Computational Aspects of Metaphor

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Outline of This Seminar

- Definitions of Metaphor
- Straw-Men: Some models of Metaphor
- Aspects of Metaphor
- Levels of Metaphor
- Conceptual Scaffolding
- Metaphors all the way down: Case-Binding
What is Metaphor?


- The transfer of a name or lexical description from one concept to another on the basis of deep and apropos similarity

- A device for making the dissimilar seem more similar, the unfamiliar appear more familiar (like analogy), AND the familiar more unfamiliar

- A systematic conceptual phenomenon that manifests itself in language AND in other communication media (e.g., film, dance, music)
**Some Terminology Metaphor and Analogy**

Metaphor is a device for seeing something in terms of something else (Burke, 1945)

<table>
<thead>
<tr>
<th>Seeing Something</th>
<th>via Something Else</th>
<th>by Whom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic (or Tenor)</td>
<td>Vehicle</td>
<td>Richards (1936)</td>
</tr>
<tr>
<td>Focus</td>
<td>Frame</td>
<td>Black (1962)</td>
</tr>
<tr>
<td>Primary Subject</td>
<td>Secondary Subject</td>
<td>Black (1979)</td>
</tr>
<tr>
<td>Target Domain</td>
<td>Source Domain</td>
<td>Gentner, Lakoff</td>
</tr>
<tr>
<td>Input Space</td>
<td>Input Space</td>
<td>Fauconnier and Turner</td>
</tr>
</tbody>
</table>
Some Representative Models of Metaphor Processing

- Aristotle’s *Comparison Model from “The Poetics”*
- *Salience Imbalance* (Ortony)
- *Formal Semantics approaches* (e.g., metaphor as compressed simile)
- *Preference Breaking model* (Wilks, Fass, etc.)
- *Literal Pretence models* (Barnden et al.)
- *The “Contemporary” theory of Metaphor* (Lakoff and Johnson)
(a) genus to species: "Here stands my ship", in which "to be at anchor" is a specialization (species) of the more generic term "to stand still".

(b) species to genus: "Truly ten thousand noble deeds hath Odysseus done", $\rightarrow$ "ten thousand deeds" is a specialization of "large number".

(c) species to species: "Drawing off the life with bronze" and "Cutting off the water with unwearied bronze" are both variations of "to take away".

(d) proportional analogy: "The wine cup is to Dionysus as the shield is to Ares", in which the analogy allows the phrase "cup of Ares" to replace "shield", and the phrase "shield of Dionysus" to replace "cup".
Metaphors will of course also be similes, and similes are metaphors that invite explanation.
Essential Idea: Metaphor is a form of comparison between two entities.

Implication: Metaphors are compressed unmarked similes with tension.

Interpretation: Features common to tenor and vehicle are highlighted.

Problems: Comparison is a symmetric operation, but metaphor is an asymmetric phenomenon.

What features are highlighted when the tenor is unknown?

E.g., Shin-Ho Kim is the Abe Lincoln of Korea.
Max Black: Metaphor as Conceptual Juxtaposition

- Essential Idea: *Metaphor juxtaposes two conceptual systems*
- Implication: *Metaphors operate at level of conceptual representations*
- Interpretation: Vehicle: system of associated commonplaces (1962)
  Topic: also belongs to a system of relations (*Endoxa*)
- Problems: *What exactly is an “implication complex”* (1979)
  
  Too vague for computational purposes
  Many authors read from Black what they want to read
  Many researchers claim to be Black's true heirs
Metaphors involve salience imbalance (hence asymmetry), similes do not.

Good metaphor satisfies an imbalance in the salience levels of different features in the tenor and vehicle concepts.
Formal-Semantics Theories of Metaphor Processing

• Essential Idea: *Metaphor is a logical linguistic phenomenon*

• Implication: *Metaphor is within scope of e.g., Montagovian models*

• Interpretation: A function $\lambda(x)$ is formulated to represent the features shared by tenor and vehicle

• Problems: *A symmetric model (sees metaphor = compressed simile)*

  How should $\lambda(x)$ be formulated? $\lambda$-calculus too powerful!
  The space of possible functions is infinite.
Preference-Breaking Models (e.g., Wilks, Fass)

- Essential Idea: *Metaphor is a special and anomalous use of language*
- Implication: *Metaphors cause semantic anomalies if processed literally*
- Interpretation: The anomaly triggers a special *repair* phase in which a matching non-anomalous case-frame is chosen
- Problems: *Not all metaphors are literally anomalous.*
  
  *Predicts that metaphors should take longer to process*
  
  *Cannot distinguish between abnormal use of language and normal language use for abnormal events*
Literal Pretence (e.g., Barnden’s ATT-Meta)

- Essential Idea: *Metaphor supports rich inference in the vehicle domain*

- Implication: *These inferences can be mapped into the tenor domain*

- Interpretation: *A mapping-neutral perspective: only need to map the end-results of inferences, not intermediate steps*

- Example: “At the back of John’s mind he knew Mary was unfaithful”

- Problems: *Requires a grounding semantics (e.g., metaphors of mind)*
  *Disguises literal/figurative distinction as real/pretence*
  *How does system tell when pretence is required?*
The Contemporary Theory of Metaphor

- Essential Idea: Metaphor is the conceptual deep structure of language

- Implication: Conceptual Metaphors have many surface realizations

- Interpretation: Invariance Hypothesis tells what image-schematic elements of the vehicle are carried into the tenor

- Problems: Not a computational theory as such
  
  Suggests that the core inventory of metaphors is limited

  Leads to overly baroque Conceptual Metaphors

  E.g., Life is a Journey, Life is a Business, Love is a Nutrient, etc.
• Essential Idea: *Image schemas are "experiential gestalts"*

• Implication: *They "organize experience of the world into structures"

• Example: The CONTAINER schema *(Mark Johnson, 1987)*

Image Schemas and Conceptual Metaphors

- Source
- Path
- Goal
- Contents
- Boundary
- Portal

E.g., “get into Emacs”
E.g., “fall into a Coma”
E.g., “get into trouble”
“thinking outside the box”
Essential Idea: **Tenor and Vehicle are categories**

Implication: **Metaphor forces one category into another**

Example: “My job is a jail”, “My boss is a tyrant”, etc.

The metaphor causes us to think of Job as a sub-category of Jail.

- Jails are constraining, limiting, regulating.
- Jobs can make us feel “trapped”.
- Some jobs feel like “punishments”.
- Some jobs provide little/no freedom.
Dedre Gentner’s Structure-Mapping Theory (SMT)

Systematic Mappings are performed on the basis of structural connectivity/coherence
Gerard Steen’s Metaphor Checklist

- **Conceptual Analysis**
  
  *What is the metaphorical proposition? What is the literal referent and non-literal predicate?*

- **Linguistic Analysis**

  *What is the metaphoric expression? Non-literal Focus, literal frame?*

- **Communicative Analysis**

  *What is the metaphorical utterance? Literal topic, non-lit. comment?*
**Steen’s Checklist: An Example**

### Metaphor: “The bird of prey hung ready over the crowd”

<table>
<thead>
<tr>
<th>Linguistic</th>
<th>Focus: <em>the bird of prey</em></th>
<th>Frame: <em>X hung ready over ...</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>Lit ref: <em>helicopter</em></td>
<td>Non-lit predicate: <em>bird of prey</em></td>
</tr>
<tr>
<td>Communicative</td>
<td>Topic: <em>helicopter</em></td>
<td>Comment: <em>be bird of prey</em></td>
</tr>
</tbody>
</table>

### Metaphor: “The river betrayed its proximity”

<table>
<thead>
<tr>
<th>Linguistic</th>
<th>Focus: <em>betrayed</em></th>
<th>Frame: <em>the river X’ed its prox.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>Lit ref: <em>river, proximity</em></td>
<td>Non-lit predicate: <em>betray</em></td>
</tr>
<tr>
<td>Communicative</td>
<td>Topic: <em>the river</em></td>
<td>Comment: <em>betrayed its prox.</em></td>
</tr>
</tbody>
</table>
Other Authors and Frameworks


• *No-Meaning-Theory*. Donald Davidson, 1979.


• *Relevance Theory*. Sperber and Wilson, 1985.


Metaphor is Asymmetric

The information flow in a metaphor is directional, from the vehicle to the tenor.

My Surgeon is a Butcher

is not the same as

My Butcher is a Surgeon

Reversing the elements of a metaphor will almost always change its meaning!
Domain Incongruence: at the heart of Metaphor

The same features can have different meanings in different domains.

So, in what sense can features be shared between domains?

E.g., A **loud** tie is a **garish** tie
Metaphor changes the way we view the World

Surgery \textit{from} Surgeon \textit{attr} Precise

Slaughter \textit{from} Butcher \textit{attr} Bloody

\textbf{Metaphor forges} connections between concepts that allow \textit{nuances} of association to develop across domains
Levels of Metaphor Processing

Metaphors can be understood and processed at different levels:

- **The Localist level** (or Scaffolding)
  - dictates the relative organization of concepts to each other
  - employs core spatial metaphors to juxtapose themes/ideas

- **The Conceptual Level**
  - reveals the rich internal structure of concepts
  - employs structure-mapping between conceptual structures
Spatial Metaphors are the Organizational Building Blocks of Language

(a) Classifier Signs

(b) Marry: Strong connection of Man and Woman,

(c) Divorce: Strong disconnection of Man and Woman.

(d) Discuss: Repeated connection of Two people

Japanese Sign Language (JSL) uses core spatial metaphors of connection/disconnection
Spatial Metaphors in Japanese-Sign Language

(a) Classifier Signs

(e) Married Couple: Man and Woman connected.
(f) Father: Man upward on Family Line.
(g) Mother: Woman upward on Family Line.

Note how the metaphors have direct English equivalents
Spatial Metaphors in Japanese-Sign Language

(a) Classifier Signs


Note again how the metaphors have direct English equivalents
Spatial Metaphors in Japanese-Sign Language

(a) Classifier Signs

(l) Inflation: Continuous Raising of Prices / Money.

(m) Economy: Continuous Movement of Money.

(n) Tradition: Movement from Son to Son to Son.

