

On Semantic Information in Nature

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Information Universe

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Today most professional historians 'specialize'. Thus armed, they can comfortably down any amateurs who blunder ... into their heavily fortified field To test it, a historian must dare to travel abroad, even in hostile country; to express it he must be ready to write essays on subjects on which he may be ill-equipped to write books

Hugh Trevor Roper, citation in „Vanished Kingdoms“ by Norman Davies)

Meaningful, Semantic Information

Meaning, knowledge, cognition (Bernd-Olaf Küppers) :

- “Meaningful information in an absolute sense does not exist. Information acquires its meaning only in reference to a recipient. Thus, in order to specify the semantics of information one has to take into account the particular state of the recipient at the moment he receives and evaluates the information.” Cognition uses knowledge and creates knowledge.

Meaning has Structure: Syntax, Semantics and Pragmatics (Charles W. Morris) :

- Syntax: rules for sequencing signs and words to form sentences.
- Semantics: relationship between a sign or words to what it is pointing to in reality.
- Pragmatics: rules for applying words and signs in context.

Models of Information

Information / Complexity

- C.E. Shannon
- A. Kolmogorov
- G. Chaitin
- ...

Information Models

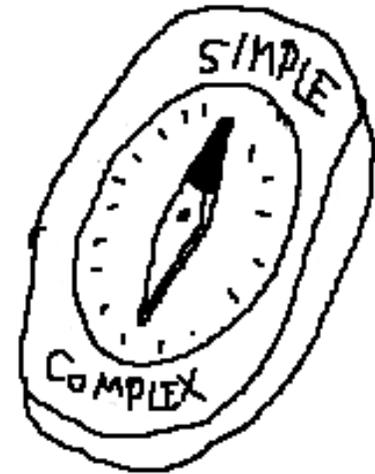
- R. Carnap / Y. Bar-Hillel
- M. Eigen
- C.F. v. Weizsäcker
- W. Hofkirchner
- M. Burgin
- D. Deutsch
- ...
- N. Chomsky
- G. Bateson
- C.W. Morris
- ...

Biological Information

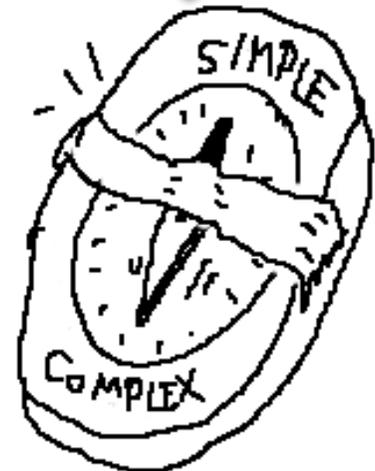
- Ruth G. Millikan
- J. Maynard Smith
- E. Jablonka
- ...
- J. Min
- N. Shea

Semantics

- What is information meaning / semantic
- how came Semantic Information into existence?
- how did Semantic Information develop?



Occam's razor



Semantic Information in Nature

Biological Evolution

- Semantic Information is biological and is exclusively created /used by biological evolution.
- Different branches of evolution possess different semantic information.
- Semantic information varies in each evolutionary branch in its specific limits.

Life

- Semantic information
 - is connected to life – and vice versa.
 - exists exclusively in living organism.
 - includes Shannon Information

