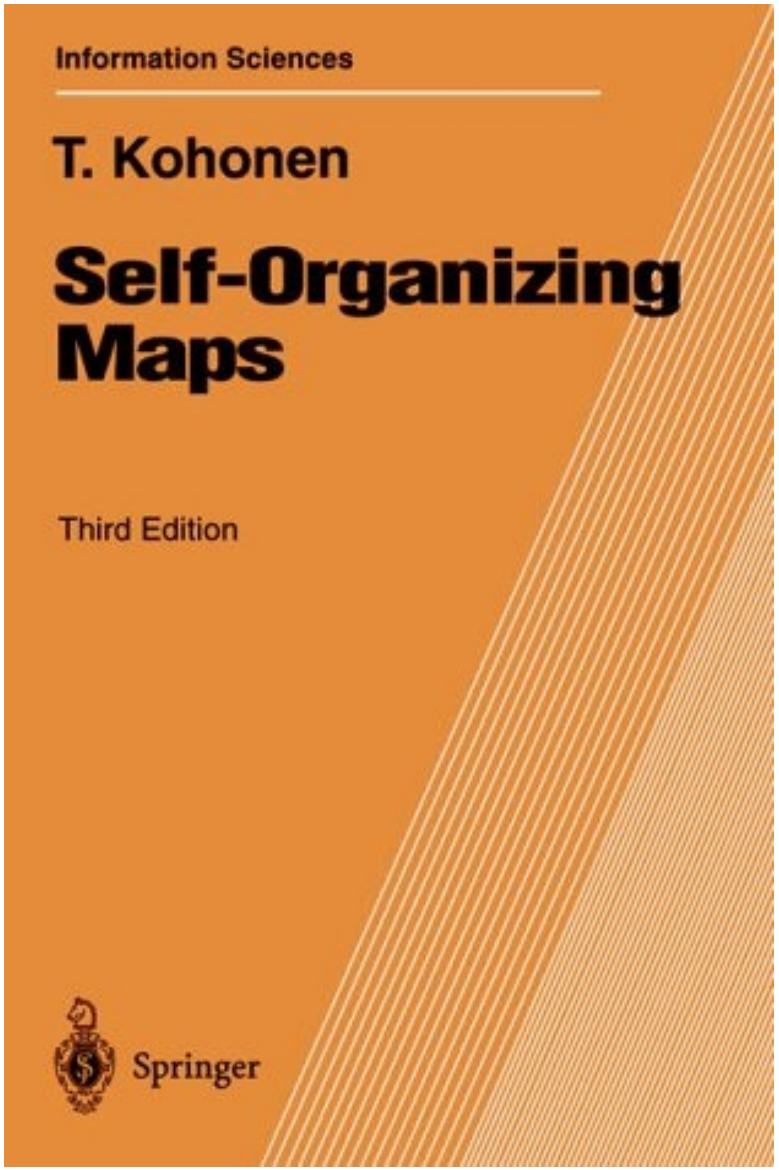
(importance of pattern recognition and learning)



Background 2:

Self-Organizing Map as a

- Method of Data Analysis and Visualization, and
- Model of (Conceptual) Learning



The most influential neural network model in the category of unsupervised learning

(Book: 1995, 1997, 2001;
Original publication: 1982)

“...population of competing demons...”
Stellan Ohlsson, 22.8.2012

Voilà:

Basic learning principles of the **Self-Organizing Map** model:

