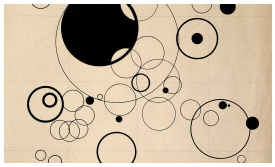
Peter Gärdenfors

REASONING WITH CONCEPTS

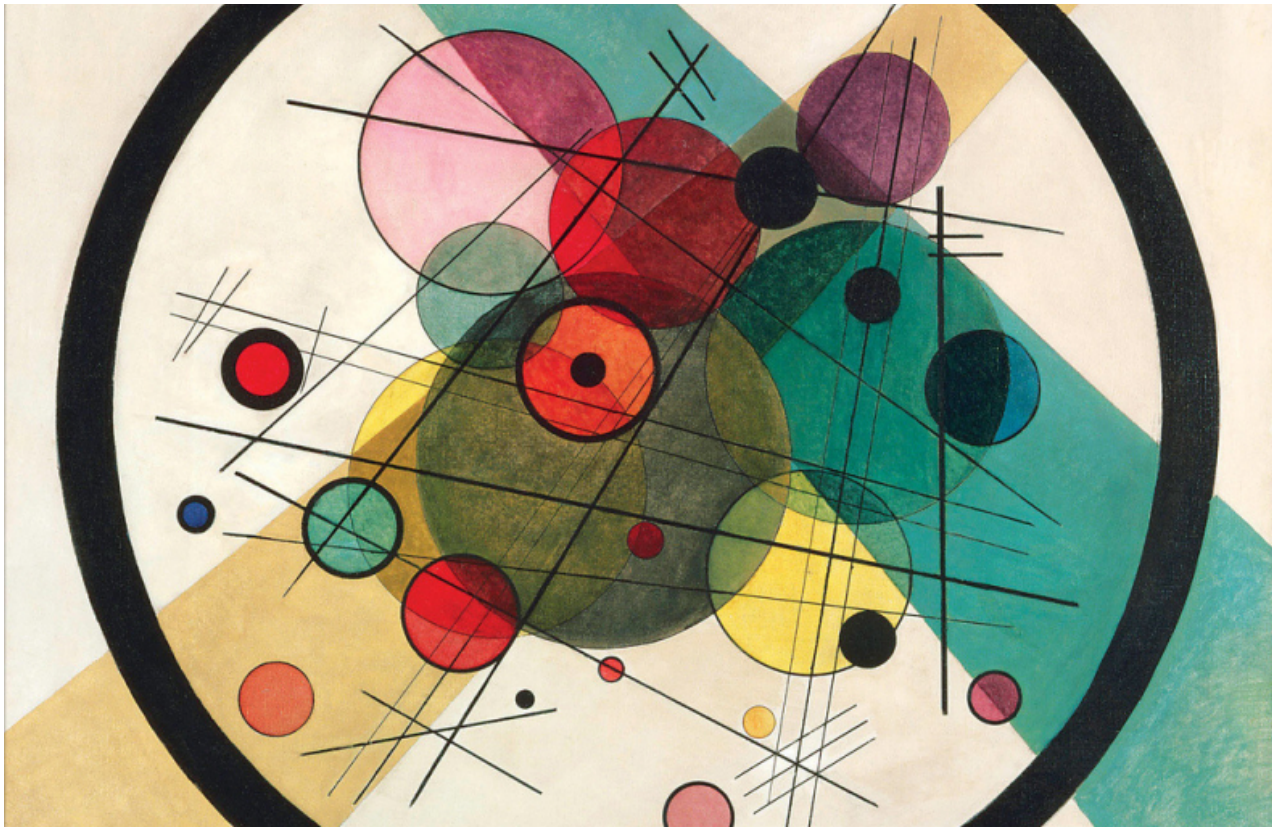
A ROBOT MODEL OF INNER SPEECH BASED ON CONCEPTUAL SPACES
ANTONIO CHELLA



A COMPUTATIONAL MODEL OF CONCEPTUAL HETEROGENEITY AND CATEGORIZATION WITH CONCEPTUAL SPACES
ANTONIO LIETO

TOPOLOGICAL ASPECTS OF THE PSYCHEDELIC EXPERIENCE
BARTEK SKOWRON

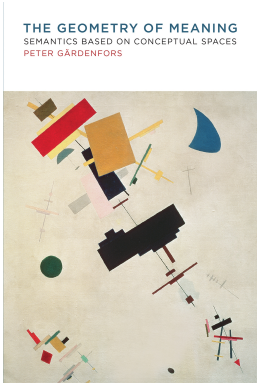
NEWSLETTER



Workshop Con Spa @Work at Warsaw University of Technology

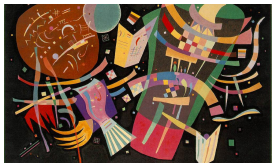
We are pleased to announce the new edition of the workshop Conceptual Spaces at Work, which will take place at the Warsaw University of Technology on 1 and 2 June 2023.

The workshop will continue an interrupted tradition of meetings on conceptual spaces, previously held in Lund in 2012, Stockholm in 2016 and Palermo in 2018.



CONCEPTUAL SPACES: NORMATIVE AND DESCRIPTIVE ASPECTS
CORINA STRÖßNER

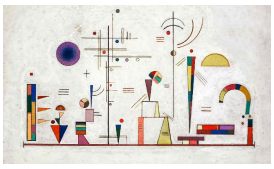
THE LEARNABILITY OF NATURAL CONCEPTS
IGOR DOUVEN



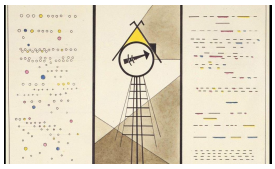
TBD
LUCAS BECHBERGER

FORMALITY, CONCEPTS, AND LEXICAL ENTAILMENT
MATÍAS OSTA-VÉLEZ

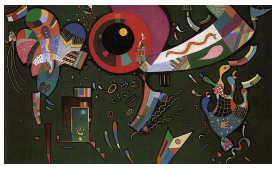
CONCEPTUAL PROGRESS IN SCIENCE: A CONCEPTUAL SPACE APPROACH
MATTEO DE BENEDETTO



STILL A PLEA FOR AN OPTIMAL DESIGN OF CONCEPTUAL SPACES?!
NASIM MAHOOZI



