Mental Metaphors from the Master Metaphor List: Empirical Examples and the Application of the ATT-Meta System

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1. Introduction

The main aim of this report is to provide a measure of objective evaluation of ATT-Meta, a system we have implemented for conducting some of the reasoning needed in the understanding of metaphorical utterances. The report thereby also provides some evaluation of the overall theoretical approach informing ATT-Meta (Barnden & Lee, 2001). The evaluation of ATT-Meta consists of showing, at least in embryo, how the system can deal with example metaphorical utterances that rest on some of the conceptual metaphors in the Master Metaphor List developed at Berkeley (Lakoff, 1994). We will call conceptual metaphors "metaphorical views" as we find this term clearer. The List lists 207 metaphorical views used in contemporary American English. The examples we deal with are derived from ones we found by searching the Collins COBUILD Bank of English. We do not claim that all aspects of the examples are covered, but we do show how ATT-Meta can draw important information about the target domains involved in the examples. We call such items of information "[target-domain] informational contributions."

Recent work in cognitive linguistics has argued that metaphor, rather than being novel and unusual, is a pervasive and conventional aspect of language. One important direction of research has been the cataloguing of metaphorical views involved in everyday use (for example, Lakoff & Johnson, 1980). The Master Metaphor List is possibly the largest and most complete catalogue. However, it suffers from two limitations. First, the metaphorical views are defined only loosely, both in terms of the concepts and domains invoked and the mappings between different domains. Secondly, the list does not provide attested examples of the usage of the views. This paper goes some way to addressing both problems by providing, for some of the views in the List, (a) some of the examples we found in the Bank of English of the usage of those views, and (b) our illustrative implementations of how to handle such examples in ATT-Meta. We will focus on most of those metaphorical views in the Master Metaphor List that are concerned with mental states/processes and the mind. It is difficult to define exactly which views these are (for example, is love a mental state?), but we have at least included all the views from the List whose name includes the word "mind," "idea" or "belief" (for instance, IDEAS ARE POSSESSIONS). In all, we address thirteen views from the List. We concentrate on mental metaphor because this has been the focus of most of our previous work on metaphor.

The remainder of the paper is structured as follows. In Section 2, we will briefly describe ATT-Meta's handling of metaphorical reasoning and sketch how metaphorical views are represented within the system. In Section 3, we will sketch ATT-Meta implementations for the thirteen meta-

phorical views mentioned, and outline what ATT-Meta can do on simple examples inspired by instances of their use from the Bank of English. Section 4 will conclude with some further discussion.

2. ATT-Meta

This paper will merely sketch some aspects of ATT-Meta to the extent needed for the current paper, but further details can be found in (Barnden *et al.*, 1996; Barnden, 1998; Barnden & Lee, 1999; Barnden & Lee, 2001; Lee & Barnden, 2001).

ATT-Meta is an AI system capable of both simulative reasoning about beliefs and metaphorical reasoning. Reasoning is done by the use of back-chaining rules of inference which allow differing qualitative degrees of certainty. Nested reasoning spaces are allowed to facilitate simulation of other agents and metaphorical reasoning. Two types of nested space are maintained: simulation-pretence cocoons and metaphor-pretence cocoons. Simulation-pretence cocoons are used to model the beliefs of other agents. Metaphor-pretence cocoons are a special type of simulation-pretence cocoon where the agent modelled is a hypothetical agent who is assumed to believe the manifested metaphor is literally true. For the remainder of this paper we will only be concerned with metaphor-pretence cocoons.

Knowledge of different domains is encoded in sets of facts and rules which apply to a particular domain. Since metaphorical views involve a mapping from one domain (the source) to another (the target), ATT-Meta uses "conversion rules" which explicitly map propositions from one domain to another. ATT-Meta has a small set of conversion rules for each metaphorical view it knows about, as well as holding knowledge about the source domain of each such view. (ATT-Meta's conversion rules can go from target to source as well as from source to target, for reasons given in Barnden (in press).

In the ATT-Meta approach, a metaphorical view can be defined by constructing a small set of conversion rules and a set of rules to represent the source domain (and sometimes a small set of "ancillary assumption" rules that are similar to conversion rules--see Barnden & Lee, 2001). Understanding of a metaphorical utterance proceeds by creating a metaphor-pretence "cocoon" (reasoning space) where the utterance is taken as literally true, then finding implications of this within the cocoon, by source-domain reasoning, and then mapping some implications to the target domain via conversion rules. The within-cocoon derivation process can involve a substantial amount of reasoning.

In ATT-Meta, predicates can be graded, using a scale of qualitative degrees. For instance, someone can be represented as understanding a situation to a "medium" degree. However, the gradedness is almost always suppressed in the implementation descriptions below, in the interests of simplicity of exposition, even though in the actual implementation many predicates are graded.