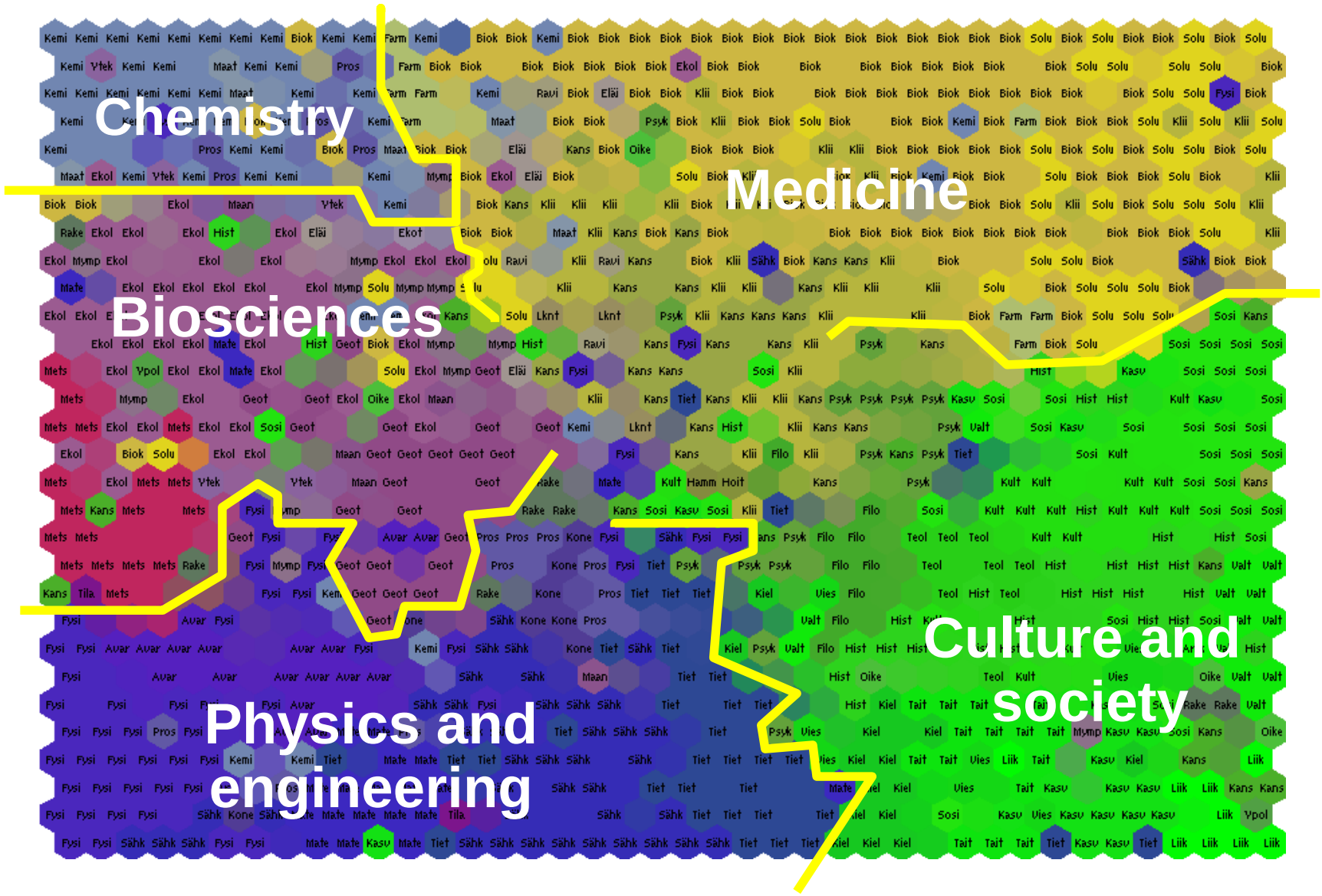
1. An input vector $\mathbf{x}_t$ s compared with
   all the model vectors $m_{i(t)}$.

   The best-matching unit (node) on the map,
   i.e., the node where the model vector is most
   similar to the input vector in some metric
   is identified. This best matching unit is often
   called the **winner**.