INVARIANCE AND THE NUMBER CONCEPT
PAULA QUINON



ON THE PLACE OF TOPOLOGY IN THE THEORY OF CONCEPTUAL SPACES
THOMAS MORMANN

Venue: Politechnika Warszawska, Plac Politechniki 1, room 206 (up the stairs to the second level and to the left, round the internal court)

Virtual venue (via Zoom):
Thursday June 1st Meeting ID: 996 4086 6765 Access code: 304284

https://zoom.us/j/99640866765?pwd=M3AwYml6Z2NiYohBaFI3WkpMS1VMdz09

Friday June 2nd Meeting ID: 914 4769 9238 Access code: 679976

https://zoom.us/j/91447699238?pwd=bWozUFRJNFhhQmFYTnpNR1V1eThFUT09

Program:

Thursday June 1st
9.30 – 9.45 Welcome from Paula Quinon and Peter Gärdenfors and coffee
9.45 – 10.45 Peter Gärdenfors (in person)
10.45 – 11.00 Coffee Break
11.00 – 12.00 Antonio Chella (virtually)
12.00 – 12.05 Coffee Refill
12.05 – 13.05 Corina Strößner (virtually)
13.05 – 14.30 Lunch
14.30 – 15.30 Igor Douven (in person)
15,45 – 16.00 Coffee Break
16.00 – 17.00 Matías Osta-Vélez (in person)
17.00 – 18.00 Nasim Mahoozi (virtually)

Friday June 2nd
9.15 – 9.30 Coffee
9.30 – 10.30 Lucas Bechberger (virtually)
10.30 – 11.30 Antonio Lieto (virtually)
11.30 – 11.45 Coffee Break
11.45 – 12.45 Thomas Mormann (virtually)
12.50 – 14.30 Lunch
14.30 – 15.30 Bartłomiej Skowron (in person)
15,45 – 16.00 Coffee Break
16.00 – 17.00 Matteo de Benedetto (in person)
17.00 – 18.00 Paula Quinon (in person)