Also, hypotheses are tagged with qualitative certainty levels, which are suppressed in this report. The inferred conclusions presented in examples below all achieve the certainty level called "presumed," which is one step below complete certainty. The certainty scale is distinct form the gradedness scale mentioned in the previous paragraph.

3. Mental Metaphors

Mental events, such as forgetting and thinking, and states, such as beliefs and intentions, are often described metaphorically. This is for two reasons. First, our mental lives play a central role in our lives and therefore are a common topic for discourse. Secondly, mental phenomena are, at best, poorly understood and often hard to describe in non-metaphorical terms. Instead speakers often rely on metaphorical views that relate aspects of mind to more concrete concepts and domains. A partial survey is given in Barnden (1997). See also our databank of examples of the use of metaphorical views of mind (Barnden, n.d.).

In this section we will provide illustrations of how such metaphorical views of mind, drawn from the Master Metaphor List, can be implemented within ATT-Meta. The format of an illustration is as follows. First, a general synopsis of the metaphorical view is given. In one or two cases, we deal with two views from the Master Metaphor List in conjunction. Following the synopsis, we include some examples of the usage of the view(s), taken from the Bank of English. A simplified, illustrative implementation of the metaphorical view is then described by means of English glosses of ATT-Meta production rules (which are, in reality, framed in a type of episodic logic used by ATT-Meta). Not all rules used in the experiments are shown. In particular, contrapositive versions of conversion rules are not shown. Finally, the nature of ATT-Meta's reasoning on a simple example of the use of the metaphorical view is briefly sketched. The example is based on the ones found from the Bank of English. The implementations have all been tested by runs of ATT-Meta. One combined production-rule set was used for all the tests, to help ensure that a well-conceived approach was taken to all the examples and views. The different metaphorical views overlap to some extent in their conversion rules and domain rules.

It is important to note that no judgement is made as to whether a particular usage is still metaphorical for a typical English speaker, or is metaphorical for all ordinary English speakers. We hold that the metaphorical status of an utterance is subjective to the understander, and therefore we deal with metaphorical utterances from the perspective of ATT-Meta, given the particular domain knowledge it happens to be given as part of the illustrative implementations.

Many metaphorical utterances describe changes and processes, but ATT-Meta does not yet have a well-developed handling of time and change. Predicates can have time arguments, but the system provides no special support for handling them. Therefore, many of our rules in this paper are highly oversimplified in omitting temporal considerations. or including only a bare-bones treatment of them. Predicates are considered either to (fail to) hold eternally or to (fail to) hold at one of two times called "now" and "before". In the English glosses of rules and facts below, the past tense refers to "before" and, unless otherwise stated, the present tense refers either to "now" or to both times (in the case of eternal predicates). The perfect tense is used for events happening at the borderline of before and now.

In the following, references in parentheses after examples are identifiers used in the Bank of English.

IDEAS ARE POSSESSIONS

Synopsis

In the metaphorical view "IDEAS ARE POSSESSIONS," mental entities are viewed as items which can be owned, discarded, swapped or simply lost (e.g., "don't give up your beliefs"). IDEAS ARE POSSESSIONS also draws on commercial aspects of the source domain: e.g. "I don't buy this idea at all."

Within the metaphorical view, the main analogical link is that believing a proposition is viewed as possessing it. No longer believing a belief is often cast as losing or even selling it, as in "you sold out your beliefs a long time ago."

Examples

1. "They do not possess the American Idea" (brbooks/04 B0000000726)
2. "The qualities successful Black people such as John Fashanu, Doune Alexander Moore and Victor Headley possess are: self-belief, self respect, a will to succeed and a capacity for hard work." (brmags/10 N0000000672)

Note that in (2) we take "possessing" the quality of self-belief to imply possessing beliefs about the worth of oneself.

Illustrative Implementation

Possessions domain:

> **(possessions are objects)**
> If X possesses Y at some time then Y is a possessable object
>   (certain)
> **(losing1)**
> If X has lost Y then X does not now possess Y
>   (presumed)
> **(losing2)**
> If X has lost Y then Y is a possessable object
>   (certain)
> **(retaining)**
> If X has retained Y then X now possesses Y
>   (presumed)
> **(inheriting)**
> If X has inherited Y then X now possesses Y
>   (presumed).

The "presumed" is a qualitative certainty rating for the rule, and can be read as "by default." Being a possessable object is an eternal property.

The rules are merely illustrative: many more would be needed in a fully realistic system.

