Similarity after Carnap

Perspectives from Philosophy and Cognitive Science

SEP 12-13, 2025

GAP.12
Satellite Workshop
University of Duesseldorf

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GAP.12: PATHWAYS TO TRUTH

Similarity after Carnap

Perspectives from Philosophy and Cognitive Science

Workshop Details

- Date: September 12–13, 2025
- Venue: University of Düsseldorf (in the course of the GAP.12 conference)
- Funding: German Research Foundation (DFG), research projects *The Role of Similarity and Reasoning in Concepts* (#493620043, PI: Corina Strößner) and *Rudolf Carnap, the Problem of Induction, and the Choice of Scientific Frameworks* (#545054032, PI: Christian J. Feldbacher-Escamilla)
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Speakers

- Javier Belastegui (Basque Country, Leioa)
- Caterina del Sordo (Basque Country, Leioa)
- Karin Enflo (Umeå)
- Christian J. Feldbacher-Escamilla (Cologne)
- Ulrike Hahn (Birkbeck, London)
- Thomas Mormann (Tsukuba)
- Matías Osta-Vélez (Duesseldorf)
- Nina Poth (Radboud, Nijmegen)
- Benjamin Santos Genta (Irvine)
- Luigi Scorzato (Genève)
- Corina Strößner (Greifswald)
- Steven Verheyen (Rotterdam)
- Daniel Weger (Frankfurt)

Aims & Scope

In his Aufbau programme, Carnap sought to provide a formally rigorous account of how property concepts—and ultimately scientific theories—can be constructed on the basis of similarity, particularly through a procedure he called quasi-analysis. Goodman famously challenged the viability of this method, later even claiming that the appeal to similarity is inherently problematic. As a result, similarity came to be viewed with scepticism in many quarters of analytic philosophy. Although Carnap distanced himself from many aspects of the Aufbau, he remained committed to the foundational role of similarity, especially through the notion of attribute spaces in his later work on inductive logic. The divergence of views on similarity also resonates in contemporary cognitive science: Does similarity constitute a foundation of cognition, or is it an effect to be explained by inferential processes?

This workshop aims to bring together scholars from both philosophical and psychological traditions to debate the role of similarity in constituting categorization, analogical reasoning, and belief systems—and to explore the continuing relevance of Carnap's work in this debate.

Schedule:

Friday, September 12, 2025

09:00 – 09:15	Welcome
09:15 – 10:15	Mormann: A representational generalization of Carnap's quasi-analysis for Goodman's interpretation of the Aufbau as a theory of mapping scientific knowledge
10:30 – 11:15	Scorzato: Similarity, Direct Measurements, Conceptual Spaces and Kolmogorov-Chaitin complexity for scientific theory selection and induction
11:15 – 12:00	Belastegui: What Carnap's Aufbau can do for conceptual spaces
12:15 – 13:00	Enflo: Sameness and Similarity
13:00 – 14:00	Lunch break (Mensa)
14:00 – 14:45	Poth: Similarity and probability in generalisation
14:45 – 15:30	Strößner: Similarity first
15:45 – 16:30	Weger: Structuring Qualities: From Carnap's Quasi-analysis to Quality Space Theory
16:45 – 17:45	Hahn: The limited place in cognitive space (joint work with C. Hodgetts)
19:00 –	Dinner (To, Graf-Adolf-Strasse 70A, 40210 Düsseldorf)

Saturday, September 13, 2025

09:00 – 10:00	Verheyen: Minds and Machines Learning Convex and Connected Concepts (joint work with I. Douven)
10:15 – 11:00	Osta-Vélez: Covariation, higher-order similarity, and the structure of concepts
11:00 – 11:45	Genta: Inductive Logic and Analogies
12:00 – 12:45	del Sordo: Reconstructing Rational Reconstruction: Quasi-Analysis vs. Explication in Carnapian Conceptual Engineering
12:45 – 13:30	Feldbacher-Escamilla:The Role of Similarity in Carnap's Program of an Inductive Logic
13:30 – 14:00	Lunch break (Delivery)
14:00 – 15:00	Final discussion

Abstracts

What Carnap's Aufbau can do for conceptual spaces

Javier Belastegui (University of the Basque Country)