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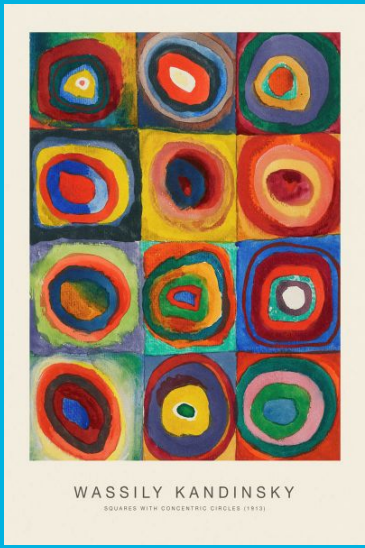


Abstracts

Antonio Chella

A Robot model of Inner Speech based on Conceptual Spaces

The talk will discuss the modeling of inner speech by conceptual spaces. Inner speech plays a central role in our daily lives. A person thinks over her perspectives, mental states, external events, and emotions by producing thoughts in sentences. Talking to herself allows one to pay attention to internal and external resources, learn and store new information, retrieve known facts, control and regulate behavior, and simplify demanding cognitive processes. Inner speech allows the creation of the structure of the perception of the external world and the self by enabling high-level cognition, self-attention, self-control, and self-regulation. The talk will discuss a computational model of inner speech based on conceptual spaces and show some preliminary examples of robot inner speech.

Antonio Lieto

A Computational Model of Conceptual Heterogeneity and Categorization with Conceptual Spaces

I will present the rationale followed for the conceptualization and the following development the Dual PECCS system that relies on the cognitively grounded heterogeneous proxytypes representational hypothesis [Lieto 2014].

Talks by

Antonio Chella
Antonio Lieto
Bartłomiej Skowron
Corina Strößner
Igor Douven
Lucas Bechberger
Matías Osta-Vélez
Matteo de Benedetto
Nasim Mahoozi
Paula Quinon
Peter Gärdenfors
Thomas Mormann

Such hypothesis allows integrating exemplars and prototype theories of categorization as well as theory-theory [Lieto 2019] and has provided useful insights in the context of cognitive modelling for what concerns the typicality effects in categorization. As argued in [Lieto et al., 2018b] a pivotal role in this respect is played by the use of the conceptual spaces framework and by its integration with a symbolic knowledge representation layer.

Lieto, Antonio, Daniele P. Radicioni, and Valentina Rho. "Dual PECCS: a cognitive system for conceptual representation and categorization." Journal of Experimental & Theoretical Artificial Intelligence 29, no. 2 (2017): 433-452.

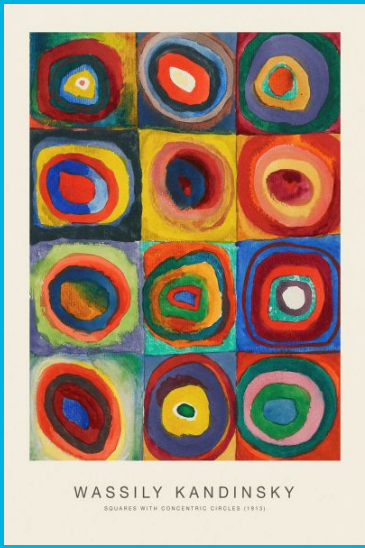
Lieto, Antonio. "A computational framework for concept representation in cognitive systems and architectures: Concepts as heterogeneous proxytypes." Procedia Computer Science 41 (2014): 6-14.

Lieto, Antonio, Christian Lebiere, and Alessandro Oltramari. "The knowledge level in cognitive architectures: Current limitations and possible developments." Cognitive Systems Research 48 (2018): 39-55.