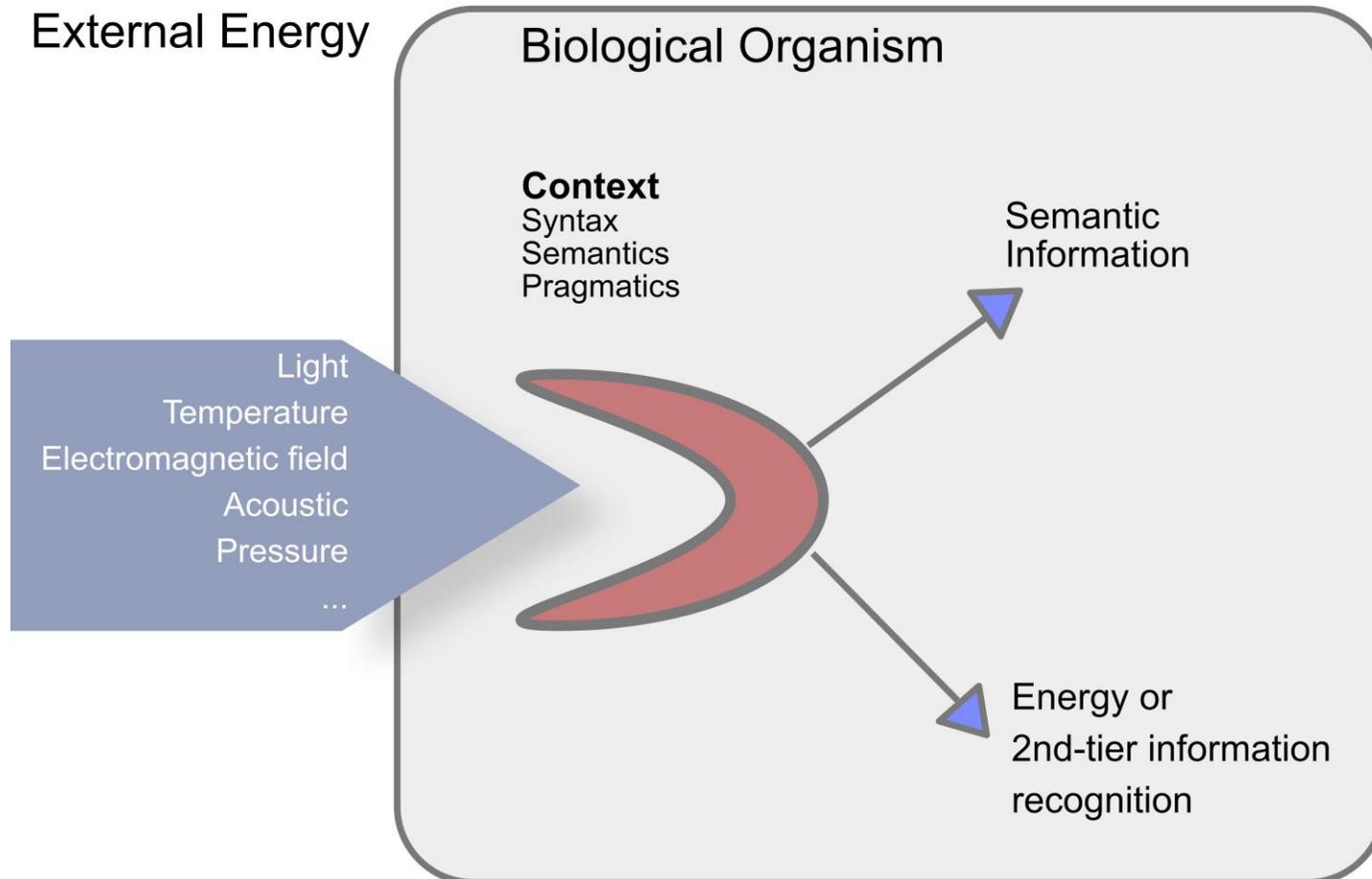
Energy

- Semantic Information is a potential of structured energy.
- Information is a quality of energy - not all energy comes as / with information.
- Biological receiver classify and process received energy as informational.