Note again how the metaphors have direct English equivalents.
Localist Foundations: Holding the pieces in place

Key

Attempted Causality

Actual Causality

Causal Enablement

Connection

Disconnection

Enter / Contain

Exit / Release

Up

Down

Causality Operators

Spatial Operators

Containment Operators

Orientation Operators
An Example: Spatial Orientation and Actual Causality

“Strong Inflation is withering my savings”
An Example: Spatial Orientation and Containment

“The bank put ACME into receivership”
An Example: Cascaded Causality and Containment

“IBM divorced Microsoft to marry Apple and release the Power-PC”
Metaphor requires **Top-Down and Bottom-Up Processing**

"Chomsky rebuilt Modern Linguistics ..."

"... from the ground up."
Scaffolding forms part of Lexico-Syntactic Structure

IBM = Cat Scaffold PN IBM
Scaffold

Coma = Cat Scaffold N down(Health)
Scaffold

A = Cat COMP Det 1 Scaffold 1
Scaffold

Fell = Cat V Sem Patient
Into down(2, 3)
From up(4, 5)
Scaffold < contain(3, 1), disconnect(5, 2) >

A = Cat COMP P 1 Scaffold 1
Scaffold
Consider the utterance:

“America withdrew its ambassador from the Russian puppet government of Bulgaria”

**Interpretation (i):** America withdrew its ambassador from the Bulgarian government which is a puppet of Russia
Multiple Scaffoldingss may be Possible: #2

Consider again the utterance from another perspective:

“America withdrew its ambassador from the Russian puppet government of Bulgaria”

**Interpretation (ii):** America withdrew its ambassador from the Russian government which is a puppet of Bulgaria
SMT can be the Instrument of World Knowledge

Which country, BULGARIA or RUSSIA, better fits the role of PUPPET?

Role-fitting is a question well suited to structure-mapping theory.
SMT as a Mechanism for Structural Disambiguation

SMT can be used to compare a conceptual structure to a Role-Schema

From this perspective, BULGARIA is a better puppet than RUSSIA.
SMT as a Mechanism for Case-Role Binding

SMT can be used to compare a conceptual structure to a Role-Schema.

Thus SMT can be used to bind sentence arguments to the appropriate case roles.

E.g., The hacker opened the protected file with a stolen password.
Summary and Conclusions

- Metaphor is an asymmetric phenomenon that is more than mere simile
- Metaphor involves multiple levels of representation and inference
- Metaphor requires an organizing structure for juxtaposing entities
- Metaphor needs a mapping element for exploiting conceptual structure

SMT can serve as a structural fitting mechanism for:

- Structural Disambiguation and Context/Expectation fitting
- Case-Role binding in creative and semi-creative uses of language
Further Reading


- *Metaphor and Thought*. Andrew Ortony (ed.), 1979


- *Researching and Applying Metaphor*. Cameron and Low, (eds.), 1999
Structure-Mapping and Analogy

Candidates

P-maps

G-maps

Transfer

Structure-Mapping Engine

Sub-Graph Isomorphism

Systematicity

Coherence

No-Goods

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What is Analogy?

- **Analogy** is a didactic relative of *metaphor*, in which an explicit cross-domain correspondence is established to allow the reader to make causal inferences for oneself.

For example, Galileo uses the metaphor of a ball dropped from the crows-nest of a ship to illustrate relative motion with the earth as a frame of reference.

But do metaphors actually mandate such inferences? Not always, clearly:

Consider the mapping implied by the LIFE analogy of the *Kennedy era = Camelot*:

<table>
<thead>
<tr>
<th>JFK</th>
<th>→ Arthur</th>
<th>RFK</th>
<th>→ Lancelot</th>
<th>JoeKennedy</th>
<th>→ Uther</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oval-Office</td>
<td>→ RoundTable</td>
<td>Jackie</td>
<td>→ Guinnevere</td>
<td>LeeHarvey</td>
<td>→ Mordred</td>
</tr>
</tbody>
</table>

However, does this imply *Jackie* was *adulterous* with *RFK*? Probably Not!
Dedre Gentner’s **Structure-Mapping Theory (SMT)**
Structure-Mapping Theory (SMT): Assumptions

Origins: Patrick Winston (1980), Dedre Gentner, Ken Forbus, Brian Falkenhainer

- **Assumes**: Syntactic representations of semantic relationships (e.g., FOPC)
- **Assumes**: Relations/predicates are more salient than objects to an analogy
- **Assumes**: Causal structure is hierarchical in nature / representation
- **Assumes**: Causal structure is the most salient aspect of a domain to an analogy
- **Assumes**: The representation of causal-structure is domain-neutral
- **Assumes**: The best analogies are highly systematic
- **Assumes**: Systematicity is a measure of hierarchical connectedness

[ *a related but distinct notion to systematicity as used by Lakoff and Johnson 1980* ]
The Mathematical-Level: Structure-Mapping Theory

**Def:** The mapping of relevant nodes and relations from one conceptual structure onto corresponding elements in another structure, in a way that preserves the Systematicity, and thus the abstract meaning, of the mapped elements.

**Equivalent to:** Find the largest isomorphic sub-graph of two graphs (NP-hard)

**Analogical Mapping (AM):** Given the directed and arc-labeled graphs $S = (SV, SA)$ and $T = (TV, TA)$, we ask, do there exist subsets $SA' \subseteq SA$, $TA' \subseteq TA$, $SV' \subseteq SV$, $TV' \subseteq TV$, with $|SV'| = |TV'|$ and $|SA'| = |TA'| \geq K$ such that the sub-graphs $S' = (SV', SA')$ and $T' = (TV', TA')$ are isomorphic? Two graphs $S'$ and $T'$ are isomorphic if there exists a function $f: S' \rightarrow T'$ such that $<v_i, v_k> \in S'$ iff $<f(v_i), f(v_k)> \in T'$.

**Open Problem:** How does one determine relevance in large knowledge-bases?
**What is Analogy? DARPA defines Analogy by Example**

<table>
<thead>
<tr>
<th>HPKB</th>
<th>TQO125c</th>
</tr>
</thead>
<tbody>
<tr>
<td>How is a terrorist group’s interest in group cohesion like a criminal organization’s interest in maintaining security?</td>
<td></td>
</tr>
</tbody>
</table>

**Answer:**

1. *Like criminal organizations, terrorist groups have an interest in keeping their membership cohesive to maintain their security. A fragmented and disloyal membership can compromise a group’s safety, undermine its operations, and threaten its survival.*

**Source(s):**

2. *International System Framework.*
Cyc’s Knowledge-Based Approach to Disanalogy

HPKB TQO125b How is a terrorist group’s interest in increasing financial assets different from a criminal organization’s interest in earning profits?

Answer:

1. Each group’s interest reflects different goals.

2. A terrorist group’s interest in increasing its financial assets, while important, is not its main purpose. Rather, acquiring assets is the means by which the group meets its operational and organizational requirements and achieves its goals. A criminal organization’s interest in earning profits, in contrast, is its central goal.

Source(s):

Domains as Sub-Graphs in a Knowledge-Base: An Example

rich(BillGates)
rich(Manager)
create(BillGates, MS_BASIC)
control(BillGates, Microsoft)
control(Microsoft, Windows)
control(BillGates, Redmond)
part(Windows, GUI)
part(GUI, GraphWindow)
part(GUI, GraphicIcon)
control(GraphIcon, GraphWindow)
create(Manager, SoftwareManual)
depend(Manager, Programmer)
location(Redmond, Seattle)

The domain of MICROSOFT
devout(Pope)
devout(Cardinal)
devout(Priest)
perform(Pope, Mass)
control(Pope, Catholicism)
control(Microsoft, Windows)
control(Pope, Vatican)
part(Catholicism, Cathedral)
part(Cathedral, StainedWindow)
part(Cathedral, ReligiousIcon)
affect(Priest, Catholicism)
control(Cardinal, Priest)
depend(Priest, Bible)
location(Vatican, Rome)

The domain of CATHOLICISM
Structure-Mapping between Two Domains

NB: Concept Relations may be stated or inferred (hence relevance problem)
Hot Topics in Analogical Research

**Interplay** between *attributional* and *structural* knowledge in analogy:
*(psychological evidence suggests structure is good, attributes not so good!)*

**Memory Organisation**: How does the structure of long-term memory interrelate with analogical reasoning *(i.e., how does one affect the other?)*

**Conceptual Slippage**: Real knowledge is *redundant, inconsistent, ambiguous* and *multi-resolutional*, so how can a mapping-theory grounded in sub-graph isomorphism possibly cope? *(Hofstadter et al., fluid analogies group)*

We’ll have something to say about each of these topics in this seminar.
Aspects of the Classical View of Analogical Structure-Mapping

The classical view of SMT can be reduced to two key stances:

**Stance (1):** *The “Pre-Packaged Domain” Assumption*

Semantic/Episodic memory is already conveniently pre-segmented into distinct cases, episodes or domains that can be retrieved as a whole.

**Stance (2):** *The “Structure is (almost) Everything” Assumption*

Two objects entities in an analogy are similar by virtue of occupying relationally isomorphic positions into their respective case structures.
**Structure-Mapping Engine of Forbus, Gentner, Falkenhainer**

- **P-Maps** (*partial* mappings) are constructed by aligning individual propositions.
- **G-Maps** (*global* mappings) are maximal consistent aggregations of P-Maps.

Uses a similar aggregation process to a chart-parser or ATMS.
The “Classical” Pre-Segmented View of Episodic Memory

In the “classical model” domains are distinct and pre-segmented
Contextual Influences on Analog/Case Retrieval

Because metaphors and analogies are goal-driven, they are sensitive to speaker’s communicative intent. Consider for instance:

The U.S. (~1987) is deciding whether to help the Contras against the Sandinistas. In arguing its position there are two key analogies:

- **PLO versus the Israelis,**
- **Hungarians versus the Soviet Communists.**

If the U.S. wants to help the Contras, it should choose the Hungarian analogy, since the U.S. helped the Hungarian rebels.

It should not choose the Israeli analogy, as the U.S. refused to help the PLO.