Bartłomiej Skowron

Topological aspects of the psychedelic experience

The psychedelic experience, i.e., the experience after the use of LSD or psilocybin, among others, is one of the most colorful and content-rich experiences given to man - hence it is not surprising that for several years now, despite an unfavorable legal and political aura, there has been a renaissance of research into the uses of psychedelics. Psychedelic consciousness, located somewhere between the natural waking state and the unconscious, expands and unifies with the world. The boundaries between self and non-self disappear. These experiences significantly affect a person's conceptual space. In particular, it is indicated that concepts lose their edges and seamlessly overlap. Connections appear in consciousness between regions of subjective experience (as well as regions of the brain) that previously had nothing to do with each other but now turn out to be connected by multiple threads. Nevertheless, the liquefaction of conceptual structure, the increasingly difficult categorization of concepts, and the weakening ability to differentiate concepts are estimated to be the cognitive cost of this experience. That is, they constitute a kind of functional cognitive loss.



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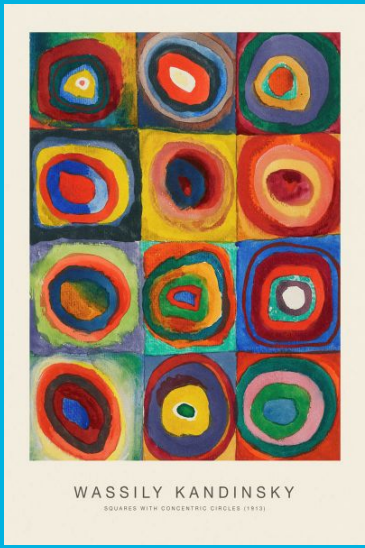
Despite significant perceptual enrichment, the experience of strongly unfocused attention causes standardly understood information to get lost, as it were, in conceptual disorganization and disorder. In the paper, I will topologically justify the thesis that this disorder can be regarded as a phase of the cognitive process that prevents excessive cognitive rigidity and, in philosophy, dogmatism.

Corina Strößner
Conceptual spaces: normative and descriptive aspects

Conceptual spaces are a frequently applied framework of representing conceptual content. One of the central aims of using them is to determine what makes a concept natural. The notion of natural concepts seems to combine normative rational aspects (their relation to induction, optimal payoff between frugality and informativity, ontological appropriateness etc.) as well as rather descriptive ones (learned easily, lexicalized in natural language etc.). Generally, conceptual spaces have been used in dominantly descriptive but also in normative research. In this respect, we might call them a hybrid framework. In this respect, they are somewhat similar to Bayesianism, which is a paradigmatic example of a hybrid approach, that is an approach with an interplay between empirical and normative claims (joint work with U. Hahn). In the talk, I will first discuss hybrid frameworks on a general level. In the second part of the talk, I will place conceptual spaces in this discussion, debating the extend to which they are used to formulate normative claims as well as descriptive one and how these two relate.

Igor Douven
The learnability of natural concepts

According to a recent proposal, natural concepts are represented by the cells of an optimally designed similarity space. In this proposal, optimality is a matter of satisfying principles that a good engineer would follow if tasked with designing a conceptual system for creatures with our perceptual and cognitive capacities. One of these principles is that natural concepts should be easily learnable. While there is evidence for various parts of the optimal design proposal, there is so far no evidence directly linking naturalness to learning. I look at various computational models of learning known from artificial intelligence and machine learning and



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apply them to run simulations in perceptual color space. The results from the simulations will be seen to indicate that naturalness indeed facilitates learning.

Lucas Bechberger
Using Conceptual Spaces for Artificial Intelligence

sssIf we want to implement an artificial intelligent agent based on the framework of conceptual spaces, at least three important questions need to be addressed:

1.) How can conceptual regions be defined in a parametrizable way, which lends itself to an actual implementation in software?

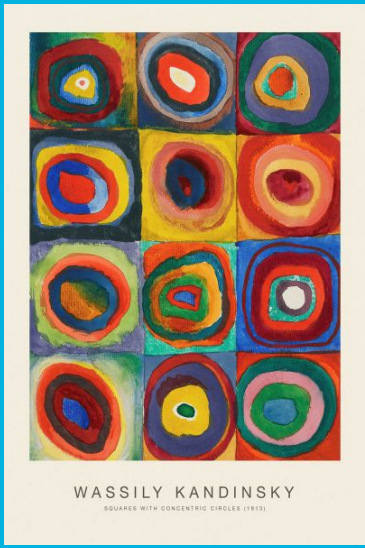
2.) How can we map raw sensory input (e.g. camera images) into low-dimensional, interpretable similarity spaces?

