Emergent structures in the Ontological model of the Lexical Concepts and Constructions

Or: how can some-thing arise from no-such-a-thing?
And what language has to do with it?

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How does the science describe the world?

• Science is a formalized method of researching things and relations that exist in a reality.
How do scientist do it?

• **Analytic paradigm:**
  • Scientist describe a segment of reality in terms of its components.
  • Reduce the complex phenomena into more simple phenomena
    • more stable
    • easier to predict
  • Structural summarization

• **Disciplinary perspectivization**
What are the effects of such a scientific paradigm?

• Every discipline produces its particular ontology:
  • a set of concepts and categories in a subject domain that shows their properties and relations between them

• Ontology is a prerequisite for a coherent **disciplinary research** in any domain

**Advantages**
• Allows for a rich, detailed and structurally coherent description of a domain

**Disadvantages**
• Perspectives often not well interconnected (without bottom-up, top-down causal relations)
• Reductivist
Interlude: Effects of a reductive scientific paradigm

- Every sociologist wants to become a psychologist
- Every psychologist wants to become a biologist
- Every biologist wants to become a physicist
- Every physicist wants to become a mathematician
- Every mathematician wants to become a god

A theory of everything (ToE), final theory, ultimate theory, or master theory is a hypothetical single, all-encompassing, coherent theoretical framework of physics that fully explains and links together all physical aspects of the universe.

Theory of everything formula
How to deal with negative effects of perspectivization / reductionism?

The solution:

• **Meta-ontology** that would combine all the knowledge from particular ontologies.

• **Meta-ontology** is a prerequisite for a coherent inter-disciplinary research.

The problem:

• How many things are there *really*?

• Can we produce a wholesome meta-ontology model that could:

  *describe connections / relations between domains* $A \in B$
  *distinguish emergence of distinct properties* $A \neq B$
The systemic paradigm of Emergence

Latin *emergere* "bring forth, bring to light," intransitively "arise out or up, come forth, come up, come out, rise," from assimilated form of ex "out" (see ex-) + mergere "to dip, sink, :: rising from a liquid by virtue of buoyancy."

What is Emergence / emergent properties?

The notion of emergence, or emergent properties, [is] one of the most important concepts in the modern theory of complexity and, more generally, in the systemic conception of life.

Emergent properties are the novel properties that arise when a higher level of complexity is reached by putting together components of lower complexity.

What is Emergence / emergent properties?

The notion of emergence, or emergent properties, is one of the most important concepts in the modern theory of complexity and, more generally, in the systemic conception of life.

Emergent properties are the novel properties that arise when a higher level of complexity is reached by putting together components of lower complexity.

The properties are novel in the sense that they are not present in the parts: they emerge from the specific relationships and interactions among the parts in the organized ensemble.

Emergence examples

- The solvent properties of water
  neither hydrogen atoms nor oxygen atoms in isolation possesses solvent properties and neither do they possess scaled-down versions of the properties. The solvent action seems to emerge from a non-linear combination of the properties of hydrogen and oxygen.
- Lipids, cell, ant behaviour, nervous system, social systems

Emergent properties

- Product of the synergies between the parts
- Cannot be observed locally in subsystems but only as a global structure
Why should a linguist care about a meta-Ontology?

- Where is a language, or the language in the overall schema of things?
- Does language emerge out of nowhere, biology, culture?
- Is the structure of language (phonemes, morphemes, words, idioms, ...) enough to represent what language is, and what it is for?
- Is meaning a **real thing**? What **kind of a thing**?
- What do we **do** when we speak words?
Uses of a meta-Ontology for a linguistic research?

Holistic description of *lexical concepts* in usage
E Ontological model:

**OMLCC**

- The OMLCC models the knowledge derived from lexical concepts and constructions according to the systemic meta-theory grounded on the ontological relations in the world.