**The goal (help the Contras) thus primes the Hungarian case for retrieval.**
A Distinct and Pre-Segmented Domain: The Cola Wars
An Analogous Pre-Segmented Domain: The Browser Wars

Microsoft

Create

Control

Windows™

Part

Part

Part

Create

MS-Excel

MS-Word

IExplorer

IExplorerUserBase

NetscapeUserBase

NetscapeNavigator

WebAccess

NetscapeIn

Affect

Affect

Affect

Create

Control

Enable

SoftwareProduct

"Soft"

Attr

Target

MassMarket

Isa

Isa

Attr
The Classical Approach to Structure-Mapping I

**Mapping Workspace**

- (rivalry Microsoft Netscape) 
- (make Microsoft Windows) 
- (contain Windows IExplorer) 
- (make Netscape NetscapeNavigator) 
- (browser NetscapeNavigator) 
- (expect Government MSBundle) 

**MSBundle:**
- (contain Windows NetscapeNavigator)

**CokeBundle:**
- (contain CokeSixPack PepsiCan)

- (rivalry CocaCola PepsiCo) 
- (make CocaCola CokeSixPack) 
- (contain CokeSixPack CokeCan) 
- (make PepsiCo PepsiSixPack) 
- (make PepsiCo PepsiCan) 
- (contain PepsiSixPack PepsiCan) 
- (expect Government CokeBundle)
The Classical Approach to Structure-Mapping II

Features/Attributes are viewed as atomic symbols with no semantic structure.

BUT: they do have an open textured structure that can be mapped recursively!

Attribute pairs like Lean/Solvent, Smart/Bright, Beautiful/Radiant and Garish/Loud can be mapped because of their rich semantic textures.
Similarity Defines the Limits of Acceptable Slippage

In fact, for analogical mapping *open-texture* is often both necessary and sufficient!

Tiger & Economy are similar because of Domain Incongruence and shared features.

Good analogies are often grounded in a layer of non-relational similarity.
Spreading Activation: Overcoming the limits of Pre-Segmentation

A Bidirectional Search is initiated from the root nodes of each domain graph. A variable horizon allows SMT to be used in an anytime algorithm.

When isomorphic pathways of equal length collide, a partial mapping is generated.

Consistent partial mappings (pmaps) are merged, in order of richness, to create a global mapping.
SAPPER: Combining Semantic Similarity with Structure-Mapping

Sapper is an SMT algorithm that grounds mappings in semantic similarity (bridges)
Bridging Rule #1: Sharing Attributes Directly a.k.a. Triangulation

Sapper lays *bridge links* between nodes in memory that have *common associations*.
Bridging Rule #2: Building bridges Recursively a.k.a. Squaring

High-level bridges are created using relational similarities grounded in literal similarity.

Low-level bridges are created using literal similarities.

Cathedral ⊳ Contains ⊳ StainedWindow ⊳ Contain ⊳ Image ⊳ Colour ⊳ Contain ⊳ Text

Contain ⊳ Cathedral ⊳ GUI ⊳ Contain ⊳ GraphicWindow
Both SME (revised after 1989) and Sapper are incremental mapping engines.

Both start with the richest seed mapping (a p-map) and greedily add all p-maps that are consistent with this, in descending order of richness, to create a global mapping.

**Selection Strategy (1):** Pick the most entity-rich and connected p-map

A good heuristic. But if this seed proves to be a poor choice, any resulting g-maps will be poor and almost certainly sub-optimal. SME uses this strategy.

**Selection Strategy (2):** Consider every initial p-map as a possible seed

Less likely to fall into traps, but only computationally attractive when number of initial p-maps is low. Sapper uses this strategy.
Starting at the source-node of the analogy, find the largest symmetric loop that connects the source-node to the target-node.

Seed-Map selection in Sapper
Elaborative Inference over Time: “Anytime” Structure-Mapping

Horizon-driven models of SMT are amenable to iterative/progressive deepening
As defined in Graph-Theoretic Terms, SMT is a very brittle process:

**Reason (1): The “Distorted Mirror” Problem**

There may not exist a coherent isomorphism for a given structure in another domain. To construct a satisfying mapping, the system must relax some wellformedness constraints.

**Reason (2): The “Different Lens” Problem**

Both domains (source and target) may have been defined at different levels of detail, for different purposes/applications by different knowledge-engineers.
Henry points to the cup of coffee sitting right in front of him.

Now Eliza must perform an analogical action from her viewpoint on the other side of the table. Does she point to the coffee-cake, which occupies the same relative position as Henry’s coffee? Or does she point to her own coffee?
Conceptual Slippage: Warping Semantic Representations

Long-term memory stores different concepts in different ways, at different levels of detail. When mapping between two such concepts it may be overly constraining to seek a strict isomorphism between domains.

For example, consider Ford's metaphor "The **Sports-car as Jaguar panther**"
Conceptual Slippage: Warping Semantic Representations

Fuzzy equivalence (e.g., *partonomy* often implies *containment*)

Fuzzy Transitivity (e.g., varying the *resolution* of representation)
Slippage Rules in Sapper

\[ P(\pi \rightarrow \pi') > \varepsilon \]

\[ P(\pi \rightarrow \pi'') > \varepsilon \]

\[ P(\pi' \rightarrow \pi) > \varepsilon \]

\[ P(\pi' \rightarrow \pi'') > \varepsilon \]
Evaluation Data I:  15 “Profession” Domains
Peaceful Zerdia gives supercomputers to its warlike neighbor, Gagrach as an appeasement. But Gagrach uses the computers to guide missiles toward Zerdia.
SMT Experimental Results: Sapper vs. SME and ACME

- **Sapper** was experimentally compared with two leading classical models:
  - **SME** (or **Structure-Mapping Engine of Falkenhainer, Forbus & Gentner**) and **ACME** (Analogue Constraint Mapping Engine of Holyoak & Thagard)

- 100 analogies, in the profession domain (e.g., Composer as General) were tested. Each domain contained on average 120 relations/predicates.

- **Optimal SME (from 1989)** failed to interpret all but the five simplest (the average case would require many billions of years for this factorial model)

- For **Greedy-SME (from 1990)**, 17%- 40% of interpretations were incoherent.

- **ACME** failed to construct a constraint network for any analogy. Such networks has size $O(N^4)$ where $N$ is the size of each domain.

- Sapper, like SME, analyzed each metaphor in a matter of seconds, but in each case produced a near-optimal coherent interpretation.
Sapper and SME differ in the following key respects:

- **Domain representation**
  - **Domains** in Sapper are ad-hoc and constructed as needed using S.A.
  - **Domains** in SME are pre-existing and pre-segmented storage areas

- **P-Map representation**
  - **P-Maps** in Sapper are pathways through semantic memory
  - **P-Maps** in SME are sub-trees of a hierarchical domain representation

- **Major Consequences**
  - All KR schemes facilitate the construction of rich path-structures
  - Not all KR schemes facilitate the construction of rich tree structures
Structure-Mapping in Concept Combination

- There are many approaches to concept (noun) combination
  - E.g., Wisniewski, Markman, Costello and Keane, Gagne, etc.
- Some assume SMT is relevant: e.g., Markman’s Alignable Differences
- Others (e.g., Keane and Costello) assume distinct mechanisms at work
- Many (e.g., Gagne) assume that concept-combination is relational
- But structure-mapping is a combination mechanism par excellence
- Question: Can SMT be used to explain concept combination?
Assumptions and Speculations

- **Primary Assumption**: Concepts are mental building blocks *(stickle-bricks?)*

- Words combinations provide valuable insights into their structure.

- Like sentences, combinations can be *literal* or *metaphoric*.

- Do we adopt traditional view, and assume a separate mechanism for each?

- We adopt a unitary view, and assume both are covered by same mechanisms.

- *Metaphor involves structure-mapping, so we expect combination will also.*

- *Structure-Mapping can enlighten the processes of gradual elaboration*
There exists a formidable grey area between metaphoric (e.g., *Juliet is the Sun!*) and literal (e.g., *this Table is Round*) combinations.
A key tenet of analogical research is that concepts are best described as systems of relations and not *flat feature sets* or even *frames*.

E.g., to classify someone as a Philosopher requires a defn. of Philosophy (Cognitive Linguists calls this figure-ground distinction *base profiling*).

So, "Moral Philosopher" requires us to consider "Moral Philosophy".

**NN-compound** interpretation viewable as a process of Structure-Mapping where perhaps one or both of the domains is merely alluded to.

**NN-compound** interpretation requires us to reconstruct these domains, using SMT as a guide (e.g., “Math Clinic”).
Rule-based Approaches: e.g., CYC

Background knowledge can be axiomatized in a logical inference framework like Cyc.

This framework will provide a representation language (e.g., CycL) and an ontology.

```
($forall ?PER
  ($exists ?FANCLUB
    ($implies ($and ($isa ?PER FamousPerson)
      ($isa ?FANCLUB ($MobFn Person)))
      ($groupMembers ?FAN ?FANCLUB))
    ($feelsTowardsObject ?FAN ?PER
      ($Admiration ($Positive)))))
```

- Axioms are associated with concepts (collections or individuals) in micro-theories.
- *Micro-theories* can be considered *Domains*, yet not fine-grained enough for SMT.
Rule-Based Approaches to Noun-Noun Compounds: A Cyc Example

Given a logical framework and an ontology of concepts, one is tempted to characterize the noun-noun compounding process in rule-based terms

\[
\text{($nnRule \ "potato gun"}
\begin{align*}
\text{($and} & \text{ ($gen1s :NOUN1 #$PartiallyTangible)} \\
\text{($gen1s :NOUN2 #$ProjectileLauncher)} \\
\text{($not} & \text{ ($gen1s :NOUN1 #$Organism-Whole))} \\
\text{($isa :NOUN} & \\
\text{($SubcollectionOfWithRelationToTypeFn :NOUN2 #$launchesProjectile :NOUN1)})
\end{align*}
\]

Problems: Too TOP-DOWN and Prescriptive

Concepts should combine as a matter of definition and meaning

Rules are easily defeated by special contexts
The “Modifier” as Domain Signifier: An Example

enlightening(Mathematics)
controls(Mathematician, Maths)
isa(MathTeacher, Mathematician)
depend(MathTeacher, MathBook)
part(MathBook, Proof)
part(MathBook, Knowledge)
depend(Student, Knowledge)
location(Student, Classroom)
affect(Innumeracy, Student)

The (partial) domain of MATHEMATICS
The “Head” as Domain Signifier: An Example

curative(Medicine)
location (Medicine, Clinic)
controls (MedicProf, Medicine)
isa(Doctor, MedicProf)
affect(Clinic, Disease)
opposite(Health, Disease)
affect(Doctor, Health)
perform(Doctor, Curing)
depend(Health, Curing)

The (partial) domain of CLINIC
Structure-Mapping between Modifier and Head domains

NN-Compounds like “Math Clinic” are compressed SMT directives
An Important Class: XYZ Identity Compounds

E.g., "War Elephants were the Tanks of the Desert" (or "Hannibal's Tanks")

Can be recruited by Higher-Level Object Metaphors (e.g., Hannibal = Rommel, Carthaginians = African Corps, Scipio = Montgomery, Roman Empire = British Empire, Zama = El Alamein)
Domain Incongruence Points to Structure-Mapping

The same “features” have different meanings in different domains:

Elaborate metaphors are layered on top of less elaborate primary metaphors (e.g., see Grady)
## Structure-Mapping Combination Schemas

In the following schemas, : denotes structure-mapping alignment.