Conversion rules:

Conversion rules map between the two domains of a metaphorical view. In the present case, the conversion rules must capture that possessing a belief means believing a belief, and not possessing it means not believing it. In the rules, "it is being pretended that P" signifies that P holds in the pretence cocoon. A "propositional idea" is an idea that can bear a truth value and be a belief.

    (possessing-TO-believing)
    If Y is a propositional idea and it is being pretended that X possesses Y at time T then X believes Y at T
      (presumed)

    (NOT-possessing-TO-NOT-believing)
    If Y is a propositional idea and it is being pretended that X does not possess Y at time T and that Y is a possessable object then X fails to believe Y at T
      (presumed).

Reasoning:

The above rules are capable of dealing with examples such as "John inherited the belief" and "John lost the belief." For example, the latter could be dealt with by creating a pretence cocoon where it is pretended that John has literally lost the belief, b:

$$\text{in-pretence-cocoon(has-lost(John, b)).}$$

Within the cocoon, using the **losing1** and **losing2** rules, ATT-Meta can infer that John does not now possess the belief, and that the belief is a possessable object. Then, using the **NOT-possessing-TO-NOT-believing** conversion rule, ATT-Meta can infer that John now fails to believe the belief.

BELIEFS ARE FASHIONS / BELIEFS ARE CLOTHES

Synopsis
Fashions are the latest and most admired style in, for example, clothes, cosmetics and behaviour. In the metaphorical view "BELIEFS ARE FASHIONS", fashionable beliefs are beliefs which are believed by the average up-to-date person. Conversely, beliefs which are considered unfashionable (taken to mean the same as out of fashion) are beliefs which were once commonly accepted but have now been rejected by the average up-to-date person. Note that out-of-fashion is stronger than merely failing to be fashionable, and something can be neither fashionable nor out of fashion.

Examples

3. "Consider the newspaper industry, the ease of entry and increase in titles conflict with the fashionable belief that the media are dominated by large media companies." (brbooks/04 B0000000352)
4. "I retain an unfashionable belief in a personalized devil." (brbooks/04 B0000001196)

Illustrative Implementation

Fashion domain:
For simplicity, we confine the notion of fashion to possessable objects.

> **(fashion-possessable)**
> If something is fashionable at some time then it is a possessable object
>   (presumed)
> **(outoffashion-possessable)**
> If something is out of fashion at some time then it is a possessable object
>   (presumed)
> **(possess-fashion)**
> If something O is fashionable at T and A is an average up-to-date person
> then A possesses O at T
>   (presumed)
> **(lack-out-of-fashion)**
> If something O is out of fashion at T and A is an average up-to date person
> then A does not possess O at T
>   (presumed)
> **(not-fashionable)** If something is out of fashion at T then it is not fashionable at T
>   (certain)
> **(not-out-of-fashion)**
> If something is fashionable at time T then it is not out of fashion at T
>   (certain).

Conversion rules:
Only the conversion rules of IDEAS ARE POSSESSIONS (see above) are needed here.

Reasoning:
The system can deal with examples such as (4) by creating a pretence cocoon where it is pretended that someone, say John, has literally retained a belief, b, which is now literally out of fashion:

in-pretence-cocoon(has-retained(John, b))
in-pretence-cocoon(out-of-fashion(b, now)).

Using the **retaining** rule from the possessions domain, ATT-Meta can infer within the cocoon that John possesses b now. Hence, using the conversion rule **possessing-TO-believing** from IDEAS-ARE-POSSESSIONS, ATT-Meta can infer that John believes b now. But using the **lack-out-of-fashion** rule, ATT-Meta can infer within the cocoon that any given average-up-to-date-person does not possess b now, so that, by the **NOT-possessing-TO-NOT-believing** rule, that person fails to believe the idea now.

IDEAS ARE RESOURCES

Synopsis

In the metaphorical view "IDEAS ARE RESOURCES," ideas can be "used up" and a person can "run out of" ideas. This implies that ideas are finite in number and are consumed by use. This metaphorical view is a special case of IDEAS ARE POSSESSIONS: we assume that people own their resources.

Examples

5. "Cash flows in as ideas run out" (guard/13 N7000950812)
6. "But then Eubank simply ran out of ideas and Thornton took the fifth and sixth rounds" (today/UK N6000920921)

Illustrative Implementation

In the following, being a resource is an eternal property.

Resources domain (extension of Possessions domain--see above):
  (resource-is-possession)
  If X is a resource for Y then Y possesses X (before and now)
    (presumed)
  (resource-is-usable)
  If X is a resource for Y then X is a usable object
    (certain)
  (runout-resource)
  If Y has run out of X then X is a resource for Y
    (certain)
  (runout-stops-usability)
  If Y has run out of X then Y cannot use X now
    (presumed).