As Sznajder (2016) argued, there are resemblances between Carnap's attribute spaces and the conceptual spaces introduced by Gärdenfors (2000,2014). This connection keeps leading to interesting results, e.g. (Douven, Verheyen, Elqayam, Gärdenfors, Osta-Vélez, 2025). Earlier in his Aufbau (1923, 1928), Carnap sketched a theory of constructional systems of concepts based on the method of quasi-analysis, which reconstructs concepts as sets of similar objects, see (Richardson, 1998), (Del Sordo; Mormann, 2022). But Carnap's quasi-analysis faced Goodman's (1953) companionship and imperfect community objections. These were discussed by Proust (1986), Brockhaus (1963), Mormann (1994, 2009) and Leitgeb (2007, 2011). Independently, Rumfitt (2015) and Mormann (2020, 2021) developed polar spaces as an application of conceptual spaces to vagueness. Then, Belastegui (2022) showed that polar spaces are mathematically equivalent to the similarity structures of Carnap (1923), and that these avoid Goodman's objections because they require the existence of objects that behave like prototypes (Rosch,1975). Unless one constrains the convex regions in a conceptual space, imperfect communities can arise. Nevertheless, these cannot arise when concepts are represented as Voronoi cells, because Voronoi tessellations are Carnapian similarities. Thus, using Voronoi tessellations avoids Goodman's objections justifiably because it appeals to the prototype theory of concepts. Providing this justification is, I claim, what Carnap's Aufbau can do for conceptual spaces.

Reconstructing Rational Reconstruction: Quasi-Analysis vs. Explication in Carnapian Conceptual Engineering

Caterina del Sordo (University of the Basque Country)

The contemporary debate on Carnapian conceptual engineering largely hinges on the late Carnap's notion of explication. By contrast, the early Carnap's notions of rational reconstruction and quasi-analysis have received comparatively little attention. Emphasis has been placed on the continuity (Dutilh-Novaes 2020) or discontinuity (Carus 2007) between rational reconstruction and explication. So far, the comparisons between rational reconstruction and explication have not taken into account the scientific revaluation of Carnap's quasi-analysis, as developed by Mormann (2009) and Leitgeb (2007). In this contribution, I aim to bridge this gap by drawing a comparison between explication and rational reconstruction that takes into account the mathematical revaluation of Carnap's quasi-analysis. I will argue for a thesis of discontinuity between rational reconstruction and explication. Specifically, I contend that (1) rational reconstruction and explication are distinct kinds of conceptual constructions. Moreover, I contend that (2) rational reconstruction exhibits philosophical virtues in responding to objections commonly raised against Carnapian conceptual engineering. To demonstrate (1) and (2), I assume that explication is equivalent to Carnap's (1950) performances of explication. I also assume that rational reconstruction is equivalent to Carnap's performance of quasi-analysis in the Aufbau (1928).

Sameness and Similarity

Karin Enflo (Umeå University)

The literature is abundant with similarity conceptions: qualitative similarity, structural similarity, set similarity, a.s.o. Do these similarity conceptions have anything in common, in virtue of which they are all similarity conceptions? I will propose that they can all be related to the concept of sameness, although in three different ways, corresponding to three different types of similarity conceptions: commonality conceptions, closeness conceptions and hybrid conceptions. These conceptions can be used to answer three different questions, relating similarity to sameness (where "sameness" should be understood as "full property-overlap", not as "numerical identity"). The commonality conception can be used to answer the question: in what ways are A and B (partially) the same? The similarity of A and B is regarded as their commonality. The closeness conception can be used to answer the question: what changes would make A and B the same? The similarity of A and B is regarded as their closeness, the opposite of their distance. The hybrid conception tries to answer both questions. Examples of commonality conceptions are partial identity and number of shared properties. Examples of closeness conceptions are metric similarity and transformations. Tversky's contrast similarity is an example of the hybrid type.

The Role of Similarity in Carnap's Program of an Inductive Logic

Christian J. Feldbacher-Escamilla (University of Cologne)

Similarity plays a crucial role in Rudolf Carnap's work on inductive logic. Carnap challenged the traditional view that inductive methods contradict empiricism due to their reliance on a synthetic a priori uniformity assumption. Carnap proposed a logical alternative to frequentist probability, advocating for a probabilistic uniformity assumption. He aimed to categorize all probabilistic statements as analytical and part of an inductive logic. In doing so, he faced several challenges. Two of which turned out to be particularly persistent. First, the challenge of an adequate logical probabilistic treatment of universal statements. Second, the challenge of adequately characterising so-called "analogical inferences". Both, universal statements and analogical inferences, make up for an important core component of scientific theorising. Regarding the former, Carnap saw a solution in transforming the philosophy of science dealing with universal statements towards one of dealing with their inferential role. Regarding the latter, Carnap modified his systems of an inductive logic, adding more and more free parameters and specifying increasingly sophisticated notions and measures of similarity to account for such inferences. In this talk, we will outline the historio-systematic context and cornerstones of Carnap's programme and detail the development of different notions of similarity involved in it.