<table>
<thead>
<tr>
<th>Combination Schemas</th>
<th>Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;tiger economy&quot;, &quot;house boat&quot;</td>
<td>M : H</td>
</tr>
<tr>
<td>&quot;Chicken wing&quot;, &quot;museum exhibit&quot;</td>
<td>M—relation* → H</td>
</tr>
<tr>
<td>&quot;rib cage&quot;, &quot;chair leg&quot;</td>
<td>M—relation → R : H</td>
</tr>
<tr>
<td>&quot;digital warfare&quot;/&quot;computer game&quot;</td>
<td>M←relation1—C—relation2→ H</td>
</tr>
<tr>
<td>&quot;air cavalry&quot;</td>
<td>C←relation—M: H</td>
</tr>
<tr>
<td>&quot;criminal insanity&quot;</td>
<td>M: I←relation*—H</td>
</tr>
<tr>
<td>&quot;nuclear terrorism&quot;</td>
<td>M←relation1—C: I←relation*—H</td>
</tr>
</tbody>
</table>

* Can be considered a SMT generalization of Gagne and Shobin
Outline of This Seminar

• A definition of Conceptual Blending

• Key Ideas in Blending Theory

• Visual Blending: Image recruitment and taking metaphors literally

• Optimality Principles: Building well-formed Integration Networks

• Narrative Pastiche as Conceptual Blending

• Concluding Remarks: Further Parameterizing the Blending process
What is Conceptual Blending?

- Contains schematic structures for unifying the input spaces
- Similar to the **GROUND** of a metaphor, providing common vocabulary

What kind of schematic structures does it contain?

- **Image Schemas** (e.g., **CONTAINER**, **PATH**, **ORIENTATION**)
- **Metaphor schemas** (e.g., **PERSONIFICATION**, **INTENTIONAL-STANCE**)

How about an example?

Consider the metaphor “Death is a Farmer who is a reaper of souls”

G.S. provides the personification schema unifying Death and Farmer
The Standard "Two-Space" Model of Metaphor

"Tenor"
- Bill Gates
- Rich
- Microsoft
- Seattle
- MS-Basic
- Redmond
- Windows
- GUI
- Programmer
- Manager
- Software Manual
- GraphicWindow
- GraphicIcon

"Vehicle"
- Pope
- Rome
- Vatican
- Mass
- Devout
- Priest
- Cathedral
- Religious Icon
- Bible
- Stained Window
- Catholicism
The “Improved” Four-Space Model of F&T

**Generic Space:**
Specifies the *ground* of the integration/blend.
+ Contains relevant image-schemas to guide the blend.

**Input Spaces:**
The tenor and vehicle(s) to be blended / integrated.

**Blend Space:**
The result of blending the inputs is a new space.
+ This space may accrete new content independent of
How does Blending Work?

- Conceptual content in several input spaces is integrated into a new space
- **BUT**: only a selective projection of input content is put into blend space
- What is selectively projected is determined by:
  - The schematic structures in Generic Space
  - Optimality constraints on Blend construction (well-formedness)
- The blend space is connected to the inputs but is independent of them:
  - The blend space can be elaborated to recruit 'missing' structure
  - It may acquire new content that contradicts the original inputs
Many Blends Become Lexicalized in a Language

A person who sells flowers

Florist (1)

A shop where flowers are bought

Florist (2)
What is the Mysterious Generic Space?

- Conceptual content in several input spaces is integrated into a new space
- **BUT**: only a selective projection of input content is put into blend space
- What is selectively projected is determined by:
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<table>
<thead>
<tr>
<th>Cinematic Blend</th>
<th>Original Story Basis</th>
<th>Target Genre</th>
</tr>
</thead>
</table>
# Narrative Blending: Creative Pastiche

<table>
<thead>
<tr>
<th>Cinematic Blend</th>
<th>Original Story Basis</th>
<th>Target Genre</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Flintstones (TV)</td>
<td>The Honeymooners (TV)</td>
<td>Neolithic life</td>
</tr>
<tr>
<td>The Magnificent Seven (1960)</td>
<td>The Seven Samurai (1954)</td>
<td>Western</td>
</tr>
<tr>
<td>True Romance (1993)</td>
<td>Badlands (1973)</td>
<td>Neo-Pulp</td>
</tr>
<tr>
<td>Forbidden Planet (1956)</td>
<td>Shakespeare’s The Tempest</td>
<td>Science Fiction</td>
</tr>
<tr>
<td>Water World (1995)</td>
<td>Mad Max</td>
<td>Water-sports</td>
</tr>
</tbody>
</table>
Koestler’s Bisociation: “The Monk Problem”

Here is a classic brain-teaser puzzle, cited by Arthur Koestler (1964):

“A Buddhist monk ascends the holy mountain to pray. Setting out at dawn on Monday morning, the monk arrives at the top of the mountain at sunset, following the only road to the top, a narrow winding path. After praying and meditating for the week, he climbs down the mountain on Friday. Leaving the mountain top at dawn, he descends the path to the bottom, arriving at sunset.”

**Question:** Is there a point on the path such that the monk is at this point at the same time of day on both journeys?
Solution:
Blend both trips on both days so both occur on the same day. Traveling up and down the mountain on the same path, the monk must meet himself.
Simpler Alternative:
Graph each journey (height versus time). It’s impossible to draw the graphs so that they do not intersect.
Complex Variations of the Problem without Blends

Complex Variation:
Imagine the monk returns at NOON and that he RUNS down the mountain in two hours.
“I claim that reason is a self-developing capacity. Kant disagrees with me on this point. He says it’s innate, but I answer that that’s begging the question, to which he counters, in Critique of Pure Reason, that only innate ideas have power. But I say to that, What about neuronal group selection? And he gives no answer.”

- **The Inputs:** Kant space/time-frame, Modern time-frame
- **Generic space:** provides DEBATE Frame, organizes participants.
- **The Blend space:** we occupy the same debate frame as Kant
- **Selective projection:** we do NOT project different times / dates
The concept “Black Hole” is a paradigmatic example of blending.

**Inputs:** BLACKNESS (dark, unknown, unseen) & HOLE (rip, tear, drain)

**Generic Space:** SPACE-TIME AS FABRIC image-schema

**Blend Space:** DARK + UNKNOWN + UNSEEN RIP IN SPACE-TIME FABRIC

**Elaboration:**
- Hole as Trap - inserted items are not retrievable
- Hole as Garbage Disposal - inserted items are crushed
- Hole as Shrinking Radiator - Hawking radiation
A function of blending is to compress relations between spaces.

Inter-space relations between inputs → Intra-space relations in blend.

E.g., similarity + difference become identity + change.

E.g., sequence becomes causation.

E.g., *The Death as the Grim Reaper* Blend:

- association becomes partonomy (skull becomes part)
- metonymy becomes identity (identity with skeleton)
Blending in Words and Sentences

- **Formal blends:**
  - Chunnel = Channel + Tunnel,
  - Bollywood = Bombay + Hollywood
  - McJobs = McDonalds + Jobs

- **Causal Constructions:**
  - "Mary sneezed the napkin off the table"
  - SNEEZE ⇒ BLOW + "Mary blew the napkin off the table"
De-Automatization and Re-Blending

- Idiomatic phrases are non-compositional + automatically chunked
- But a special class of piecewise combining idioms can be de-automatized
- E.g., in "spill the beans" - the "beans" refers to a secret
- De-automatization occurs when we try idioms literally + compositionally
- Now, if we make compositional changes, we can re-blend the idiom
  - changes include: specialization (e.g., French beans)
  - changes include: visualization (i.e., Rebus construction)
Icon Concept Recruitment:
Non-iconic concepts can be more recognizably visualized by recruiting a more iconic metaphor or metonym.

Here, BANK is better represented via the more visual metaphor PIGGY-BANK.

De-blending / Disintegration:
Note how this visual image deconstructs the BANK-AS-PIG metaphor. Yamaichi is visually depicted as a DEAD PIG.

Pig also fits the theme of Tamaguchi, so

YAMAICHI = PIG = GOVERNMENT PET.
Examples of Visual Blending: #2

**Icon Concept Recruitment:**
Contextual forces influence the recruitment of iconic concepts.

Here, **RUSSIAN POLITICIANS** (not iconic) are represented as **RUSSIAN DOLLS** (highly iconic). But why dolls?

**Lexical Metaphor Recruitment**
The cartoonist wishes to visualize the idiom “Russian politicians *are falling like [bowling] pins*”.

To depict **RUSSIAN POLITICIANS** as pins, it is more apt to represent them as **RUSSIAN DOLLS**, which resemble pins.
Examples of Visual Blending: #3

Lexical Metaphor Recruitment:
The cartoonist wishes to visualize the metaphor **POLITICAL RESHUFFLE** by returning to the literal source of the metaphor, **CARD-SHUFFLE**.

Icon Concept Recruitment:
In turn, the literal concept **CARD-SHUFFLE** introduces the highly iconic concept **FACE-CARD**, which can be visually blended with the images of the appropriate politicians.

Note also the use of other lexical metaphors **KNAVE**, **ACE** and **QUEEN**.
Lexical Metaphor Recruitment:
The cartoonist wishes to visualize the metaphor **PILLAR-OF-COMMUNITY** by re-activating the basis of the metaphor **UPSTANDING-PERSON AS PILLAR**.