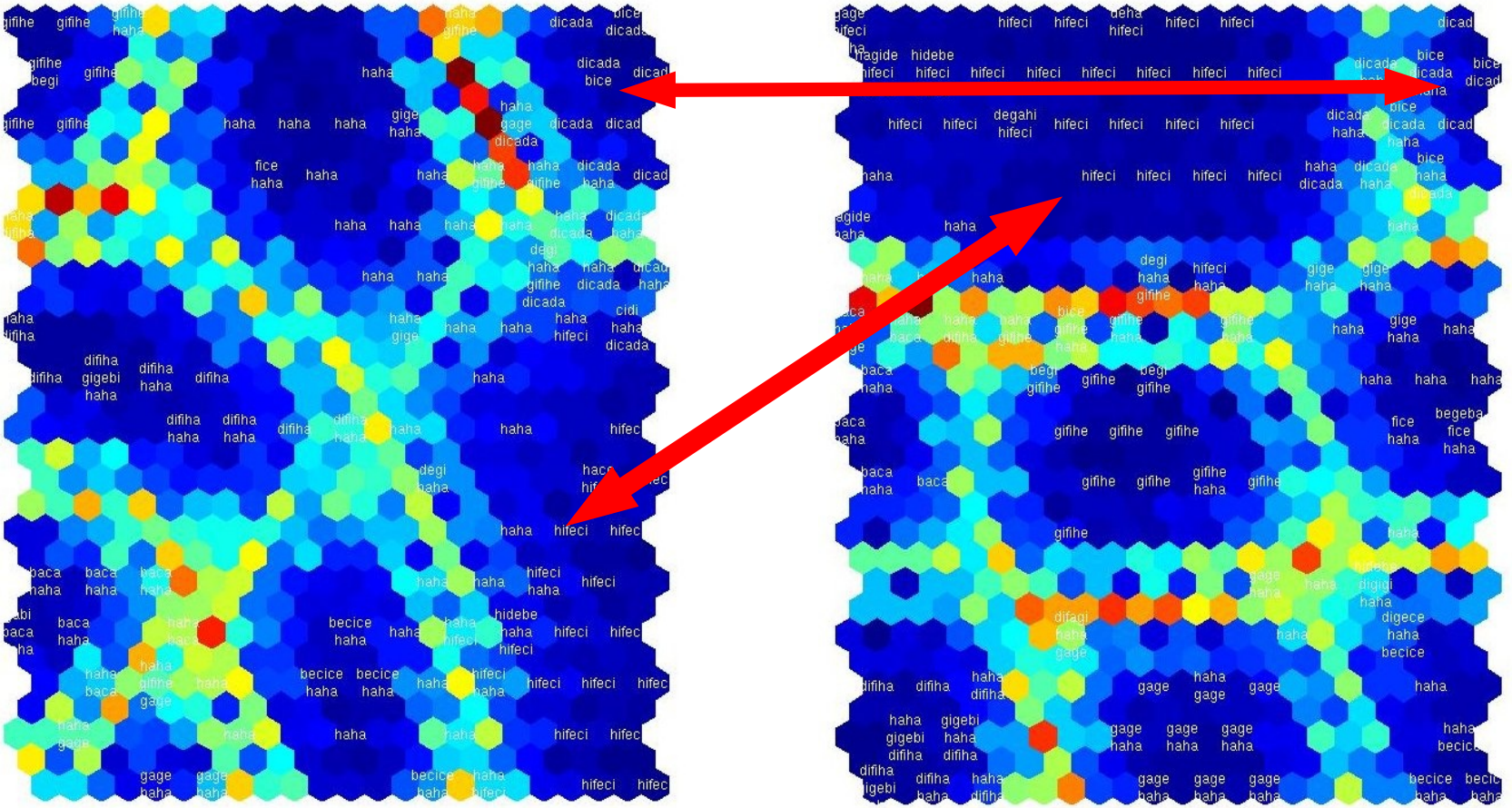
2. The model vectors of the winner and a number of
   its neighboring nodes in the array are changed
   towards the input vector according to
   the learning principle...