The Limited Place in Cognitive Space (joint work with C. Hodgetts)

Ulrike Hahn (Birkbeck, University of London)

How we judge the similarity between stimuli in the world is connected ultimately to how we represent them. Because of this, decisions about how we model similarity, either in terms of human behavior or patterns of neural activity, can provide key insights into how representations are structured and organized. Despite this, psychology and cognitive neuroscience continue to be dominated by a narrow range of similarity models, particularly those that characterize similarity as distance within "cognitive space." Despite the appeal of such models, their topological nature places fundamental constraints on their ability to capture relationships between objects and events in the world. To probe this, we created a stimulus set in which the predicted similarity relationships (based on an alternative model of similarity) could not be simply embedded within Euclidean space. This approach revealed that the spatial model distorts these predictions, and the perceived similarities of human observers. These findings indicate that cognitive spaces—that underlie much recent work probing both visual and conceptual representations in cognitive neuroscience—are limited in fundamental ways that restrict their theoretical and practical utility.

A representational generalization of Carnap's quasi-analysis for Goodman's interpretation of the AUFBAU as a theory of mapping scientific knowledge

Thomas Mormann (Tsukuba)

According to Carnap's AUFBAU, the concept of similarity occupies center stage in the logical constitution of the world. The basic method of constitution for Carnap was the method of quasi-analysis. Quasi-analysis crucially depends on the concept of similarity. According to Goodman, Carnap's similarity-based method of constitution was fatally flawed. On the other hand, Goodman praised the AUFBAU as a philosophical work of first rank relevant for future philosophy of science. "The AUFBAU cannot yet be relegated to the status of a monument having purely historical interest. Its lessons have not been fully enough learned." Goodman claimed: "The function of an AUFBAU constructional system is ... to map experience. A map is schematic, selective, conventional and uniform. And these characteristics are virtues rather than defects." In this talk I want to argue that a representational generalization of quasi-analysis renders plausible Goodman's reading of the AUFBAU as a theory of mapping scientific knowledge. This mapping account may be an interesting project even for contemporary philosophy of science.

Covariation, higher-order similarity, and the structure of concepts

Matías Osta-Vélez (Heinrich-Heine University Düsseldorf)

Most theories of concepts focus on first-order similarity—how individual instances share features or occupy nearby regions in multidimensional space. However, many conceptual phenomena hinge on detecting patterns of feature covariation rather than simple overlap (Richardson 2019; Solomon & Schapiro 2024). For example, two animal categories may differ in their average feature values yet share analogous internal covariation structures, supporting analogical reasoning and robust generalization. This talk explores the role of covariation in terms of higher-order similarity, arguing that structural similarity across covariational patterns is a crucial yet underappreciated dimension of conceptual organization. I argue that data analysis techniques such as principal component analysis can help formalize this kind of similarity. This perspective accounts for the formation of overhypotheses and structural phenomena such as consistent contrast and value systematicity (Billman & Davies 2005, Dewar & Xu 2010). By moving beyond first-order similarity to the structure of relations among features, we arrive at a two-tier model of conceptual knowledge: intra-concept coherence for local prediction and inter-concept covariational alignment for efficient generalization. This framework might help explain why some conceptual systems are easier to learn, transfer, and remember.

Similarity and probability in generalisation

Nina Poth (Radboud University Nijmegen)

Using multidimensional scaling, Roger Shepard explained accurate generalisation across contexts by appealing to both geometric similarity representations and probabilistic inference. However, such an explanation would be more complex than if one appealed to either principle alone. There is currently no widespread agreement on whether similarity is more fundamental than probability, or vice versa, or how exactly the two relate. A different notion of similarity – structural similarity – highlights the action-relevance ('exploitability') of internal representations and requires these to map onto the environment statistics relevant to explain accuracy or adaptive success. I provide a new systematisation according to which the different notions of probability and similarity complement one another in explaining the possibility of accurate generalization based on learned concepts.