Information processing of Semantic information

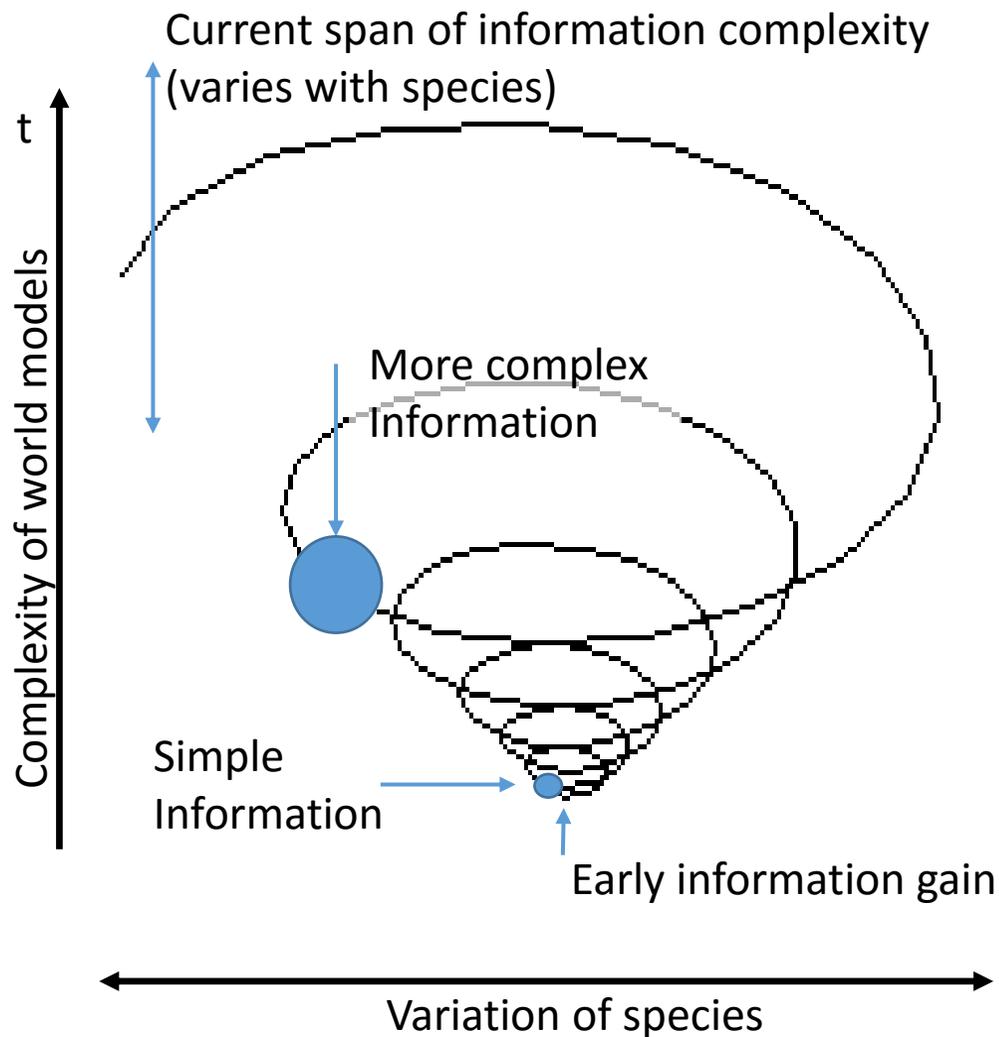
- Narrow sense: a capability which is restricted to biological organisms.
- Broad sense: supported by external artifacts as e.g. computers, abacus, libraries etc..