Competition (and collaboration between the “neighbors”)

Map of Finnish Science



Modeling communities of linguistic and conceptual systems



(Lindh-Knuutila, Lagus, Honkela, 2006)

Background 3:

Modeling Conceptual Subjectivity

Intersubjective Concept Spaces

(Honkela, Könönen, Lindh-Knuutila & Paukkeri 2008)

C_i: N-dimensional metric **concept space**

S: symbol space, The **vocabulary** of an agent that consists of discrete symbols

$\lambda : C_i \times C_j \rightarrow R, i \neq j$
A **distance** between two points **in** the **concept spaces** of different agents

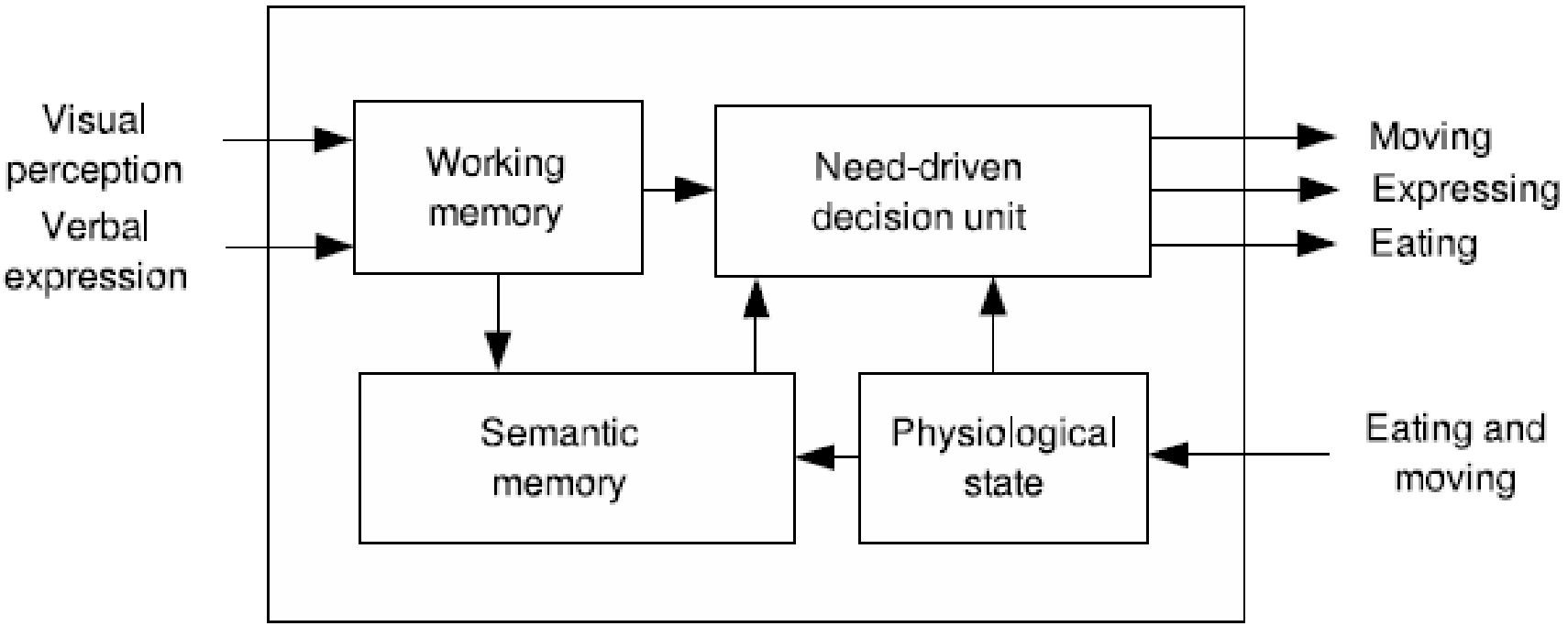
$\xi: s_i \in S_i \rightarrow C$
An individual **mapping** function **from symbols to concepts**

$\varphi_i: S_i \rightarrow D$
An individual **mapping from** agent i's **vocabulary to** the **signal space** D and an inverse mapping $\varphi^{-1}{}_i$ from the signal space to the symbol space

Observing f_1 and after symbol selection process, agent 1 communicates a symbol s* to agent 2 as signal d. When agent 2 observes d, it maps it to some $s_2 \in S_2$ by using the function $\varphi^{-1}{}_1$. Then it maps the symbol to some point in its concept space by using ξ_2. If this point is close to its observation f_2 in the sense of λ, the communication process has succeeded.

