Why We’re So Smart
Dedre Gentner

Human cognitive abilities
- The ability to draw abstractions from particulars
- The ability to maintain hierarchies of abstraction
- The ability to concatenate assertions and arrive at a new conclusion
- The ability to reason outside the current context
- The ability to compare and contrast
- The ability to reason analogically
- The ability to learn and use external symbols to represent numerical, spatial, or conceptual information
- Language

Sources of human superiority
- Innate domain theories
- Innate processing abilities
- Participation in human language and culture

What makes humans smart
- Ability to learn by analogy
- Possession of symbol systems
- A relation of mutual causation between them whereby our analogical prowess is multiplied by the possession of relational language.

The career of similarity
- Quine (1960) proposed that over development children move from perceiving only brute perceptual similarity to perceiving more sophisticated likeness.
- Gentner and Rattermann (1991) proposed a developmental progression
  1. From simple reasoning to overall similarity to attending to selective similarity
  2. From a focus on object similarity to a focus on relational similarity and from perceptual commonality to conceptual commonalities.

Structure-Mapping
- Structure-mapping theory postulates that comparison process is one of alignment and mapping between structured conceptual representations.
  1. The dog chased the cat.
  2. The coyote chased the lynx.
  3. The shark chased the mackerel.
  4. Amalgamated Tire Co. made a takeover bid for Racine Ironworks.
  5. The cat chased the mouse.

Why relational language matters
- Unlike object concepts, relational concepts are not automatically learned.
- Relational concepts are not simply given in the natural world: they are culturally and linguistically shaped.
- Relational terms are hard to learn.
- Children often initially interpret relational terms as object reference terms, and only later come to appreciate the relational meaning.
Ways in which relational language can foster the learning of relational patterns
- Abstraction
- Initial registration
- Selectivity
- Reification
- Uniform relational encoding

Uniform relational structure, retrieval and transfer
- The claim that uniform relational language aid analogical retrieval is important, because analogical retrieval is generally quite poor.
- People routinely fail to be reminded of past experiences that are relationally similar to current experiences.
- The use of common relational encoding can promote analogical retrieval in adults.
- Conversations with adults might be important in shaping children’s memories.

Relational language in cognitive development
- Gentner and Rattermann tested the power relational labels to promote relational insight, using a simple mapping task.
- 3-year-olds given relational language performed well in the cross-mapping task.
- 3-year-old children were fairly able to transfer their learning to new triads with no further use of the labels by the experimenters.
- The use of common relational labels prompted children to notice and represent the common higher-order relation of monotonic increase.

Loewenstein and Gentner (1998, 2002)
- At age 3;6, children who had heard the box locations described in terms of spatial relations on, in, and under performed substantially better on the mapping task than the control children.
- By age 4;0, children no longer needed to hear the relational language to succeed at the mapping task.
- Overt use of relational language can invite children to represent and use higher-order relational structure.

Symbol use in other primates
- Number
- Chimpanzees can point to the array they wanted, but could not point to the array they did not want.
- The situation changed when the same chimpanzees were tested with numerical symbols.
- Abstract symbols allow chimpanzees to process the quantities at a level of abstraction removed from the rich sensory power of the actual food.

Human development
- Children are better able to resist a tempting object match when the objects are perceptually sparse than when the objects are richly detailed and thus far more compelling as similarity matches.
- Preschoolers do better in a model-room mapping task when given
Relational labeling and relational matching

- While many animals can succeed in a relational matching task (6), but not an analogical matching task (7). (p. 218)
- Symbol training is crucial to relational matching, but not sufficient.
- Chimpanzees can do object matching but macaque monkeys can’t given the same training.

Summary and discussion

- Structure-mapping processes is innate.
  - The ability to notice and abstract relational regularities across exemplars is in place even in 7- and 8-month-olds.
- Human cognition arises not only from the world as directly perceived, but also from learned symbol system that facilitate the apprehension of relational structure.
- Acquisition of technical language can confer new cognitive possibilities.

Language and thought

- According to Vygotsky, with the advent of language children augment their prelinguistic cognitive abilities.
- Sapir-Whorf view: grammatical structure of a language shapes its speakers’ perception of the world.
- Gentner: learning specific relational terms and systems provides representational resources that augment our cognitive powers.