Transforming Energy into Semantic Information

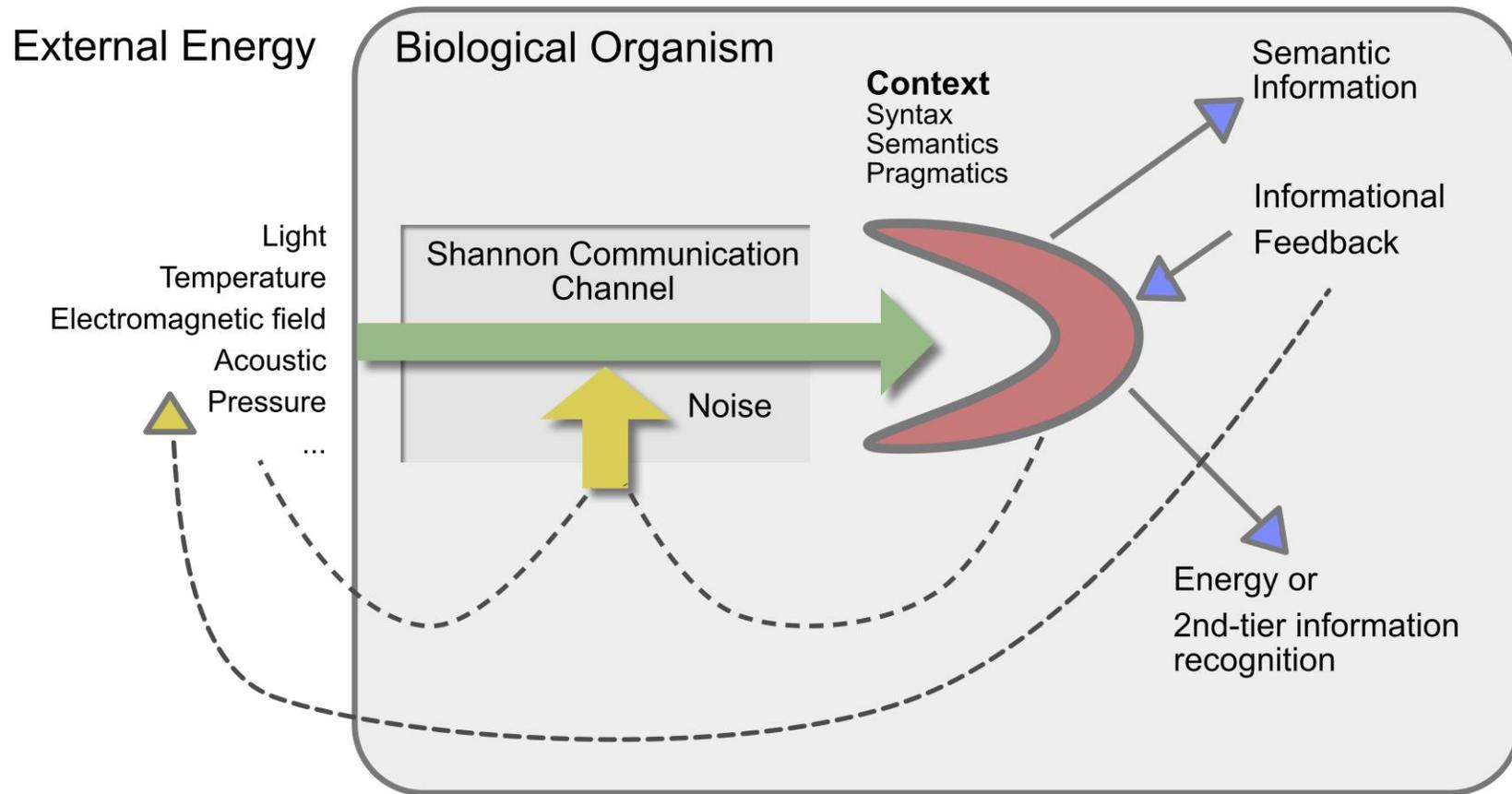


How Semantic Information came into being

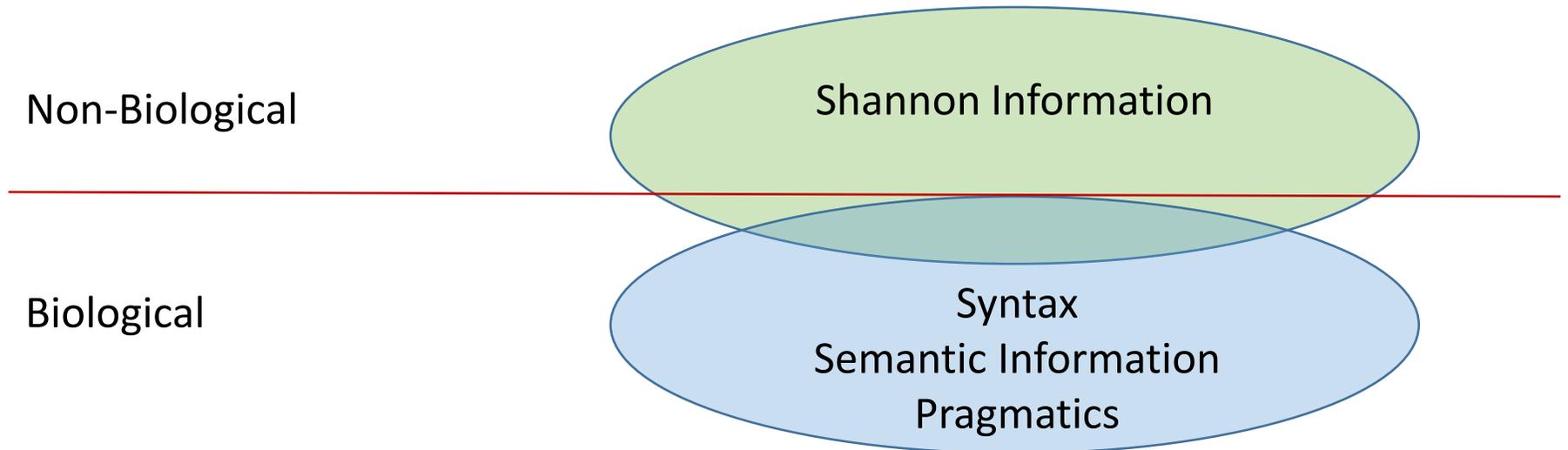
- By Evolution from early on
- In parallel with biological matter
- When
 - ... components of matter optimized and became self-organized (e.g. to obey 2nd Law)
 - ... as part of this process certain energy became more informational than energy supply
 - ... informational processes evolved when evolution developed
 - ... complex energy pattern became information
- Rules for incoming information and energy developed from the beginning
- Matter allows and facilitates processing of ever increasing complex information developed with evolution



A Shannonian View



Shannon Information vs. Semantic Information



Energetic Evolutionary Information Model

Aspects of Reality	Attributes of Information EEIM	
Evolution	1	Semantic Information is exclusively being “produced” by evolution
	2	Semantic Information is a quality of-informational-energy
Energy	3	Semantic Informational energy provides semantic information to accordingly prepared receiver instances
	4	Not all energy is Semantic informational
Semiotics	5	Information is bound to syntax, semantics and pragmatics
	6	Semantic Information requires a sending instance
	7	Semantic Information requires a biological receiver able to interpret incoming information
Biological receptors	8	Interpreting receiving instances for Semantic information are living organisms exclusively
	9	Organisms possess processing capabilities for information according to their place in evolution
Information processing	10	SSP in context is needed to transform received information into new information
	11	Animals are able to process Semantic information