Extension of information theory

Applying Utility in Concept Learning

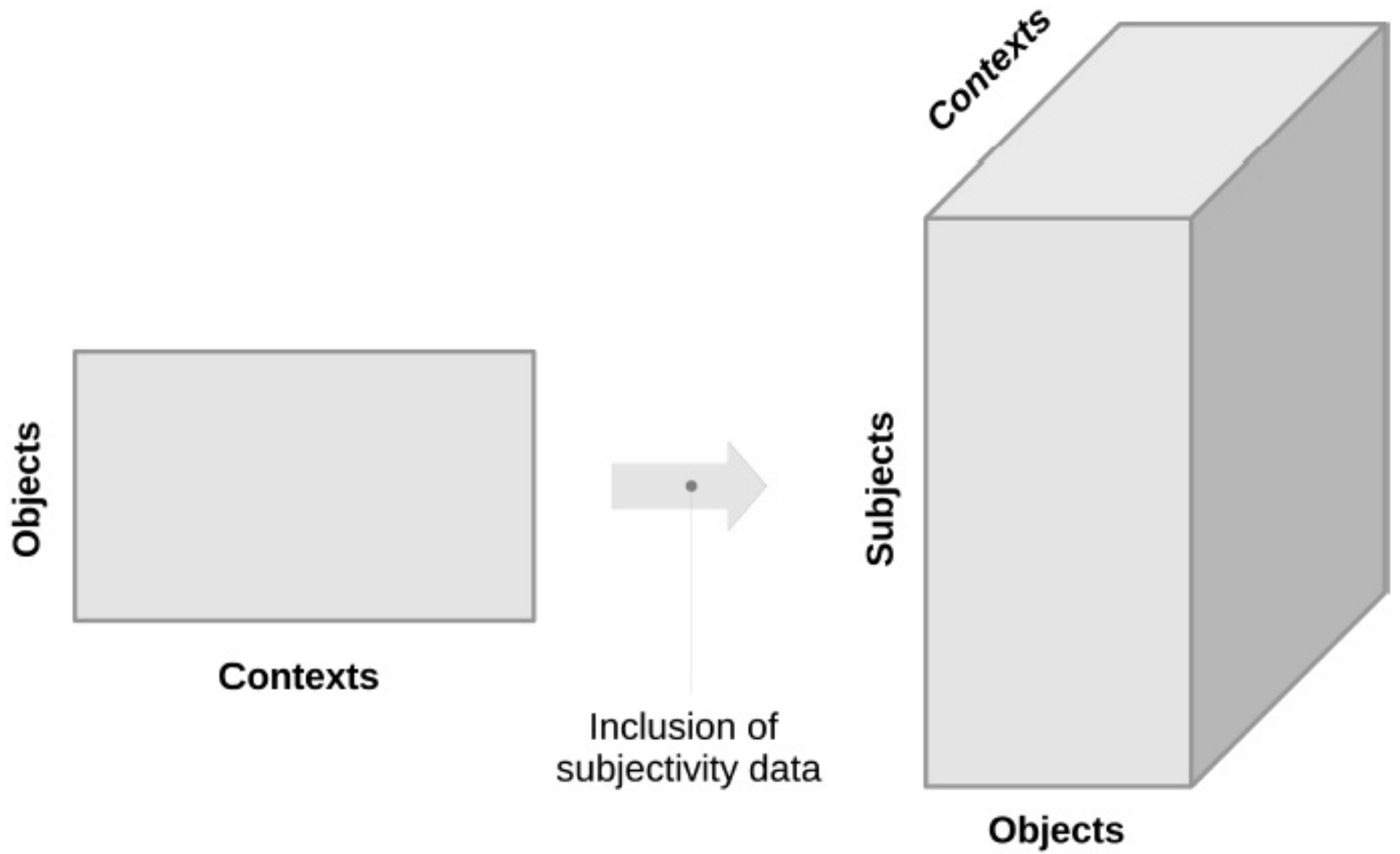


Timo Honkela and Juha Winter. Simulating language learning in community of agents using self-organizing maps. Computer and Information Science Report A71, Helsinki University of Technology, Helsinki, Finland, December 2003.