Icon Concept Recruitment:
In turn, the literal concept **PILLAR** is very similar to the literal concept **STATUE**, indeed, statues often serve as pillars. This similarity allows **PILLAR** to be visually blended with political images via the intermediary concept **STATUE**.
A Blend/Integration-Network is well-formed when the following hold:

1. Integration Constraint: individually manipulated elements

2. Web Constraint: blend connectivity to input elements

3. Unpacking Constraint: input spaces can be reconstructed

4. Topological Constraint: inputs are isomorphically combined

5. Good Reason Constraint: equiv. to systematicity in SMT
Consider the blend **POLITICS IS WAR**. The **Integration constraint** requires:

All blended elements (such as **POLITICIAN** and **WARRIOR**) should be readily manipulated as single conceptual units, e.g., as **POLITICAL-WARRIOR**.

*I.E., Blended elements are effectively fused to create new compound concepts that can be manipulated as if they are atomic entities.*
Consider the blend POLITICS IS WAR. The Web constraint requires:

This constraint counter-balances the Integration constraint and ensures that integration does not sever the links between newly blended elements and their original inputs.

I.E., This requires that the fused concept POLITICAL-WARRIOR remains connected to both the concepts POLITICIAN and WARRIOR.
Consider the blend POLITICS IS WAR. Unpacking requires that:

Any agent who comprehends the blended-space of an integration should be able to reconstruct the network of input spaces (using Web) that gave rise to it *

I.E., This requires that the concept POLITICAL-WARRIOR should be sufficiently connected in the ontology to allow us to unpack the spaces POLITICS and WAR.

* NB: especially necessary for creative of humorous blends
Consider the blend *POLITICS IS WAR*. **Topology** requires that:

The relational structure of the blended space employs any relationships from the input spaces in a manner which is consistent with their original form (e.g., not reversed, etc.)

I.E., This is the equivalent of the Isomorphism imposed by Structure-Mapping Theory. So Topology requires the input spaces are isomorphically aligned before projection into the blend space.
Consider the blend POLITICS IS WAR. Good Reason requires that:

An element of the input spaces is projected into the blend space only if there is good reason to do so, because it is part of a larger projected structure. Disconnected or floating elements should not be projected.

I.E., This is the equivalent of the systematicity required by SMT. Only structurally connected sub-graphs of the inputs are projected into the blend space.
Implementations of Blending Theory

Not very many attempts. Here are a representative few:

  A structure-mapping model of metaphor and analogy, extended with notions of generic space.

- **Divago** (Francisco Pereira, 2000, 2001, 2002, 2003 ...)
  A model of computational creativity and free generation that uses frames, concept maps, and Sapper-like mapping.
  *Used for noun-noun compounds, image blends for games*

- **Category Theory** (Joseph Goguen, 1999)
  User interfaces, Algebraic Semiotics
Not all Mapping Blends are Isomorphic

**Problem:**
Place the letters ‘A’ ... ‘J’ into the circles so that no adjacent circles contain contiguous letters.

**Hints:**
- Fill the red circles first!
- Think in an un-isomorphic way
**Constructor Space:**
This space contains the schematic structures that allow the generic-space to be constructed from the input spaces.

This allows the blending process to be further abstracted and parameterized.

**Which Constructors?**
- The triangulation rule
- The squaring rule
- Slippage rules
The Limits of Blending: Enough is Enough

- Does CBT specify which composite structures are NOT blends?

  *E.g.,* is the noun-combination “red pencil” a blend?

- More importantly, is it worth analyzing as a blend?

- Is blending a vocabulary or a cognitive model? Is it cognitively real?

- F&T suggest that even “sensor fusion” is blending.

- If every composite thing is a blend, is blending a vacuous theory?

- Is Conceptual Blending Theory a falsifiable scientific theory?
Concluding Remarks

- Blending is an appealing and powerful framework for concept integration

- **BUT:** Still not a theory - it is not yet falsifiable

- **BUT:** Overly powerful - seeks to explain too much for too many

- **BUT:** Not clearly associated with any cognitive process or mechanism

- **BUT:** Not yet fully realizable as a computational model

- **YET:** May survive as a compelling model if suitably down-sized
Analogical Mapping
In Lexical Ontologies

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Tony.Veale@UCD.ie
### Seminar Overview: Four Themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Authors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taxonomies and Ontologies</strong></td>
<td>[Aristotle, Lenat]</td>
<td>Classical approach to the Systematic Org. of Knowledge (concepts, words)</td>
</tr>
<tr>
<td><strong>Basic-level Categories and Natural Hierarchies</strong></td>
<td>[Rosch, Lakoff]</td>
<td>Cognitively plausible organization of human knowledge</td>
</tr>
<tr>
<td><strong>Analogue Reasoning</strong></td>
<td>[Evans, Gentner, Winston]</td>
<td>Coherent mappings/correspondences from one domain of discourse to another.</td>
</tr>
<tr>
<td><strong>WordNet</strong></td>
<td>[Miller, Fellbaum]</td>
<td>A large-scale taxonomy of lexical concepts describing English.</td>
</tr>
</tbody>
</table>
The Scholastic Aptitude Test (S.A.T.) uses Lexical Analogies

E.g.,

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>is to</th>
<th>Weed</th>
<th>as</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Cancer</td>
<td>is to</td>
<td>Tumour</td>
<td></td>
</tr>
<tr>
<td>(b) Shampoo</td>
<td>is to</td>
<td>Hair</td>
<td></td>
</tr>
<tr>
<td>(c) Seducer</td>
<td>is to</td>
<td>Lady</td>
<td></td>
</tr>
<tr>
<td>(d) Ketchup</td>
<td>is to</td>
<td>Fries</td>
<td></td>
</tr>
<tr>
<td>(e) Bacteria</td>
<td>is to</td>
<td>Antibiotic</td>
<td></td>
</tr>
</tbody>
</table>

Or, in a more compact format:

Doubloon is to Coin as ??? is to Ship
(a) genus to species: "Here stands my ship", in which "to be at anchor" is a specialisation (species) of the more generic term "to stand still".

(b) species to genus: "Truly ten thousand noble deeds hath Odysseus done", in which "ten thousand deeds" is a specialisation of the term "large number".

(c) species to species: "Drawing off the life with bronze" and "Cutting off the water with unwearied bronze" are both variations of the abstraction "to take away".

(d) proportional analogy: "The wine cup is to Dionysus as the shield is to Ares", in which the analogy allows the term combination "cup of Ares" to replace "shield", and the combination "shield of Dionysus" to replace "cup".

Multi-Relational Analogies: Structure-Mapping Models

Relational-networks structure are connected using an isomorphic mapping
In contrast, **Lexical Analogies** exploit **Semantic Field** structures.
A Aristotelian tradition of Genus, Species and Differentia
WordNet: A Lightweight Ontology of Lexical Concepts

Concepts are SynSets (Synonym Sets) Nouns hierarchy is organized by isa links
Metaphoric Trivialization

```
PHYSICAL_OBJECT
  isa
  ARTEFACT
    isa
    FURNITURE
      isa
      TABLE
        isa
        ARM CHAIR
          ...isa...SUM
          DINING CHAIR
            isa
            OFFICE CHAIR
              isa
              ...OTHER

NATURAL_KIND
  isa
  BEING
    isa
    HUMAN
      isa
      ZEUS
        isa
        APOLLO
          ...OTHER

isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
isa
```
Basic-Level Categories

**Household Domain**
- **FURNITURE**
  - **TABLE**
  - **CHAIR**
  - **BED**
  - **ARM CHAIR**
  - **DINING CHAIR**
  - **OFFICE CHAIR**

**Greek Domain**
- **BEING**
  - **HUMAN**
  - **GOD**
  - **ANIMAL**
  - **ZEUS**
  - **HERA**
  - **APOLLO**
"Who is the Hellenic Minerva?"
Analogical Pivots

“What is the kosher beta?”

Pivots are the analogical signposts into different domains of an ontology
Identifying the Target Domain of a Lexical Analogy

The Modifier term provides a domain cue that lexically primes other retrieval cues
Some Examples of Lexical Analogies  (using WordNet)

Lexical analogies map an entity from one semantic field to another

*Relative position within category/semantic-field is preserved by the mapping*

### Some Examples

<table>
<thead>
<tr>
<th>Varuna is the Hindu Zeus</th>
<th>Thor is the Viking Donar</th>
</tr>
</thead>
<tbody>
<tr>
<td>A mosque is a Muslim church</td>
<td>A synagogue is a Jewish mosque</td>
</tr>
<tr>
<td>The Quran is the Islamic bible</td>
<td>The Vedas are the Hindu Koran</td>
</tr>
<tr>
<td>An ophthalmologist is an eye surgeon</td>
<td>A plagiarist is a literary thief</td>
</tr>
<tr>
<td>The Christian Mecca is Bethlehem</td>
<td>The Hindu heaven is Nirvana</td>
</tr>
<tr>
<td>Lobster eggs are called roe</td>
<td>A beer house is a brewery</td>
</tr>
<tr>
<td>A Mexican chilli is a jalapeno</td>
<td>The Christian Beelzebub is Satan</td>
</tr>
</tbody>
</table>
Most analogies relate elements that differ in a single dimension of meaning:

E.g., Jewish Mosque = Synagogue (Religion)
and Hat Tailor = Milliner (Covering)

Entities in a 1-D analogy can be situated on a segmented 1-D line
Mapping can be done between different entities along the same line
A Typology of Lexical Proportional Analogies

Some lexical analogies are richer than others and involve more structured semantic fields / conceptual spaces:

(a) **0-dimensional**: Two unique concepts can differ along 0 dimensions of meaning
(b) **1-dimensional**: Two unique concepts can differ along 1 dimension of meaning
(c) **2-dimensional**: Two unique concepts can differ along 2 dimensions of meaning
(d) **3-dimensional**: Two unique concepts can differ along 3 dimensions of meaning
(e) **n-dimensional**: Two unique concepts can differ along n dimensions of meaning

Let’s look at some examples before exploring the ramifications of this typology
A Typology of Lexical Proportional Analogies

We can generalize from these simple analogies to formalize different classes of possible lexical analogies based on their dimensionality.