3.) How can we learn conceptual regions based on both empirical evidence (bottom-up information) and knowledge-based constraints (top-down information)?

My talk summarizes the main contributions of my PhD research with respect to these three challenges: First, I will describe a thorough mathematical formalization of conceptual spaces based on fuzzy star-shaped sets. Then, I will present a hybrid approach, which grounds conceptual domains both in psychological (dis)similarity ratings and in deep neural networks. Finally, I will sketch how one can learn conceptual regions under knowledge-based constraints with logic tensor networks.

Matías Osta-Vélez
Variability, Correlations and Conceptual Coherence

Research in cognitive psychology shows that the usefulness and inductive power of concepts can fluctuate, and this is typically attributed to the differing degrees of 'coherence' that concepts might have. However, the notion of 'coherence' lacks a clear definition in the literature. I will advance a comprehensive explanation of what conceptual coherence entails, and propose a measure that combines ideas from conceptual spaces and principal component analysis. I will also discuss the interconnections among coherence, uncertainty, and induction.



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Matteo de Benedetto

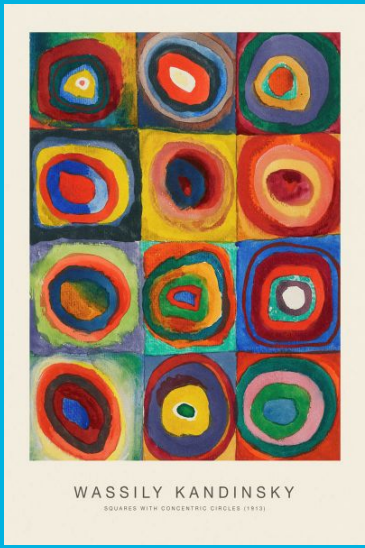
Conceptual Progress in Science: A conceptual space approach

Several episodes of progress in the history of science seem to involve a conceptual kind of progress, according to which a certain (set of) concept(s) constitutes a functional improvement in comparison to its predecessors in terms of the inferences that it allows scientists to make. Several accounts of conceptual progress in science have been proposed in the literature (e.g., Laudan 1978, Kitcher 1995, Brigandt 2011), but not much effort has been put into formally modeling this notion. In this talk, I will propose a formal model of conceptual progress in science that understands it as a kind of approximation to a pragmatically optimal (part of a) conceptual structure. My model will build upon conceptual spaces theory and its rich representation of concepts in order to geometrically characterize this approximation-understanding of conceptual progress. In order to substantiate my model, I will apply it to some paradigmatic episodes of conceptual progress from the history of life sciences and psychology.

Nasim Mahoozi

Still a plea for an optimal design of conceptual spaces?!

According to the conceptual space approach, concepts can be represented as convex regions in geometrical-topological similarity spaces. The main focus has been on the geometrical structure of the conceptual spaces. In this talk, following Mormann, I will consider a particular topological structure, i.e. concepts are represented in a conceptual space that is topologically structured. The conceptual spaces approach has had huge empirical support in cognitive psychology. Nevertheless, even the design constraints proposed by Douven&Gärdenfors (2020) to optimize the conceptual design has been subject to apparently serious criticisms. I will consider some of these criticisms and will argue that a suitable topological design of the conceptual spaces may provide good answers to the criticisms. I will categorize the criticisms into uniqueness problem according to which there is no unique way of choosing a metric and problems regarding the principle constraints on a conceptual system, such as convexity criterion and well-formedness. Then, focusing on vague concepts, I will show that the optimized geometrical-topological conceptual spaces are not sufficient to encompass the perplexity of



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vagueness. So, the search for an optimized conceptual system should be continued.

Paula Quinon
Invariance and the number concept

This talk is based on a paper in collaboration with Peter Gärdenfors.