- The epistemology of this meta-description of lexical concepts and their relations assumes that
  - lexical concepts refer to the perceived, experienced and conceptualized things in the material, psychological and social domain.
E Ontological model: Constituents – *Entity & EntityProperty*

**Ontology**

- Entity - 1: fear 2: flight
- EntityProperty – 1: negative, 15km/h]

AFFECT.FEAR{hedonic valence: negative, arousal: high}, PHYSICAL REACTION.FLIGHT{speed: 5-15km/h}

Things (NODES) that constitute the domain are called entities (ENTITY, CLASS, OBJECT, CATEGORIES)

NODES/ENTITIES have PROPERTIES (FEATURES)
Ontology

• Entity
• EntityProperty
• Relation
• RelationProperty

Ontological model: Constituents – **Relation & RelProperty**

Ontology Model

Emergence

Connections between ENTITIES are RELATIONS
RELATION have PROPERTIES (FEATURES)

AFFECT.FEAR{hedonic valence:negative, arousal:aroused}-[:HAS_REACTION{frequency:often}] -> PHYSICAL REACTION.FLIGHT{speed:5-15km/h}
E Ontological model: **Network principle**

**Ontology**
- Entity 1...x
- EntityProperty 1...x
- Relation A...X
- RelationProperty A1...Xx

**Network**

A group of ENTITIES connected by RELATIONS form a NETWORK
A group of ENTITIES connected by stable RELATIONS form a NETWORK that itself can become an ENTITY with PROPERTIES. Network is an emergent ENTITY that can exhibit emergent PROPERTIES not reducible to its constituents.
Ontology

- Entity 1...x
- EntityProperty 1...x
- Relation A...X
- RelationProperty A1...Xx

The Networks can become **new objects** that in recurrent fashion create new self-organizing networks with emergent hierarchy of properties on different levels of complexity and ‘dynamic stability’.

# OMLC – E Ontological Model of Concepts

<table>
<thead>
<tr>
<th>Superclass</th>
<th>Property</th>
<th>Lexical concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>0) Existence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Material</td>
<td>ONT: OBJ</td>
<td>EPIST: OBJ</td>
</tr>
<tr>
<td>2) Psychological</td>
<td>ONT: SUBJ</td>
<td>EPIST: SUBJ</td>
</tr>
<tr>
<td>3) Socio-cultural</td>
<td>ONT: OBJ</td>
<td>EPIST: OBJ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ontology</th>
<th>Emergence</th>
<th>OMLC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>01. Existence</strong></td>
<td>A (Entity) exists</td>
<td></td>
</tr>
<tr>
<td><strong>02. Emergence</strong></td>
<td>A (Form) becomes B (Transformation)</td>
<td></td>
</tr>
<tr>
<td><strong>03. Material Structure</strong></td>
<td>A (Part) 1…n isPartOf B (Whole), B (Whole) hasParts A1…n (Part); MeronymicRelation: {stuff — object, component—(complex) object, member — collection}</td>
<td></td>
</tr>
<tr>
<td><strong>04. Spatial</strong></td>
<td>A(Figure) is_in_spatial_relation_to B(Ground); MeronymicRelation: {place — area}</td>
<td></td>
</tr>
<tr>
<td><strong>05. Force</strong></td>
<td>A(Force Structure) influences (by mechanical / liquid / thermodynamic force) B (Patient); MeronymicRelation: {portion — mass}</td>
<td></td>
</tr>
<tr>
<td><strong>06. Motion</strong></td>
<td>A (Mover) moves propelled by (Force) (on) B (Path/Patient 03-04 ) with (Instrument/ Vehicle 03); MeronymicRelation: {mover — path}</td>
<td></td>
</tr>
<tr>
<td><strong>07. Sequence Activity</strong></td>
<td>A (SequenceActivity Entity) has sequence (3-6); MeronymicRelation: {feature — event}</td>
<td></td>
</tr>
<tr>
<td><strong>08. Information System</strong></td>
<td>A (InformationSystem Animate) {self-sustaining structure, organism} acts/reacts (to) B (Environment 1-8)</td>
<td></td>
</tr>
<tr>
<td><strong>09. Perception</strong></td>
<td>A (Perceiver 8-11) perceives 9 (with_instrument_of_perception 8) B(object of perception 1-8)</td>
<td></td>
</tr>
<tr>
<td><strong>10. Affect</strong></td>
<td>A (Experiencer 8-14) experiences (with_organs_of_affect_experience 8) B (experience / quality / affect state / emotion 10)</td>
<td></td>
</tr>
<tr>
<td><strong>11. Cognition</strong></td>
<td>A (Cogitor 8-14) remembers, reasons, thinks 11 B (Mental_Representation / Categorization / Cognitive Appraisal 11)</td>
<td></td>
</tr>
<tr>
<td><strong>12. SocIdentity</strong></td>
<td>A (Person 8-14) identifies as B (Social Identity 12)</td>
<td></td>
</tr>
<tr>
<td><strong>13. SocBehaviourInteraction</strong></td>
<td>A (Person.Agent 8-14) behaves, performs B (Social interaction/ritual 13) with (Instruments_of_action)</td>
<td></td>
</tr>
<tr>
<td><strong>14. SocCommunication</strong></td>
<td>A (SocCulturalCommunicator 8-14) communicates with B (Reciever 8-14) about C (theme 1-14) on D (conventionalized code)</td>
<td></td>
</tr>
<tr>
<td><strong>15. SocCulturalInstitution</strong></td>
<td>A (SocCulturalInstitution) is set of conventionalized (B Convention) and institutionalized (C institution) norms (D norms) expressed in communication, interaction, behaviour and identity, maintained by the socially distributed institutional power (E social power), mandated by some cultural model of representation</td>
<td></td>
</tr>
<tr>
<td><strong>16. CulturalModel</strong></td>
<td>A (Cultural Model) is a set of values connected with material structures, experience, social events and rituals, narration, belief systems, individual and social values, institutions shared by agents/members of the Social community in some locality (Locality B) and in some historical span (Historic span C)</td>
<td></td>
</tr>
</tbody>
</table>
Ontology as a graph: Everything is related by multiple relations
Existing ontologies: Wikidata - knowledge base
## Wikidata: List of relations (properties)