(0-D) **Synonyms**: Two lexical concepts can differ along 0 dimensions of meaning.

(1-D) **Loose**: Two lexical concepts can differ along 1 dimension of meaning.

(2-D) **Precise**: Two lexical concepts can differ along 2 dimensions of meaning.

(3-D) **Exacting**: Two lexical concepts can differ along 3 dimensions of meaning.

Analogies of higher-dimensionality allow a user to pin-point a concept in a target domain with higher levels of exactitude.
Entities in a 2-D analogy can be situated in a 2-D space and mapped accordingly. Mapping can be done within columns or between columns (same row).
Three-Dimensional Analogies

Greek | Roman | Celtic

supreme | wisdom | love | sea
fertility | queen | war | hearth
moon | sun

3-Dimensional analogies are rare beasts, but we must imagine that even higher-dimensionality analogies exist.
Multi-Dimensionality in Lexical Ontologies like WordNet

Defn: goddess of wisdom and ... implicit

Defn: supreme cosmic deity implicit

GREK_DEITY

greek

GREEK_DEITY

ZEUS

GAEA

ATHENA

DEITY

hindu

HINDU_DEITY

BHUMI_DEVI

VARUNA

GANESH
Multiple -Dimensionality  =  Multiple -Inheritance
Conversely, Single-Inheritance = Single-Dimensionality

This is how the impoverished letter ontology actually looks in WordNet
Implicit Alignable Features must be Reified from Glosses

Defn: god of wisdom or prophesy

Defn: goddess of wisdom and...

alignable
Technique applied to 69,780 unique word senses in WordNet 1.6 (whose glosses contain 35,397 different unlemmatized content words).

2806 of these content words are reified, creating 9822 new differentiators.

These new nodes differentiate 2737 existing superordinate nodes.

18,922 subordinate nodes receive one or more additional basic-level parents.

An review suggests that WordNet is being differentiated in new and analogically interesting ways.
## Empirical Analysis

<table>
<thead>
<tr>
<th><strong>Common Basis</strong></th>
<th><strong>Greek</strong></th>
<th><strong>Roman</strong></th>
<th><strong>Hindu</strong></th>
<th><strong>Norse</strong></th>
<th><strong>Celtic</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>supreme</td>
<td>Zeus</td>
<td>Jove</td>
<td>Varuna</td>
<td>Odin *</td>
<td>N/A</td>
</tr>
<tr>
<td>wisdom</td>
<td>Athena</td>
<td>Minerva</td>
<td>Ganesh</td>
<td>N/A</td>
<td>Brigit</td>
</tr>
<tr>
<td>beauty, love</td>
<td>Aphrodite</td>
<td>Venus</td>
<td>Kama</td>
<td>Freyja</td>
<td>Arianrhod</td>
</tr>
<tr>
<td>sea</td>
<td>Poseidon</td>
<td>Neptune</td>
<td>N/A</td>
<td>N/A</td>
<td>Ler</td>
</tr>
<tr>
<td>fertility</td>
<td>Dionysus</td>
<td>Ops</td>
<td>N/A</td>
<td>Freyr</td>
<td>Brigit</td>
</tr>
<tr>
<td>queen</td>
<td>Hera</td>
<td>Juno</td>
<td>Aditi</td>
<td>Hela</td>
<td>Ana</td>
</tr>
<tr>
<td>war</td>
<td>Ares</td>
<td>Mars</td>
<td>Skanda</td>
<td>Tyr</td>
<td>Morrigan</td>
</tr>
<tr>
<td>hearth</td>
<td>Hestia</td>
<td>Vesta</td>
<td>Agni</td>
<td>N/A</td>
<td>Brigit</td>
</tr>
<tr>
<td>moon</td>
<td>Artemis</td>
<td>Diana</td>
<td>Aditi</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>sun</td>
<td>Apollo</td>
<td>Apollo *</td>
<td>Rahu</td>
<td>N/A</td>
<td>Lug</td>
</tr>
</tbody>
</table>

Recall/Precision: 61%/93% (dynamic) versus 34%/12% (static)
Productive Semantic Fields for Analogical Extension

**Nationalities**

Mexico_Dish \( \{ \text{taco}, \ \{ \text{burrito}, \ \{ \text{refried}\_\text{beans} \} \} \) …

**Compass Directions**

Northern_Constellation \{Hercules\}  Southern_Constellation \{Andromeda\}

**Ingredients and Substances:**

Cheese_Dish \( \{ \text{Pizza}, \ \{ \text{Lasagne} \} \), Meat_Dish, Rice_Dish, etc. ...

**Instrument and Activity Types:**

Team_Sport, Ball_Sport, Court_Sport, Racket_Sport, Net_Sport

**Cultural Dimensions**

Ontological Insights

- Large ontologies are prone to errors of omission and imbalance:
  - Too undifferentiated for fine grain similarity judgements;
  - Too lop-sided for precise analogical mapping.

- Basic categories are the key to taxonomic analogies/similarity judgements

- New categories can be inferred using principle of taxonomic alignability

- Basic Categories are the Sign-Posts for effective analogical reasoning

- Complementary to work in Structure-Mapping approaches

- Potential Applications: The Analogical Thesaurus
**Empirical Evaluation: Analogical Thesaurus**

<table>
<thead>
<tr>
<th></th>
<th>Deity to Deity Task</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static WN representations</td>
<td></td>
<td>0.115</td>
<td>0.34</td>
</tr>
<tr>
<td>Dynamic WN representation (+ gloss-feature reification)</td>
<td></td>
<td>0.935</td>
<td>0.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Letter to Letter Task</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static WN representations</td>
<td></td>
<td>0.04</td>
<td>0.98</td>
</tr>
<tr>
<td>Dynamic WN representation (+ gloss-feature reification)</td>
<td></td>
<td>0.96</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Let’s return to the Scholastic Aptitude Test (SAT)

E.g.,

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>is to</th>
<th>Weed</th>
<th>as</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Cancer</td>
<td>is to</td>
<td>Tumour</td>
<td></td>
</tr>
<tr>
<td>(b) Shampoo</td>
<td>is to</td>
<td>Hair</td>
<td></td>
</tr>
<tr>
<td>(c) Seducer</td>
<td>is to</td>
<td>Lady</td>
<td></td>
</tr>
<tr>
<td>(d) Ketchup</td>
<td>is to</td>
<td>Fries</td>
<td></td>
</tr>
<tr>
<td>(e) Bacteria</td>
<td>is to</td>
<td>Antibiotic</td>
<td></td>
</tr>
</tbody>
</table>

Or, in a more compact format:

| Doubloon | is to | Coin | as | Galleon | is to | Ship |

<table>
<thead>
<tr>
<th>Courier</th>
<th>is to</th>
<th>Message</th>
<th><em>(from, via, by, of)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Soldier</td>
<td>is to</td>
<td>Battle</td>
<td><em>(in, to, …)</em></td>
</tr>
<tr>
<td>(b) Package</td>
<td>is to</td>
<td>Postman</td>
<td><em>(of, from, via, …)</em></td>
</tr>
<tr>
<td>(c) Judge</td>
<td>is to</td>
<td>Verdict</td>
<td><em>(of, from, , by, …)</em></td>
</tr>
<tr>
<td>(d) Prophet</td>
<td>is to</td>
<td>God</td>
<td><em>(to, from, …)</em></td>
</tr>
<tr>
<td>(e) Athlete</td>
<td>is to</td>
<td>Race</td>
<td><em>(in, …)</em></td>
</tr>
</tbody>
</table>

*Under-specified phrasal contexts yield a comparable vector-space description*

*LT combine different modules using a weighted sum (via Machine-Learning)*

*Use Web-search to find page counts that can then populate feature vectors*
Pairwise WordNet Similarity for solving S.A.T. Analogies

E.g.,

- **Ostrich** is to **Bird**
  - Ostrich is a **big** bird
- (a) **Cub** is to **Bear**
  - Cub is a **small** bear
- (b) **Lion** is to **Cat**
  - Lion is a **big** cat
- (c) **Ewe** is to **Sheep**
  - Ewe is a **female** sheep
- (d) **Turkey** is to **Chicken**
  - Turkey is **big** bird
- (e) **Jeep** is to **Truck**
  - Jeep is a **big** car

**Analogical Similarity** is a relative measure that creates its own abstractions

Analogical Similarity can be formulated as a Pairwise similarity measure
Pairwise Similarity for solving S.A.T. Analogies

<table>
<thead>
<tr>
<th>Buddhist</th>
<th>is to</th>
<th>Buddhism</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Soldier</td>
<td>is to</td>
<td>War</td>
</tr>
<tr>
<td>(b) Muslim</td>
<td>is to</td>
<td>Islam</td>
</tr>
<tr>
<td>(c) Christian</td>
<td>is to</td>
<td>Bible</td>
</tr>
<tr>
<td>(d) Scientist</td>
<td>is to</td>
<td>Science</td>
</tr>
<tr>
<td>(e) Doctor</td>
<td>is to</td>
<td>Medicine</td>
</tr>
</tbody>
</table>

\[ \pi (\text{Buddhist} : \text{Buddhism}, s_i : t_j) = \mathcal{E}(\tau(\text{Buddhist}, s_i), \tau(\text{Buddhism}, t_j)) \]

In each case, we need to a pair-wise measure of similarity. E.g.,

\[ s_0 : t_0 \]
\[ s_1 : t_1 \]
\[ s_2 : t_2 \]
\[ s_3 : t_3 \]
\[ s_4 : t_4 \]
\[ s_5 : t_5 \]
Taxonomic Similarity in **WordNet**: A lightweight Lexical Ontology

\[ \omega = \text{Lesk gloss overlap} \]

\[ \tau(c_i, c_j) = \frac{2 \* \delta(p_{ij}) + 2 \omega}{\delta(c_i) + \delta(c_j) + 2 \omega} \]
Categories of **Function** are more important than that of **Categories of Form**

**Crude Oil** → **non-Container**

Mapping of *Container* to *non-Container*

Metaphor: Researchers call this intuition “The Invariance Hypothesis”
Analogical Similarity = Pairwise **Taxonomic Similarity**

Let $\tau(x, y)$ = the taxonomic similarity of $x$ and $y$ (e.g., MSRA measure)