Knowledge	12	Information may potentially be transformed into knowledge
	13	Organisms possess knowledge according their background in evolution
	14	Organisms processing knowledge are able to produce knowledge processing artifacts
Entropy	15	Shannon’s Information Theory allows for the probability of the appearance of signals. It does not cover semantic.

Conclusion

Semantic Information

- ... is not apriori
- ... is exclusively in evolution
- ... is a quality of energy
- ... is not an “it”
- ... is structured (syntax, semantics, pragmatics)
- ... is partly Shannon Information
- ... has been and is a result and a driving force of biological evolution

Evolution creates meaning

Impact on Science / Open questions

- Semantic Information is a conceptual structure of evolution – others will follow
 - e.g. From Spacetime evolution created Space and Time, however Spacetime exists independently
- Experimental verification / falsification

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What is new?

- semantic information has been developed in biological evolution
- syntax, semantics, and pragmatics have been developed in biological evolution
- semantic information is energy
- Information is not an “it”
- Information is a priori

Can it be proven / falsified?

Yes, with a three-component experiment (adopted from Ruth Millikan)

First, find a mechanism which receives a variety of inputs and which does different things on different occasions, depending upon the input. That mechanism is then a candidate to be a consumer mechanism, and the variable items are candidate representations. Now look at the evolutionary function of this putative consumer mechanism, and consider the evolutionary conditions for its operation.

