

Mental Iconicity Seminar

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W1: Iconic and Symbolic Mental Representation

The question

Varieties of representation. Representations exhibit a variety of **formats**, including **symbolic representation**, exemplified by linguistic expressions and logical formulae, and **iconic representation**, exemplified by pictures, maps, diagrams, and 3D models.

Public representations and mental representation. The most familiar representations are **public representations** or **signs**— including spoken and written words, paintings and drawings, and diagrams. But these are only made possible by the contributions of **mental representations**, including those in perception, reasoning, motor planning, and beyond.

Are there iconic mental representations? Does the distinction between iconic and symbolic signs carry over to mental representations? How are iconic representations realized in the brain. These are the questions we'll examine in this seminar.

The iconic/symbolic distinction

Key concepts

Representation. A *representation* is any entity (object, event, process) that carries content about some subject matter, broadly construed.

Signs. A *sign* is a public representation, like a sentence or a picture. (A word is an *atomic* sign, a sentence is a *complex* sign.)

Content. The *content* of a representation is what the representation “says” or “describes” about its subject matter (or what it contributes to what a complex representation describes). In the primary case, this content is true or false (accurate or inaccurate, correct or incorrect). We may allow many different kinds of content, at different levels of abstraction.

Truth/accuracy. A representation is true or accurate (relative to a system) when its content matches or corresponds with the world. Not all signs are truth-apt.

Worlds. The “world” is the situation relative to which a sentence is true or false. We may consider the actual world or possible worlds in this regard—situations which actually occur, or simply *could have* occurred.

Accuracy conditions: the *accuracy conditions* of a representation is the core of its content; they correspond to the situations in which the representation is accurate. (We can think of the content of a representation as the set of all possible worlds where the representation is accurate.)

Representational system. A *representational system* is a language or set of rules for mapping representations to contents. Representations only have content relative to a system.

Semantics. A semantics is a rule-based analysis of a representational system (typically, a public system). A semantics explains how contents are derived from signs.

Interpretation. For an agent to *interpret* a sign is for the agent to associate a sign (public representation) with a content. To interpret a sign is to follow a representational system.

Iconic and symbolic representation

Core case. Consider a picture of a tree vs. the Latin word “arbor”. Both represent a tree, in some sense, but they seem to do so in very different ways.

Intuition. Symbolic representations, like words, are (in some sense) *arbitrary*: instead of “arbor,” a different word would have worked just as well. But iconic representations, like pictures, are (in some sense) *natural*: a completely different picture would not serve just as well.

Symbolic representation. Symbolic representations include: words, sentences, mathematical and logical expressions, emblematic gestures.

Iconic representation. Iconic representations include: dials, diagrams, maps, pictures, 3D models, depictive gestures, iconic sign language.

Contrast pictures vs. diagrams: perspectival vs. non-perspectival 2D signs.

The variety of diagrams: dials, timelines, bar charts, XY-graphs, directed graphs, Euler diagrams, Venn diagrams.

Iconic and symbolic differ in the way that signs are related to contents.

Peirce. The original terminology comes from Peirce (1984):

Peirce on symbols. “There are symbols, or general signs, which have become associated with their meanings by usage. Such are most words, and phrases, and speeches, and books, and libraries.”

Peirce on icons. “There are likenesses, or icons; which serve to convey ideas of the things they represent simply by imitating them.”

Saussure. Saussure (1922) introduced the idea that “the linguistic sign is arbitrary.”

Orders of iconicity and symbolism

Complex representations. Complex representations are composed of first-order basic parts which are further organized into higher-order structures.

Linguistic representation. In language, the first-order parts are *words*, while the second-order organization of words form *phrases* and *sentences*. There is even a *third-order* organization of sentences into *discourse*.

Iconicity and symbolism at different structural orders. What has not been fully appreciated is that whether a representation is iconic or symbolic actually varies by structural order. Consider a seating chart:

The basic parts are names, clear cases of symbolism, while the spatial organization of these names is pictorial or map-like, a feature of iconicity.