GICA – Grounded Intersubjective Concept Analysis

Timo Honkela, Juha Raitio, Krista Lagus, Ilari T. Nieminen, Nina Honkela, and Mika Pantzar. Subjects, objects and contexts: Using GICA method to quantify epistemological subjectivity. In Proceedings of IJCNN 2012, International Join Conference on Neural Networks, 2875–2883.

Subjectifying: adding subjective views into object-context matrices



Outcome: Subject-Object-Context (SOC) Tensors

“The Beef of this Talk”:

Preliminary Analysis of the Concept Concept Inventory

Concept Concept Inventory (1/2)

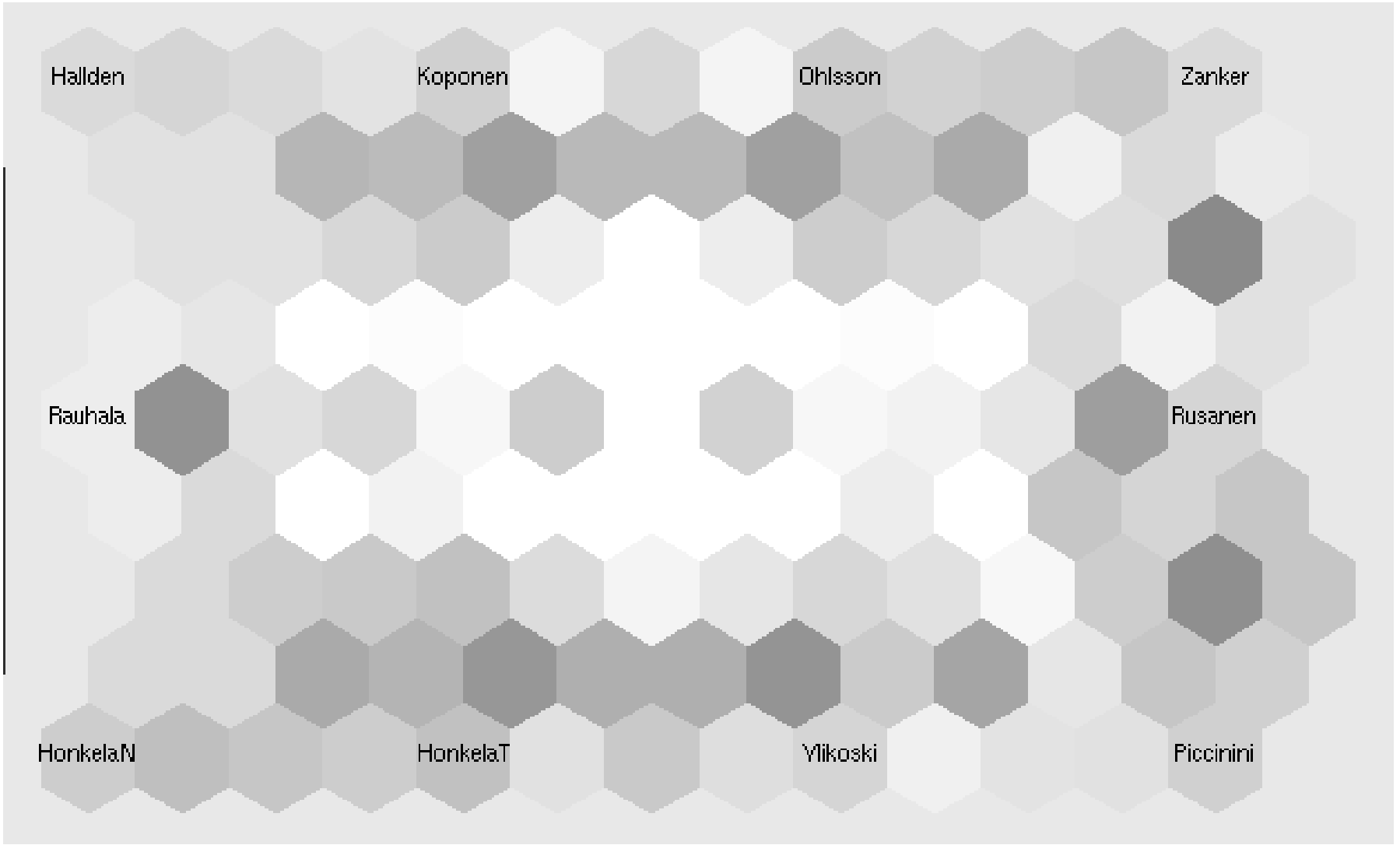
(Lappi & Rusanen)

