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Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science, 7*, 155-170.

Overview of Gentner's structure-mapping theory of analogical mapping:

- Structure-mapping theory distinguishes between three types of domain comparisons: analogy, literal similarity, and abstraction (general laws)
- Distinctions can be drawn between the type (e.g., object-attribution, relation) and nature (e.g., higher or lower order) of predicates underlying a particular comparison
- Defines analogy as "an assertion that a relational structure that normally applies in one domain can be applied in another domain"
- Cites empirical evidence that people rely on relations between object and target to interpret analogies rather than object-attributes

Gentner argues that Tversky's contrast model (older model of analogical reasoning) is insufficient because:

- Tversky's model relies on degree of overlap approach to explain how analogical relationships are formed (i.e., relative numbers of shared and nonshared predicates between source and target)
- this approach is only successful for comparisons based on similarities between source and target

Overview of steps in analogical reasoning:

1) Access: retrieval of familiar source analog given novel target problem
2) Mapping: process of determining which elements in the target correspond to the familiar source
    a. Example:
        i. How is a reservoir like a battery?
        ii. battery → reservoir
        (source, base) (target)
        iii. Reservoir is the target because it is being explained 'in terms of' a battery.

Assumptions guiding structure-mapping:

1) Domains are made up of objects, object-attributes and relations between objects
2) Knowledge treated as network made up of nodes (concepts) and predicates (propositions about the concepts)
3) Predicates form distinct groups:
    a. Can be attributes or relations
    b. Attributes take one argument
        i. Example object-attribute: YELLOW (sun)

    c. Relations take two or more arguments
        i. Example relation: REVOLVE AROUND (planet, sun); relations can be spatial, affective, reflect causality, etc.
4) Predicates can be first or second+ order
    a. First order predicates take objects as arguments
    b. Second+ order predicates take propositions as arguments
5) Representation of relationships (and the resulting conceptual network) is to be based on "the way people construe a situation"; not constrained by classical logic

Overview of structure-mapping rules:

1) Structure: object nodes of the base B (or source) map onto the object nodes of the target T; predicates of base B carry over to T; one-to-one mapping; discard attributes of objects while retaining relations between objects
2) *Systematicity Principle*:
    a. "A predicate that belongs to a mappable system of mutually interconnecting relationships is more likely to be imported into the target than is an isolated predicate."
    b. So when considering relations between B and T, higher-order relations are given preference, such that networks of source-target mappings are preferred to isolated source-target mappings; in other words, connected knowledge weighted over independent facts
    c. lower-order predicates take first-order predicates as arguments (i.e., organizing principles)
    d. Noting interconnected relationships requires at least a nascent understanding of the interdependencies between predicates
    e. Causal information is generally higher order than information about the state of objects, so these predicates are favored
3) Syntax v. content: interpretation rules are determined by syntax rather than content (i.e., mapping is determined by the structure of the knowledge representations between the base and target rather than the content of those representations)

Attributes of different types of domain comparisons:

1) Anomoly: no (or very limited) mapping between base and target on either object-attributes or relational matches
    a. Ex (perhaps): "Consciousness is a chicken coop."
2) Appearance match: base and target match only on object-attributes; no relational matches
    a. Ex: "The symbol for infinity is a sideways 8."
3) Literal similarity comparison: occurs when a large number of predicates is mapped from base to target relative to the number of nonmapped predicates; predicates can include both object-attributes and relations between objects
    a. Ex: "NASDAQ is like the NYSE."
4) Analogy: relational predicates are mapped from base to target, but few or no object attributes can be mapped; may include higher-order/causal relations

    a. Ex. “The hydrogen atom is like our solar system.” “The hysteria seemed to spread like a contagion.”
5) Abstraction: base domain is itself a relational structure; all predicates are mapped (which distinguishes this comparison from analogy, which may involve unmapped object attributes). General laws fall into this category.
    a. “The hydrogen atom is a central force system.” “The rush of water through a constricted pipe can be explained by the Bernoulli principle.”
6) Drawing finer distinctions:
    a. Literal similarity and analogy are part of a continuum rather than dichotomous; classification rests on degree to which object-attributes between base and target overlap
    b. Analogy and abstraction also exist on a continuum: if base is constructed of concrete objects that are not included in the relational mapping, classified as an analogy; base in an abstraction is categorized by object nodes that are “abstract and variable like”

Analogical shift conjecture:

1) Anecdotal argument that people ‘spontaneously’ shift from simple understanding of concepts (literal-similarity matches) to more complex understanding (analogical reasoning) when learning new domains, until finally arriving at general laws
2) Discusses tradeoff between accessibility and explanatory usefulness of potential matches between sources and targets, such that:

a) literal similarity matches are accessible (can be retrieved from object features or relational structures) but offer little explanatory power
b) ‘usefulness’ of comparison is derived from our ability to discern causal principles underlying relationship between source and target

Questions for Discussion:

1) Gentner attempts to make the argument that most metaphors are types of analogies; typically, analogies are described as types of metaphors. Indicates that mapping rules for metaphors “that are analyzable as analogies or combinations of analogies…tend to be less regular than those for analogy” (162). Why might this be the case?
2) Can analogical shift come about without training (when shifting from analogies to general laws, for instance)?
3) What makes remote analogies more difficult to achieve? To what extent do memory and perception influence analogy-making?