Variation. Signs are not just “iconic” or “symbolic”, but iconic and symbolic at different levels of organization.

Don't. So it is actually a bit misleading to contrast the symbolism of (1st order) *words* with the iconicity of (2nd order) *pictures*.

Iconicity in mental representation

From public to mental representation. So far we have focussed on public signs. But does the distinction between iconic and symbolic extend to the mind? Are there iconic and symbolic mental representations?

Language of thought. It is widely thought that thought has a language-like format—the so-called “Language of Thought Hypothesis”. And the computational approach to the mind is widely interpreted to imply that cognition involves “symbol processing.”

Diagrams, pictures, and maps in the mind. But are there iconic representations in the mind? Are there diagrams, pictures, and maps in the mind? If so, how do they work, and how should we identify them? Should we expect to find diagrams and pictures written directly into the brain?

These are the questions we will explore in this seminar.

Signatures of iconicity

What is the underlying difference between iconic and symbolic representations? We can find systematic differences in:

Sign structure (syntax)

Content

Semantics (system)

Logic

Usage

What follows are some of the most well known “signatures” (characteristic features) of iconic and symbolic representation, respectively. It's an open question whether any of these is a *defining* feature. In each case, let's ask: (a) what are exemplars of this signature? (b) what are counter-instances?

Dimensionality. Symbolic signs take the form of 1-dimensional (spatial, temporal) strings; iconic signs generally take the form of 2-dimensional spatial arrays.

Continuity. Symbolic signs always have a (smallish) finite number of discrete parts; many iconic signs are made up of continuous surfaces (and infinite parts).

Hierarchy. Complex symbolic signs typically have hierarchical, recursive structure; complex iconic signs typically have a “flat” structure.

Hierarchical structure only permits *canonical decomposition*: only *some* parts of a linguistic expression are linguistic expressions. Flat structures support *arbitrary decomposition*: any part of a picture is still a picture.

Conventionality. Symbolic signs are meaningful largely or wholly in virtue of convention; iconic signs seem to be meaningful largely in virtue of intrinsic connection between sign and content. (In a slogan: symbolic interpretation is conventional, but iconic interpretation is perceptual.)

Arbitrariness. This one comes from Saussure: “the bond between the [linguistic] signifier and the [content] signified is arbitrary;” i.e. there is no “inner” or “natural” connection between them. Contrast with pictures. What might “arbitrary” mean here?

Resemblance & isomorphism. The classical definition of iconicity: iconic representations express their contents in virtue of resemblance between sign and content. Resemblance might be first-order similarity (similarity of color, shape, size) or second-order similarity (similarity of color-relations, shape-relations, etc.).

Abstract second-order similarity is known as *isomorphism*: relations in the sign “mirror” relations in the content. By contrast, symbolic representation does not depend on any form of similarity.

Natural generativity. From Flint Schier. Iconic systems have the following property: if you learn how some signs are interpreted, you are in a position to extrapolate how all signs are interpreted. E.g. pictures, Venn diagrams. Contrast with words.

Holism. Iconic representations typically entail *clusters* of information (“holistically”), whereas symbolic representations typically entail individual *units* of information. Contrast Euler diagrams with predicate logic. Contrast pictures with predicate logic.

Representational natural kinds

No one signature wins out. No single signature seems to capture all of iconicity (or symbolism).

Natural kinds. But the convergence of these many different features suggests the existence of two underlying representational natural kinds.

Fundamental opposition. The difference seems to be more than superficial; these two representational natural kinds appear to work in fundamentally different ways.

Towards a semantic theory

A thought experiment

You and I need to communicate about the amount of water in a tank, using a basic dial.

There are only five possible gallon amounts of water to be measured (0 gallons - 4 gallons) and five possible settings of the dial.

At first we might establish a direct correspondence of dial angles with gallons... resulting in System I.

Or we might use a random process (e.g. roll of the die) to pair dial angles with gallons... resulting in System S.

Intuitively, there is something natural and direct about System I, and something arbitrary and stipulative about System S. To illustrate, use the natural generativity test.

I want to say that System I exemplifies iconicity, and System S exemplifies symbolism.