	Yes	No
* 1. Do concepts exist?	○	○
* 2. Do concepts exist independently of the activity of the human mind?	○	○
* 3. Are concepts inside the heads (brains) of individuals?	○	○
* 4. Are concepts mental representations?	○	○
* 5. Are concepts mental images?	○	○
* 6. Are concepts linguistic representations?	○	○
* 7. Are concepts prototypes or exemplars?	○	○
* 8. Are concepts abstract objects that have no material properties?	○	○
* 9. Are concepts private or subjective – i.e. each person has his or her own concepts which may be more or less similar (but not identical) to those of others?	○	○
* 10. Are concepts public – i.e. can the same concept be shared by more than one individual?	○	○
* 11. Are concepts first and foremost entities that can be used to categorize the world of experience?	○	○
* 12. Are concepts first and foremost entities that can be used refer to entities in the physical world?	○	○
* 13. Are concepts first and foremost entities that make rational thinking about abstract objects possible?	○	○
* 14. Does concept possession for putative natural kind concepts (e.g. having the concept CAT) entail ability to discriminate the object (being able to tell whether something is a cat or not)?	○	○
* 15. Are norms governing the proper application of a concept based on the concept use of the individual?	○	○
* 16. Are norms governing the proper application of a concept based on the concept use of the language community?	○	○
* 17. If a lay person uses a concept of gravity or a concept of energy, is he using the concepts of gravity and energy of physical theory?	○	○

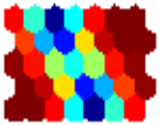
Concept Concept Inventory (2/2)

* 18. If a physical sciences uses a concept of gravity or a concept of energy, is he using the concepts of gravity and energy of physical theory?	○	○
* 19. Does concept possession for abstract concepts (e.g having the concept RECURSION) entail ability to discriminate the object (telling whether a definition or a computational operation is “recursive”)?	○	○
* 20. Are (some) concepts innate?	○	○
* 21. Are (all) concepts culturally transmitted and learned?	○	○
* 22. Are folk concepts qualitatively different from scientific concepts?	○	○
* 23. Is there a gradual continuum between folk concepts and scientific concepts?	○	○
* 24. Are (some) scientific concept such that no single individual can fully grasp them?	○	○
* 25. Do folk concepts form a coherent ontological taxonomy of the world?	○	○
* 26. Is having concepts a uniquely human capability (not found in any other animals)?	○	○
* 27. Is a natural language (Finnish, English, Greek…) necessary for concept possession?	○	○
* 28. Is some type of symbol language (arithmetic using Arabic numerals, Prolog, first order predicate logic…) necessary for concept possession?	○	○
* 29. Are concepts concrete symbols that represent (causal or abstract) relations?	○	○
* 30. Do (all) concepts have internal structure?	○	○
* 31. Must (all) concepts always have conceptual/inferential relations to other concepts? (Or is it possible to possess isolated or fragmented concepts?)	○	○
* 32. Are concepts productive? (I.e. can an endless number of new complex concepts be created from existing concepts, by some operation of concept combination?)	○	○
* 33. Are concepts compositional? (I.e. is the identity of a concept determined “without residue” from its constituent parts and their mode of combination).	○	○
* 34. Are some concepts related a priori?	○	○
* 35. Are all relations among concepts a posteriori – determined empirically?	○	○

Map of People

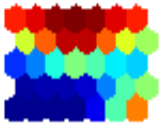


Exist?