[https://www.wikidata.org/wiki/Wikidata:Database_reports/List_of_properties/all](https://www.wikidata.org/wiki/Wikidata:Database_reports/List_of_properties/all)

<table>
<thead>
<tr>
<th>P18</th>
<th>image</th>
<th>portrait, illustration, picture, drawing, photo</th>
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<tbody>
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<tr>
<td>P20</td>
<td>place of death</td>
<td>died in, death place, POD, location of death, death location, deathplace, deathplace</td>
<td>wikibase-item</td>
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</tr>
<tr>
<td>P21</td>
<td>sex or gender</td>
<td>sexual identity of subject: male (Q561097), female (Q561072), intersex (Q1057630), transgender female (Q1052281), transgender male (Q24262393). Animals: male animal (Q44148), female animal (Q434445). Groups of same gender use “subclass of” (P279)</td>
<td>wikibase-item</td>
<td>3,342,088</td>
</tr>
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<td>P22</td>
<td>father</td>
<td>dad, has father, man, the parent of that person, parent, daddy, papa, is son of, is child of, is daughter of, dad, has father, man, the parent of that person, parent, daddy, papa, is son of, is child of, is daughter of</td>
<td>wikibase-item</td>
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<tr>
<td>P25</td>
<td>mother</td>
<td>mum, mom, mam, has mother, parent, parent, is son of, is child of</td>
<td>wikibase-item</td>
<td>31,268</td>
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<tr>
<td>P26</td>
<td>spouse</td>
<td>husband, wife, married to, consort, partner many, marriage partner married, wedded to, wed</td>
<td>wikibase-item</td>
<td>70,402</td>
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</tbody>
</table>
Existing ontologies: BigFatOntoBase- DBpedia

About: Fear

An Entity of Type: Artifact100021939, from Named Graph: http://dbpedia.org, within Data Space: dbpedia.org