Let $v$ = the number of violations of the invariance hypothesis

Let $\alpha$ and $\beta$ = configurable weights (e.g., $\alpha = 2$ and $\beta = 1$)

$$
\pi(s_i : t_i, s_j : t_j) = \alpha \cdot \max(\tau(s_i, s_j), \tau(t_i, t_j)) + \beta \cdot \min(\tau(s_i, s_j), \tau(t_i, t_j))
$$

$$
10^{v-1} (\alpha + \beta)
$$
Hypothesis: Analogical Similarity $\equiv$ Latent Semantic Similarity

Each pairing $s_i:s_j$ is a mini-document that can be mapped to LSA space
(or, transversely: each pairing $s_i:t_i$ is a mini-document in LSA space)

$$\pi(s_i:t_i, s_j:t_j) = \text{LSA}(doc(s_i, t_i), doc(s_j, t_j))$$

or
transversely
$$= \text{LSA}(doc(s_i, s_j), doc(t_j, t_j))$$
Experiment: Analogical Similarity ≠ Latent Semantic Similarity

Corpus: 374 real S.A.T. analogies (kindly provided by Turney and Littman)

<table>
<thead>
<tr>
<th>Latent Semantic Analysis</th>
<th>Direct</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term-to-term</td>
<td>0.22</td>
<td>0.18</td>
</tr>
<tr>
<td>Document-to-document</td>
<td>0.24</td>
<td>0.18</td>
</tr>
<tr>
<td>Random choice*</td>
<td>0.20</td>
<td>0.20</td>
</tr>
</tbody>
</table>

* Each S.A.T. analogy presents five candidate pairings
Finally: WordNet sits the S.A.T.

WordNet would still need a football scholarship to get into Princeton!

<table>
<thead>
<tr>
<th>Analogical Similarity Model</th>
<th>Precision</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pairwise similarity with invariance hypothesis</td>
<td>0.42</td>
<td>100% (374)</td>
</tr>
<tr>
<td><code>noun:noun</code> source pairings only</td>
<td>0.45</td>
<td>56% (211)</td>
</tr>
<tr>
<td><code>entity:entity</code> source pairings only</td>
<td>0.53</td>
<td>24% (94)</td>
</tr>
</tbody>
</table>
Metaphor as a Strategy for Producing Humour
“Robert Browning said of poetry that a metaphor was when you take two ideas and you combine them and produce not a third idea but a star. I always think the same is true of comedy and you take two ideas and produce not a star but a laugh.”

“[My favourite sketch is] The Spanish Inquisition. It's really, really funny but there's no perceptible rationale behind it, or no perceptible comic analysis - to me that's the most wonderful thing, when you can get comedy that is incapable of analysis and that's a kind of magical quality.”

_Terry Jones, writer and director, quoted in New Insight 2002._
<table>
<thead>
<tr>
<th>Metaphor</th>
<th>Humour</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Juxtaposition of two ideas or domains</td>
<td>A juxtaposition of two interpretations, scripts or perspectives</td>
</tr>
<tr>
<td>Is often marked by a semantic anomaly (e.g., Juliet is the sun)</td>
<td>Is often marked by incongruous or impossible situations</td>
</tr>
<tr>
<td>Metaphors can be striking and establish a semantic tension</td>
<td>Jokes establish a humorous <em>frisson</em> or tension</td>
</tr>
<tr>
<td>Old, tired metaphors are often called “dead” metaphors</td>
<td>Old, tired jokes are often called “dead” jokes (the joke is dead!)</td>
</tr>
</tbody>
</table>
Humour and Incongruity

All humorous stories (jokes) have one common characteristic: **INCONGRUITY**

I.E., there is a contradiction in what is expected and what develops in the end.

Some Examples:

[said by old man]  I still have sex at 74.

<< pause >>

I live at no. 75, so it’s no distance for me.

Women are always using me to advance their careers.

<< pause >>

Damned Anthropologists!!!
Raskin’s SSTH is a model of narrative humour and assumes joke narratives can be analysed using the Script structures of Schank and Abelson (1977).

Each joke will be compatible with multiple scripts, one of which will appear more salient than others to the listener.

The punch-line of the joke contains an incongruity that forces the listener to reject the salient script for an alternative that resolves the incongruity.

Incongruities in SSTH are Semantic in nature. Raskin provides a catalogue that contains death/life, sex/no-sex, etc.

In SSTH, incongruity resolution often forces the listener to backtrack.
The GTVH represents a modular re-imagination of the SSTH by Salvatore Attardo and Victor Raskin to better elucidate the individual knowledge-sources and mechanisms that contribute to the comprehension of verbal humour.

The GTVH supposes modules such as: narrative structure, text composition and logical mechanism (or LM).

The Logical Mechanism is the most controversial element of the GTVH.

The logical mechanism (LM) underlies the specific logic of the joke that leads to the incongruity that forces the script switch (as in SSTH).

Attardo and Raskin identify a variety of possible logical mechanisms.
Logical Mechanisms in the GTVH

**False Analogy**

E.g., “A mad scientist builds a rocket to travel to the sun. To avoid being cremated on arrival, he plans to launch the rocket at night.”

False analogy: SUN = LIGHT-BULB (when it is not bright, it is not on, thus not hot)

**Figure Ground Reversal**

E.g., “Q: How many X’s does it take to change a light-bulb? A: 100 – one to hold the light-bulb and 99 X’s to spin the room around.”

Reversal: the participants rotate the ground (room) rather than figure (lightbulb)
Seana Coulson’s Blending Frame-Shifting Model (2000)

**Generic Space:**
Contains unifying image schemas and abstract frames.

**Input Spaces:**
Contains two alternative perspectives on the joke, one dominant and one less so.

**Blend Space:**
Structures the content of the joke from the perspective of the second input space.
Incongruity Resolution and Humour: The Whodunnit

The Incongruity:

A famous scientist is found dead in his office, stabbed in the chest with a letter opener. He is alone, and all the doors and windows in the office are locked from the inside. There is no other way in. Did he commit suicide? Was he murdered? Whodunit?

The Resolution:

He was killed. The murderer mailed a book (by the scientist himself) to the scientist to be signed by him and returned in the enclosed stamped addressed envelope. However, a deadly hallucinogenic drug has been placed on the gum flap of the SAE, and when licked, causes the scientist to go crazy and stab himself with the letter-opener. By the time the police arrive, the signed book has been placed in the killer envelope and dropped into the outbox.
Incongruity Resolution and Humour: Magic Tricks

The Incongruity:

A hand-cuffed Houdini comes on stage and is lowered from his shackled ankles into the water cell, a glass tank completely filled with water. A curtain is drawn around the tank while he attempts to escape before he drowns. After five minutes he does not appear. An assistant in a dark robe runs to the tank and shatters it with an axe to release the performer, but the tank is empty. After the audience gasps, the assistant pulls off his robe to reveal that he himself is Houdini.

The Resolution:

Houdini escaped from the tank as soon as the curtain was pulled back – the handcuffs and shackles were a red herring. He reappeared on stage via a trap-door.
The Incongruity:

A philosopher advances a proposition that appears reasonable, or is tacitly presumed by a large part of the philosophical community (e.g., that AI is possible). By constructing a thought experiment in which this proposition is crucial, the philosopher shows how the proposition leads to an obvious contradiction.

The Resolution:

The philosopher concludes, the proposition must be false (e.g., see Searle’s dubious Chinese Room argument, medieval retorts to the Ontological Argument, etc.)
Incongruity Resolution and Humour: Script Switching

**The Incongruity:**
A man walks into a restaurant at 8pm, at the start of the busy period. The waitress comes over and says hello. The man leaves without paying and goes across to the bar across the road.

**The Resolution:**
The man is NOT going to the restaurant to eat, but to pick up his girlfriend. She works in the restaurant as a waitress, and will meet him in the bar across the road when her shift finishes.
Why are some Incongruities **Humorous**, and others not?

Incongruity Resolution is the basis of several well-known theories of humour:

E.g., Victor Raskin's **SSTH** *(Semantic Script Theory of Humour)*

Attardo & Raskin's **GTVH** *(General Theory Verbal Humour)*.

Now, perhaps incongruity Resolution *is* important, but is it the whole story?

**SO:**  What are the non-humorous incongruity resolutions lacking

**AND:**  What extra elements do the humorous incongruities possess?
Socially Grounded **Goals** …

Consider the following comment:

<< *In gruff, Marlowesque voice* >>

After dinner and a few martinis, I went to Solly's casino to play a few games. In minutes I had picked up twelve G's.
… and (Figure/Ground) Reversals of Fortune

<< In tired, not-so-Marlowesque voice >>

... It was the worst game of Scrabble I ever played!

The incongruity involves a reversal of fortune for the speaker, who goes from a winning position to a losing position once the incongruity is resolved.

The accepted social goals of the speaker are thwarted: he goes from hero to zero.

The joke shows how circumstances thwart the speaker and his goals (we share).
Visceral Humor …

<< In an upbeat happy voice >>

Q: What’s the worst thing about having a lung transplant?
… and Our Bodily-Grounded Sense of Disgust

<< In a horribly gleeful voice >>

A: The first time you cough, it isn’t your phlegm!

The sense of having someone else’s phlegm in your mouth is both unexpected and viscerally disgusting, but in a safe way (since it is not real, just imagined)

This is reminiscent of ‘Cooties’ in Evolutionary Psychology (e.g., Pinker, Cosmides, Toobey) that pre-figures the scientific notion of germs transfer

In fact, evolutionary psychology points to a whole body of physical and social schemas that serve a vital pre-theoretic function that humour can exploit.
Kinship and Cultural Taboos

[Dozens in Harlem]
Your mamma is so fat, her picture fell off the wall. Your mamma is …

[in the Ozarks]
I bet you only go to family functions so that you can meet women

[in Paris]
Hey stupid, are your Belgian or what?

In European invective, promiscuity of female kin is a potent form of humorous insult.

In Southern-Europe, blasphemy is potent, but anti-clerical humour is more acceptable
There is sometimes a SALIENCE GAP between what a speaker intends by a figurative utterance and the way that utterance is understood by the listener.

This is particularly so with IDIOMS, which are largely non-compositional to the speaker, but which must be assembled compositionally by the listener.