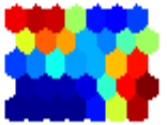
Independently?

Insideheads?

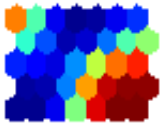


Mentalrepres?

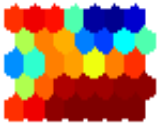
Mentalimages?



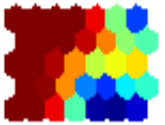
Linguisticrepres?



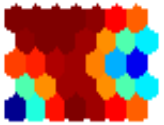
Prototypes?



Abstract?

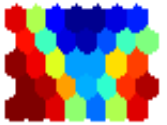


Subjective?

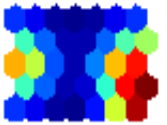


Public?

Categorizing?

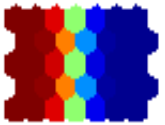


Refering?

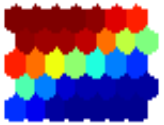


Rational?

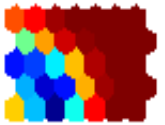
Discrimination?



Individualnorms?

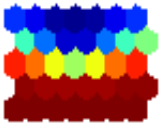


Communitynorms?

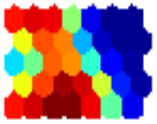


Lay?

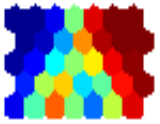
Scientific?



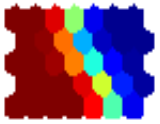
Recursive?



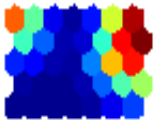
Innate?



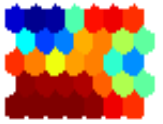
Cultural?



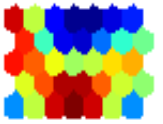
Folk?



Gradual?

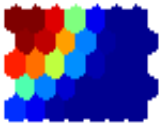


Nosingle?



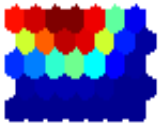
Coherent?

Human?

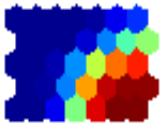


Language?

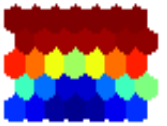
Symbol?



Concrete?



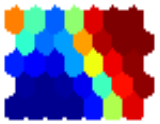
Internalstructure?



Relations?

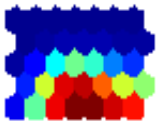
Productive?

Compositional?

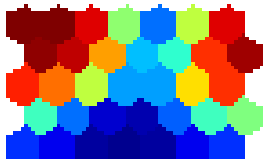


Apriori?

Aposteriori?

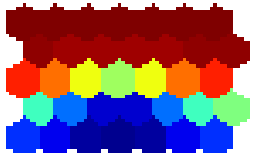


Rational?



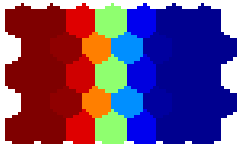
13. Are concepts first and foremost entities that make rational thinking about abstract objects possible?

Internalstructure?



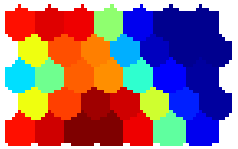
30. Do (all) concepts have internal structure?

Discrimination?



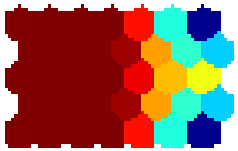
14. Does concept possession for putative natural kind concepts (e.g. having the concept CAT) entail ability to discriminate the object (being able to tell whether something is a cat or not)?

Recursive?



19. Does concept possession for abstract concepts (e.g having the concept RECURSION) entail ability to discriminate the object (telling whether a definition or a computational operation is “recursive”)?

Relations?



31. Must (all) concepts always have conceptual/inferential relations to other concepts? (Or is it possible to possess isolated or fragmented concepts?)

https://elomake.helsinki.fi/lomakkeet/36617/lomake.html