Fear is a feeling induced by perceived danger or threat that occurs in certain types of organisms, which causes a change in metabolic and organ functions and ultimately a change in behavior, such as fleeing, hiding or freezing from perceived traumatic events. Fear in human beings may occur in response to a specific stimulus occurring in the present, or in anticipation or expectation of a future threat perceived as a risk to body or life.
Existing ontologies: OntoMonster1 - ConceptNet5

ConceptNet is a multilingual knowledge base, representing words and phrases that people use and the common-sense relationships between them. The knowledge in ConceptNet is collected from a variety of resources, including crowd-sourced resources (such as Wiktionary and Open Mind Common Sense), games with a purpose (such as Verbosity and nadya.jp), and expert-created resources (such as WordNet and JMDict).
Existing Ontologies: Sci Lean – Emotion ontology MFOEM

- **IRI:** http://purl.obolibrary.org/obo/mfoem.owl
- **OBO Foundry:** Library
- **Download:** http://purl.obolibrary.org/obo/mfoem.owl
- **Home:** https://github.com/jannahastings/emotion-ontology
- **Contact:** jannah.hastings@gmail.com
- **Description:** An ontology of affective phenomena such as emotions, moods, appraisals and subjective feelings.

**Annotations**

- **comment:** The Emotion Ontology is an ontology for affective phenomena such as emotions and moods. It is being developed collaboratively between the Swiss Centre of Affective Sciences and the University at Buffalo. It builds on the Ontology of Mental Functioning (MFO) and the Basic Formal Ontology (BFO). The latest version of the ontology can always be found at http://code.google.com/p/emotion-ontology/source/browse/#svn%2Ftrunk%2Fontology.
- **contributor:** Barry Smith, Janna Hastings, Kevin Mulligan
- **title:** Emotion Ontology
- **versionInfo:** beta 2013-07-23
- **label:** The Emotion Ontology is an ontology for affective phenomena such as emotions and moods. It is being developed collaboratively between the Swiss Centre of Affective Sciences and the University at Buffalo. It builds on the Ontology of Mental Functioning (MFO) and the Basic Formal Ontology (BFO). The latest version of the ontology can always be found at http://code.google.com/p/emotion-ontology/source/browse/#svn%2Ftrunk%2Fontology.

**Number of Terms (including imported terms)** [Detailed Statistics]

- **Class:** 698
- **ObjectProperty:** 29
- **AnnotationProperty:** 81
- **Instance:** 18
Marco’s heart started to race.
OMLCC: Stored in a Neo4j graph database
Graph schema of Entities expresses POS perspectivization

**Ontology**
- Entity/Category → Nominal, Numbers, Pronouns
- EntityProperty → Adjectival
- Relation/Process → Verbal
- RelationProperty → Adverbial, Prepositions

**Morpho-syntactic coding**
- Entity 1
  - Property
  - Relation A
- Entity 2
  - Property
  - Relation X Property

**Example Text**: Little Marco easily conquered great fear.
Emergent properties of language translating properties and relations into nodes!

Little **ADJECTIVE** Marco **NOUN1** easily **ADVERB** conquered **PROCESS** great **ADJECTIVE** fear **NOUN1**
Uses of a OMLCC for figurative language research?

formalizing literal (classification, meronymic) from figurative (metaphoric) usage in lexical constructions

Fear is an emotion.
Classification (CATEGORIZATION)
Fear of snakes involves biological reaction of flight or flight.
meronomy (profiling a PART FROM THE WHOLE)
My heart pounded from fear.
metonymy {PART FOR WHOLE}
His legs were shaky for a while.
metonymy {PART FOR WHOLE}

Fear is a great enemy.
metaphor {A ISnot B but map properties of B onto A}
Metaphor is violation of meronymic ontological relation