The SALIENCE GAP means that a listener can deliberately construe a speaker utterance as literal even when the speaker’s intention is clearly figurative.

So a witty listener can exploit the SALIENCE GAP to deliberately undermine the communication goals of the speaker.

Recognizing the SALIENCE GAP requires great subtlety, quick reactions and wit.
Mrs. Churchill: Think of it as a blessing in disguise …

Winston Churchill: Well, it’s a bloody good disguise!

Werner Von Braun: I aim for the stars! (book title)

Critic: I aim for the stars, but I keep hitting London!

Wife: Your relatives, I suppose?! (pointing to apes at a zoo)

Husband: Yes, my in-laws.

Charles the Bald: What separates an Irishman from a fool?

John Scotus (Irish): Only this table!
### The Data: More Examples of Metaphoric Trumping

<table>
<thead>
<tr>
<th>Name</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vladimir Putin:</td>
<td>Russia is no longer a <em>banana republic</em>, you know.</td>
</tr>
<tr>
<td>Tony Blair:</td>
<td>I know, now Russia has to <em>import its bananas</em>!</td>
</tr>
<tr>
<td>Charles the Bald:</td>
<td>I want a man who wasn’t afraid to say “<em>Boo</em>” to a <em>goose</em></td>
</tr>
<tr>
<td>John Scotus:</td>
<td>Boo!</td>
</tr>
<tr>
<td>Wife:</td>
<td>Don’t worry, I see a <em>light</em> at the end of the tunnel.</td>
</tr>
<tr>
<td>Husband:</td>
<td>Yes, a <em>no-exit sign</em>!</td>
</tr>
<tr>
<td>Angry CEO:</td>
<td>I do the work of two people for this company?</td>
</tr>
<tr>
<td>Chairman of board:</td>
<td>Yes, <em>Laurel and Hardy</em>.</td>
</tr>
</tbody>
</table>
Metaphoric Trumping As a Logical Mechanism in Humour

We can take a game-theoretic perspective on Trumping (Speakers are Players):

**Player 1**  
Opens with a conventional figure of speech \( F \)  
(e.g., \( F = \) metaphor, metonymy, idiom, etc.)

Where: \( F \) serves a communicative goal \( G \)  
(e.g., \( G = \) ego-boost, insult, persuasion, etc.)

**Player 2**  
Responds with an utterance that extends \( F \) into \( F' \)  
(e.g., \( F' = \) a metaphorical extension of \( F \), etc.)

Whereby: \( F' \) trumps \( F \) by modifying \( F \) to imply \( \neg G \) rather than \( G \)
Hintikka’s Game-Theoretic Semantics (GTS)

Two abstract players compete to assign contrary semantics to an utterance.
Affirmation and Hyper-Understanding

Note how Player 2 overtly agrees with, and affirms, what player 1 says.
This is the very essence of trumping humour.

WHY?

Humour is a social construct that has evolved to encourage group bonding, safe release of angst and aggression, and general social cohesion.

Hyper-Understanding?

Note also that player 2 does not deliberately misunderstand what player 1 says.
In fact, the opposite is true. Player 2 demonstrates hyper-understanding.

Player 2 shows a greater understanding of the conceptual basis of player 1’s figures of speech and their implications for the communication goals at the heart of the exchange.
Compositionality and Non-Compositionality of Idioms

Idioms appear to be the figures of speech most susceptible to trumping:

- Chunked as single lexical-items, used by the speaker as a single opaque object
- Comprises multiple words, which must be processed in sequence by the hearer
- The salience gap between figurative & literal is more apparent to the hearer

Many Idioms are based on Compositional Figurative Mappings (see Gibbs 1994)

Idioms can contain separable parts with assignable figurative meanings

(E.g., “Beans” $\Rightarrow$ “Secrets” in “Spill the beans”)

These identifiable compositional sub-parts allow trumping by extension

Correspond to Idiomatically Combining Phrases (Nunberg, Sag & Wasow, 1994)
Compositional Representation of Idiomatic Expressions

Use XML to fully describe partially compositional idioms

```xml
<IDIOM id = "the cream in POSS coffee">
   <ABSTRACT theme = "positive"/>

   <FOCUS id = "cream">
      <ABSTRACT theme = "positive"/>
      <literal> cream dairy_product </literal>
      <figurative> joy positive_stimulus </figurative>
   </FOCUS>

   <GROUND id = "coffee">
      <literal> coffee beverage </literal>
      <figurative> life experience </figurative>
   </GROUND>
</IDIOM>
```
One can attune to the separable parts of idioms and modify them:

```xml
<IDIOM id = "the sour_cream in POSS coffee">
  <ABSTRACT theme = "negative"/>

  <FOCUS id = "sour_cream">
    <ABSTRACT theme = "negative"/>
    <literal> sour_cream cream </literal>
    <figurative> sorrow negative_stimulus </figurative>
  </FOCUS>

  <GROUND id = "coffee">
    <literal> coffee beverage </literal>
    <figurative> life experience </figurative>
  </GROUND>
</IDIOM>
```
Supporting and Trumping: Complementary Actions

Idioms can be trumped or supported by other, parallel idioms:

<IDIOM id = “PRO was born with a silver spoon in POSS mouth”>
  <ABSTRACT theme = “negative”/>

  <FOCUS id = “silver_spoon”>
    <ABSTRACT theme = “negative”/>
    <literal> silver metal / spoon cutlery </literal>
    <figurative> wealth financial_condition </figurative>
  </FOCUS>

  <GROUND id = “mouth”>
    <literal> mouth cavity </literal>
    <figurative> birthright inheritance </figurative>
  </GROUND>
</IDIOM>
Parallel Idioms

This idiom has a parallel structure and theme, with an overlapping lexical set:

<IDIOM id = “PRO put/has a foot in POSS mouth”>
  <ABSTRACT theme = “negative”/>

  <FOCUS id = “foot”>
    <ABSTRACT theme = “negative”/>
    <literal> foot body_part </literal>
    <figurative> gaffe blunder </figurative>
  </FOCUS>

  <GROUND id = “mouth”>
    <literal> mouth cavity </literal>
    <figurative> verbal_intelligence </figurative>
  </GROUND>
</IDIOM>
Combining/Blending Idioms for Humorous Effect

<IDIOM id = "PRO was born with a silver foot in POSS mouth">
  <ABSTRACT theme = "negative"/>
  <FOCUS id = "silver">
    <literal> silver metal </literal>
    <figurative> wealth financial_condition </figurative>
  </FOCUS>
  <FOCUS id = "foot">
    <literal> foot body_part </literal>
    <figurative> gaffe blunder </figurative>
  </FOCUS>
<GROUND id = "mouth">
  <literal> mouth cavity </literal>
  <figurative> verbal_intelligence </figurative>
  <figurative> birthright inheritance </figurative>
</GROUND>
Main Points: Salience Gaps and Humour

Theoretical Assumptions behind Trumping as a Humour-Strategy:

- Trumping is a humorous phenomenon that relies on the non-opacity of idioms
- There is a Salience Gap between figurative and literal readings
- The Gap is more apparent to the listener than to the speaker
- Perception of the Gap is influenced by the goals of the speaker and listener
- Prospective wits can learn to recognize and exploit Salience Gaps
- There are some formulaic strategies for exploiting gaps if given a rich enough representation of Idiometrically Combining Expressions
- Trumping exploits the Conceptual (not just Lexical) status of Metaphor
Levels of Creation: Optimal Innovation

Consider the following conventional figures of speech, or extensions thereof:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>“You are the cream in my coffee”</td>
</tr>
<tr>
<td>2.</td>
<td>“You are the sour cream in my coffee”</td>
</tr>
<tr>
<td>3.</td>
<td>“You are the rancid milk in my coffee”</td>
</tr>
<tr>
<td>4.</td>
<td>“You are the sugar in my tea”</td>
</tr>
<tr>
<td>5.</td>
<td>“You are the sugar in my lemonade”</td>
</tr>
<tr>
<td>6.</td>
<td>“You are the sugar in my petrol-tank”</td>
</tr>
</tbody>
</table>

An innovation is *optimal* when it allows the basis of the innovation (e.g., the original expression) can be retrieved and considered in juxtaposition with the innovation. (Rachel Giora, 2002)
The content of a joke is conveyed in temporal sequence. The listener thus builds a knowledge representation of the domain in an incremental fashion.

Consider the metaphorical insult

"Prince Charles’ family tree has Dutch-Elm-Disease"

So let’s process the joke as we hear it, word by word.

The graph to the right shows the KB structure built after “Prince Charles … ”

* Certain concepts have strong positive (good) or negative (bad) connotations. We mark these with ↑ and ↓
Note: Family Tree is a lexicalized metaphor for the ancestral history of a family. Perhaps this metaphor can be de-automatized?

Processed so far: “Prince Charles’ family tree …”
We don’t yet know what the object of “has” will be.

However, we can guess that a part relationship is appropriate.

Processed so far:

“Prince Charles’ family tree has …”
When the concept **DUTCH-ELM** is activated, so are its super-types **ELM-TREE** and **TREE**.

**FAMILY-TREE** and **TREE** are bridged by a lexical metaphor.

Processed so far:

“Prince Charles’ family tree has **Dutch-Elm** …”
The Time Course of Joke Comprehension

With the activation of Dutch-Elm-Disease, the part relation can be completed. The negative concept Deformity is also activated.

Processed so far: (finished)

“Prince Charles’ family tree has Dutch-Elm disease.”
The Time Course of Joke Comprehension

Triangulation is done between DUTCH-ELM-DISEASE and INCEST. INCEST is potentially relevant since it is connected to the activated BREEDING.

INCEST is a very negative concept.

So, suddenly, the network goes from a positive connotation to a negative.
Catastrophe and Humour (see Paulos 1980)

The narrative path of a joke is mostly continuous, until the end (Paulos’80)

The punchline introduces a discontinuity that is a mathematical catastrophe

Catastrophe Theory is a mathematical model of discontinuity

Discontinuity is essentially a form of geometric incongruity
Serenissimus was making a tour of his provinces and noticed a man in the crowd who bore a striking resemblance to his own exalted person.

He beckoned to him and asked:

“Was your mother at one time in service at the palace?”

“No, your highness”, he replied, “but my father was” 

(Freud, 1938)
Key Readings in Humour