Inductive Logic and Analogies

Benjamin Santos Genta (University of California, Irvine)

Johnson (1932) and Carnap (1950) independently derived formal versions of enumerative induction that allow for different initial priors and arbitrary sensitivity to new evidence. Though this achievement was monumental for inductive logic, the Johnson-Carnap system could not account for the effects of analogical influences on inductive inferences. The most notable criticism of the system with respect to analogical influences comes from Achinstein (1963). The contribution of my paper is twofold: first, I provide a conceptual mapping of the treatment of analogy in the inductive logic tradition, from Hosiasson-Lindenbaum (1941) and Carnap (1945; 1980) to modern commentators. In particular, I distinguish three kinds of extensions of Carnap's inductive logic system with respect to analogies: axiomatic (e.g. Huttegger 2019), parametric (e.g. Romeijn 2006), and geometrical approaches (e.g. Sznajder 2021). The second contribution of this paper is to argue that the literature was operating on a productive but fundamental mistake: the extensions of the Johnson-Carnap system did not capture the analogical influence Achinstein had in mind. A recent paper by Huttegger (2019) captures this kind of influence but does not highlight it.

Similarity, Direct Measurements, Conceptual Spaces and Kolmogorov-Chaitin complexity for scientific theory selection and induction

Luigi Scorzato (Genève)

I review the works of Gärdenfors (1990) and Scorzato (2013) and show that their combination provides an elegant solution of Goodman's new riddle of induction. The solution is based on two main ideas: (1) Clarifying what is expected from a solution: understanding that philosophy of science is a science itself, with the same limitations and strenghts as the other scientific disciplines. (2) Understainding that the concept of complexity of a model's assumptions and the concept of direct measurements must be characterized together. Direct measurements are the context where the concept of similarity becomes essential. I argue that conceptual spaces are part of the solution, but I emphasise that a concept of epistemic complexity must also be part of it, to remediate to the limitations of conceptual spaces. In particular, the fact that conceptual spaces are more robust for single-domain concepts (Strößner 2022) is not a serious limitation if their application is needed only for direct measurements.

Similarity first

Corina Strößner (University of Greifswald)

Nelson Goodman formulated his general strictures against similarity as an explanatorily useful concept as a reaction to the usage of similarity as a fundament of cognitive development in empiricist philosophy and in Carnap's Aufbau. His criticism influenced not only philosophers, but also cognitive scientists, who vividly debated on the role and nature of similarity since the 1970ies. One of the critical issues of the debate is the extent to which similarity itself is really fundamental or rather a result of reasoning, categorization and other cognitive processes. This talk aims to revisit the philosophical history of similarity as a foundational notion of explaining cognitive development. In this talk, I explore and cautiously defend the view that some variant of similarity should be considered as a fundamental notion, in line with Carnap's original framework and the tradition of classical empiricism.

Minds and Machines Learning Convex and Connected Concepts (joint work with I. Douven)

Steven Verheyen (Erasmus University Rotterdam)

In the conceptual spaces framework, natural concepts are often modeled as convex regions within a similarity space—an assumption motivated by the principle of cognitive economy. Convexity is thought to enhance learnability, making such concepts easier to acquire than those that are represented by regions that satisfy topological criteria that are less stringent. In this talk, I critically examine this hypothesis by comparing the learnability of convex concepts to that of merely connected ones. I will present findings from both computational studies using neural networks that are supposed to approximate human concept learning and behavioral experiments with human participants. All studies were conducted within a shape-based similarity space designed to represent various types of containers.

Structuring Qualities: From Carnap's Quasi-analysis to Quality Space Theory

Daniel Weger (Goethe University Frankfurt)

This talk explores the connection between the account of qualities set out by Rudolf Carnap's phenomenalist constitution system, as presented in The Logical Structure of the World and contemporary quality space theory (QST) as advocated by Clark and Rosenthal. Both frameworks assume that qualities can be characterized in terms of similarity relations: Carnap proposes that equivalence classes of elementary experiences, grouped by recollected resemblance, provide the basis for reconstructing qualities. QST, on the other hand, models qualities as locations in similarity-based quality spaces that are determined by perceptual discrimination in the relevant sensory modality. I argue that, although there is a historical link from Carnap via Goodman to contemporary QST, the differences between the two accounts prevail. This is particularly evident in at least four respects: (1) Carnap considers total experiences, whereas QST considers modalities in isolation; (2) Carnap compares successive experiences, whereas QST compares experiences elicited by simultaneously presented stimuli; (3) Carnap relies on introspection, whereas QST relies on discriminatory behavior that may occur non-consciously; and (4) Carnap treats similarity as fundamental and distinguishability as derived, whereas QST reverses this explanatory direction.