**Ontology**
- Entity
- EntityProperty
- Relation/Process
- RelationProperty

**Morpho-syntactic coding**
- Nominal, Numbers, Pronouns
- Adjectival
- Verbal
- Adverbial, Prepositions

Little **ADJECTIVE** Marco **NOUN1** easily **ADVERB** conquered **PROCESS** great **ADJECTIVE** fear **NOUN1**

Entity1 {Property 1} – [:RELATION A{Property 1...x}] -> Entity 2 {Property 2}

OMLCC : Identification of metaphors
OMLCC- Verb+Target Noun (Emotion)
# MFOEM - Ontological model of emotions METAPHORS

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>TARGET</th>
<th>GramRel</th>
<th>OntRelation</th>
<th>Freq</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>strah</td>
<td>velik</td>
<td>a_modifer</td>
<td>ont.violation.EMOTION.FEAR ISnot OBJECT that has SIZE.BIG. BIG FOR APPRAISAL.RELEVANCE</td>
<td>2077</td>
<td>Veliki strah</td>
</tr>
<tr>
<td>strah</td>
<td>ostati</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot MOVER that STAY. STAY FOR APPRAISAL.COPING POWER-/CONTROL-</td>
<td>711</td>
<td>Stoljetni strah ostao je nepromijenjen</td>
</tr>
<tr>
<td>strah</td>
<td>trebati</td>
<td>gl_post</td>
<td>ont.violation.LOVE ISnot AGENT that NEEDs X.</td>
<td>703</td>
<td>STRAH TREBA NESTATI</td>
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<tr>
<td>strah</td>
<td>kazati</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot COMMUNICATOR that SAY.</td>
<td>559</td>
<td>U vezi primanja strah kaže</td>
</tr>
<tr>
<td>strah</td>
<td>raditi</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot AGENT that DOes X. DO FOR APPRAISAL.IMPLICATION, COPING, NORMATIVE. X FOR REACTION</td>
<td>528</td>
<td>strah radi svoje</td>
</tr>
<tr>
<td>strah</td>
<td>postojati</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot OBJECT that EXISTS. EXIST FOR CATEGORIZE</td>
<td>445</td>
<td>strah postoji</td>
</tr>
<tr>
<td>strah</td>
<td>nestati</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot OBJECT that is DISAPEAR DISAPEAR FOR RELEVANCE. NOT REQUIRING ATTENTION</td>
<td>377</td>
<td>Strah je nestao</td>
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<tr>
<td>strah</td>
<td>govoriti</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot AGENT.COMMUNICATOR that SPEAKs X. SPEAK FOR APPRAISAL.COPING.CONTROL. X FOR REACTION</td>
<td>376</td>
<td>Strah je govorio njegovom razumu da se okrene i vrati natrag u sigurnost krda</td>
</tr>
<tr>
<td>strah</td>
<td>dobiti</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot AGENT that GETS X OBJECT.PART. GET for COMPONENTIALITY. X FOR REACTION</td>
<td>352</td>
<td>i da su moji strahovi dobili zamah zbog nevjere</td>
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<tr>
<td>strah</td>
<td>dolaziti</td>
<td>gl_post</td>
<td>ont.violation.FEAR ISnot MOVER that COMEs. COME FOR APPRAISAL.COPING. CONTROL/POWER</td>
<td>350</td>
<td>Strah dolazi , kao i sve prvobitno , iz sna i iz sanjanja</td>
</tr>
<tr>
<td>strah</td>
<td>otići</td>
<td>gl_post</td>
<td>ont.violation.SADNESS ISnot AGENT.MOVER that GOes. GO FOR APPRAISAL.COPING EXPERIENCER POWER+/CONTROL+</td>
<td>305</td>
<td>kada strah ode</td>
</tr>
</tbody>
</table>
MFOEM - Ontological model of emotions $ME^{(R)}_{(T)}$ONYMY

**Attributes**
- id: strah
- degree: 75
- hierarchy: 10.Affect.Emotion
- indegree: 47
- outdegree: 20
- weighted degree: 14739.0
- weighted indegree: 5477.0
- weighted outdegree: 9262.0