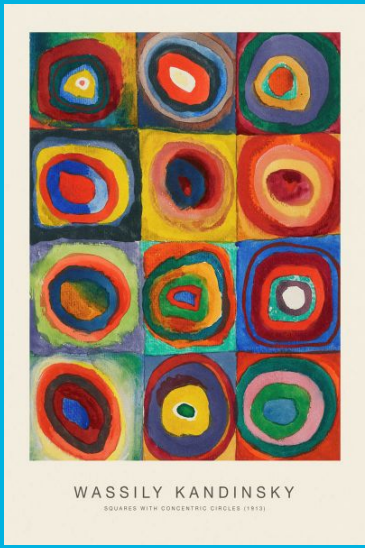
Cognitive scientists Spelke and Kintzler (2007) and Carey (2009) propose objects, actions, space, and numbers as "core domains of knowledge" that underpin the framework of concepts people use to describe and communicate about the world. Gärdenfors (2019, 2020) argues that people make sense of domains by appealing to various types of invariances in sensory signals. In this paper, we aim to extend the analysis of invariances to the domain of numbers.

As a theoretical background, we assume that numbers are properties of collections (Simons 1982, 2007, 2011; Johansson 2015; Angere 2014). We observe that the domain of number is determined by two types of invariances. First, the concept of collection itself depends on being invariant under the location of its objects. Second, the determinant invariance of the domain of number is the fungibility of objects: If an object in a collection is exchanged for another object, the collection will still contain the same number of objects. It will be shown that fungibility is closely related to one-to-one correspondence.

We first introduce the concept of a collection and show how it differs from the concept of a set. We then present the invariance of the location of objects that applies to collections, and we introduce fungibility as a second type of invariance. We illustrate our theoretical analysis with empirical material.

Peter Gärdenfors
Reasoning with concepts

This talk presents joint work with Matías Osta Vélez. We propose a unified theory based on conceptual spaces of how human reason with concepts. We cover expectations, case-based induction, generics and analogies. These areas have been studied empirically within psychology, but their relations have not been investigated. We show that by using notions such as similarity, prototypes, typicality and diagnosticity, we can provide unifying model. All these notions can be defined in terms of conceptual space.



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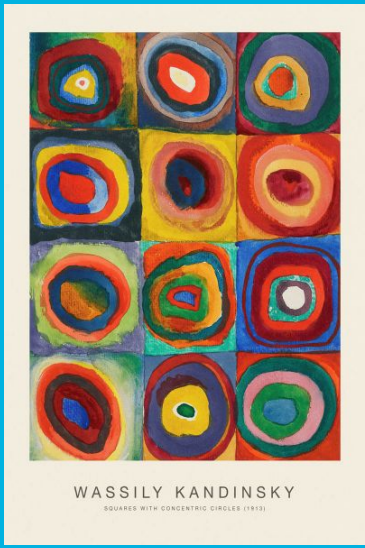
Thomas Mormann

On the Place of Topology in the Theory of Conceptual Spaces

The theory of conceptual spaces (CS) may be characterized in a quite general sense as a topological approach in so far as its criteria for (natural) concepts are based on “topological and geometrical notions such as connectedness and convexity” (Gärdenfors). The aim of my talk is to render this characterization more precise. I want to show that topological concepts in a very precise sense play a central role for the theory of CS. For this purpose, first it is shown that topology and the theory of convexity may be considered as two closely related specializations of a more general theory that can be described as the theory of “protopology”. This general theory can be intuitively characterized as a general theory of “closure operators” or “hull operators”. Then it is pointed out that CS is a combination of a so-called convex hull operator and a topological (or Kuratowski) hull operator. More precisely, a closer inspection of the Voronoi partitions of the Euclidean plane shows that these partitions turn out to be topologically inhomogeneous in the sense that they contain necessarily two quite different ingredients. The first one is essentially a convex hull operator, the second one (often ignored in the standard accounts of CS) is a topological operator that takes care of the “boundary aspects” of concepts. Relying on the work of the Ukrainian mathematician Miron Zarycki it can be shown that this operator is a genuinely topological hull operator.



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