Now, suppose we continued rolling the die and got System S*. (Unbeknownst to us, System S* perfectly matches System I with respect to inputs and outputs.)

It seems that System S* is symbolic in the same sense as System S. But then the difference between iconic/symbolic

A semantic analysis

Diagnosis. Systems S and I (and S* and I) differ with respect to the underlying interpretive rules at work in each case.

Methodology. To this end, let us try to formulate these rules explicitly.

Semantics of System I.

For any sign s in I:

$Content(s) = (angle(s) \times 1/45)$ gallons of water in the tank.

Semantics of System S:

For any sign s in S:

- (i) if $angle(s) = 90$: $Content(s) = 0$ gallons of water in the tank;
- (ii) if $angle(s) = 180$: $Content(s) = 1$ gallon of water in the tank;
- (iii) if $angle(s) = 45$: $Content(s) = 2$ gallons of water in the tank;
- (iv) if $angle(s) = 135$: $Content(s) = 3$ gallons of water in the tank;
- (v) if $angle(s) = 0$: $Content(s) = 4$ gallons of water in the tank.

Semantics of System S*:

For any sign s in S*:

- (i) if $angle(s) = 0$: $Content(s) = 0$ gallons of water in the tank;
- (ii) if $angle(s) = 45$: $Content(s) = 1$ gallon of water in the tank;
- (iii) if $angle(s) = 90$: $Content(s) = 2$ gallons of water in the tank;
- (iv) if $angle(s) = 135$: $Content(s) = 3$ gallons of water in the tank;
- (v) if $angle(s) = 180$: $Content(s) = 4$ gallons of water in the tank.

A theory of iconicity

What we find are rules with vividly different structures.

Symbolic rules are list-like or *itemized*, with a different sub-rule for each sign-type. Each sub-rule directly *juxtaposes* a sign-type with a content, with no mediating relation between them.

Iconic rules are rule-like or *uniform*, with a single sub-rule for all sign-types. This sub-rule establishes a *natural dependency* between sign-types and content, exploiting the structural aspects of the sign to define the content.

Schema:

Iconic Semantics

For any S: S = the C such that R(S, C)

Symbolic Semantics

S = C

S = C

S = C

Generalization. My conjecture is that this basic distinction can be extended to the many different forms of iconic and symbolic representation, at first- and second-orders of complexity.

Natural dependencies reflect the geodesic structure of logical and mathematical space; they are the opposite of disjunctive/grue-some properties. They are characterized by:

Uniformity. Natural dependencies relate all elements of their domains and ranges in the same way; so disjunctive functions are excluded.

Dependence. Natural dependencies track genuine dependencies between relata; so constant functions are excluded.

Natural classes. Natural dependencies relate natural classes, so uniform relations between disjunctive domains are excluded.

The problem of mental iconicity

From public to mental representation. Mental representation is conceptually and historically prior to public representation with signs. If we want to make sense of the iconic/symbolic distinction, we need to trace it back to the mind.

Interpretation. I have sketched an account of the distinction that has to do with different kinds of *interpretive rules*.

Intentionality. But minds don't interpret their own representations. They exhibit *original intentionality*. So what could mental iconicity be?

Note: "intentionality" is the philosopher's term of art for states of the world that have representational properties. It has nothing to do with *intentions* (but everything to do with *aboutness*, the etymology is linked with "aiming at").

Questions. So we will ask two questions together: (i) what are the counterparts of representational rules for mental representation? (ii) what are some plausible candidates for iconicity in mental representation?

Informational Teleosemantics. On (i): here we'll examine the idea that mental representation arises from information processing functions in the brain. Semantic rules correspond to informational functions.

Into the mind, into the brain. On (ii): I'll argue in the coming weeks that we find iconic representation, at least in the following:

Analogue magnitude representations & neural numerosity maps.

Retinotopic representations in the visual system.

Orientation and size maps in V1.

Topographic representations across sensory modalities.

Other areas of open inquiry and debate include:

Location maps in the hippocampus.

Cognitive maps in general.

Perceptual object representations.