**Inbound Links from:**
- azrokovati – strah, Hierarchy/Frame 10.Affect.Emotion, GramRelation: is_obj, TypeOfRelation: ont.meronymy.FEAR is AFFECT.EMOTION that is CAUSED. CAUSE FOR APPRAISAL IMPLICATION CAUSALITY; EMOTION MODEL; Figuratives: metonymy, Example: – 1.65 [53]
- izazvati – strah, Hierarchy/Frame 10.Affect.Emotion, GramRelation: is_obj, TypeOfRelation: ont.meronymy.FEAR is AFFECT PROCESS that is CAUSED, Figuratives: metonymy, Example: izazvati strah (19%), Score: 5.95 [330]
- izazvati – strah, Hierarchy/Frame 10.Affect.Emotion, GramRelation: is_obj, TypeOfRelation: ont.meronymy.FEAR is AFFECT PROCESS that is CAUSED. Figuratives: metonymy, Example: izazvati strah, Score: 4.89 [239]
- vidjeti – strah, Hierarchy/Frame 10.Affect.Emotion, GramRelation: is_obj, TypeOfRelation: ont.meronymy.FEAR is AFFECT has REACTION that is SEEN., Figuratives: metonymy, Example: vidjeti strah, Score: 1.45 [119]
- djeti – strah, Hierarchy/Frame 10.Affect.Emotion, GramRelation: is_obj, TypeOfRelation: ont.relation.FEAR IS NOT OBJECT.WHOLE that is SHARED in OBJECT.PART, SHARE for EMOTIONAL COGNITION, Figuratives: metaphor, Example: Djeti minoge program, strahove, osjetiže lijede., Score: 2.87 [51]
MFOEM - Ontological model of emotions $\text{ME}_{[R]}^{(T)}\text{ONYMY}$

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>strah</td>
<td>moći</td>
<td>gl_post</td>
<td>meronymy.FEAR is REPRESENTATION that CAN x. CAN FOR RELEVANCE.PREDICTABILITY</td>
<td>4294</td>
<td>Eto kako strah može biti i izvrstan motivator</td>
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<tr>
<td>strah</td>
<td>bez</td>
<td>prec_prep</td>
<td>meronymy.FEAR IsPartOf x. X FOR SOC_BEHAVIOUR</td>
<td>686</td>
<td>bez straha (18%)</td>
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<tr>
<td>strah</td>
<td>osjećati</td>
<td>is_obj4</td>
<td>meronymy.FEAR is EMOTION that EXPERIENCER FEELS</td>
<td>590</td>
<td>On osjeća strah</td>
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<tr>
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<td>početi</td>
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<td>meronymy.FEAR IS AFFECT PROCESS that has START/STOP sequence.</td>
<td>526</td>
<td>Strah je već počeo prelaziti</td>
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<td>meronymy.FEAR is EMOTION that is perceived that can be PAINfull.</td>
<td>374</td>
<td>Jer , ako kasniš samo pet minuta srce mi je u dlanu i moja me ljubav ili možda strah boli .</td>
</tr>
<tr>
<td>strah</td>
<td>izazvati</td>
<td>is_obj4</td>
<td>meronymy.FEAR is AFFECT PROCESS that is CAUSED.</td>
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<td>izazvati strah</td>
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<td>strah</td>
<td>izazivati</td>
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<td>meronymy.FEAR is AFFECT PROCESS that is CAUSED.</td>
<td>214</td>
<td>Strah izaziva sve ono</td>
</tr>
</tbody>
</table>

**Figurative language**
Conclusion

The emergence based ontological model of lexical concepts and constructions (OMLCC) :

- enables **description of lexical concepts and linguistic usage in ontology of things**
- describes metonymic profiling as a function of meronymic relations in the world
- **formalizes identification of metaphoric constructions** and other types of figurative speech, (compare cross-culturally metaphorical networks) as VIOLATION of meronymic relations activated by constructions
- **reveals dynamics between different levels of emergent properties**