Conversion Rules:

Since the metaphorical view is a special case of IDEAS ARE POSSESSIONS the conversion rules used in that view are applicable here. However, in addition, usage must also be mapped to thinking:-

  (can-use-TO-can-mentally-operate)
  If X is a person and Y is an idea and it is being pretended that X can use Y at time T then X can mentally operate on the basis of Y at T
    (presumed)

  (canNOT-use-TO-canNOT-mentally-operate)
  If X is a person and Y is an idea and it is being pretended that Y is a usable object and that X cannot use Y at T then X cannot mentally operate on the basis of Y at T
    (presumed).

Reasoning:

The above rules can be used to deal with examples such as "Eubank ran out of ideas." For example, a pretence cocoon can be set up where the ideas have literally run out:

in-pretence-cocoon(has-run-out(Eubank, Eubank-ideas)).

Using the **runout-stops-usability** domain rule, among others, and the **canNOT-use-TO-can-NOT-mentally-operate** conversion rule, ATT-Meta can infer that Eubank cannot mentally operate on the basis of the ideas now (if a set of ideas is treated as forming a single, larger idea).

IDEAS/BELIEFS ARE BEINGS WITH A LIFE CYCLE

Synopsis

Beliefs are often viewed as living beings and an analogy is often drawn between the time-course of a belief's validity and the life cycle of a being, e.g. new beliefs are born, and theories mature and when disproved are declared dead.

Examples

7. "That was the belief born in the experience of Easter." (usbooks/12 B9000001182)
8. "Eventually, the charter lapsed and the idea died." (usbooks/12 B9000000501)
9. "These elements, meanwhile, struggled on, keeping the Guild idea alive even though the actual organization was moribund." (usbooks/12 B9000000541)
10. "The idea was born in the Tomorrow's Church report, commissioned by the Melbourne arch diocese and completed last year." (oznews/16 N5000950922)

Illustrative Implementation

When a belief is alive is it believed by some set of relevant people, which can only be determined by discourse context. Accordingly we use here the unanalyzed notion of a "typical relevant person." Being a creature is an eternal property.

Living domain:

(creature)
If X is alive at some time then X is a creature
  (certain)
(born-alive)
If X has been born then X is now alive
  (presumed)
(living-has-been-born)
If X is now alive then X has been born
  (certain)
(death0)
If X is dead at some time then X is a creature
  (certain)
(death1)
If X is dead at time T then X is not alive at T
  (certain)
(death2)
If X is a creature and X is not alive at time T then X is dead at T
  (certain)
(death3)
If X has died then X was alive before
  (presumed).
(death4)
If X has died then X is now dead
  (certain).

Conversion Rules:

The metaphorical correspondences between the living domain and the domain of beliefs map vitality to being believed and deadness to absence of being believed

(living-TO-believed)
If X is a propositional idea and it is being pretended that X is alive at time T then a typical relevant person believes X at T
  (presumed)

(NOT-living-TO-NOT-believed)
if X is a propositional idea and it is being pretended that X is a creature and that X is not alive at time T then a typical relevant person fails to believe X at T
  (presumed).

Reasoning:

The implemented rules can handle examples such as those above. For example, (8) can be dealt with by creating a pretence cocoon where the idea is literally dead:

$$in\text{-}pretence\text{-}cocoon(has\text{-}died(idea)).$$

Using the **death1** and **death4** rules within the cocoon ATT-Meta can infer that the idea is now dead and therefore not alive. Then, using the **NOT-living-TO-NOT-believed** conversion rule, ATT-Meta can infer that a typical relevant person fails to believe the idea now.

IDEAS ARE CHILDREN

Synopsis

In the metaphorical view "IDEAS ARE CHILDREN", which is a special case of IDEAS ARE BEINGS WITH A LIFE CYCLE, ideas are viewed as children from a developmental perspective. Within this metaphorical view, a person is a parent of an idea, and ideas develop, grow and mature. Speakers tend to use this metaphorical view to comment on where a certain belief has come from and its current state: whether it is strongly believed or widely held. The metaphorical view also assumes that a collection of beliefs can comprise a "family" of interrelated ideas.

Example

11. "... also Max Planck, father of quantum theory..." (guard/13 N7000950629)

Illustrative Implementation

Our computational implementation has focussed on the parenting aspect of the metaphorical view: ideas give birth to others which are regarded as their children.

Parent/Children domain (extension of living domain--see above):

>   **(child-creature)**
>   If X is a parent of Y then Y is a creature
>   (certain)
>   (**parent-creature**)
>   If X is a parent of Y then X is a creature
>   (certain)
>   **(father-parent)**
>   If X is the father of Y then X is a parent of Y
>   (certain)
>   **(child-born)**
>   If X is a parent of Y then Y has been born
>   (certain).

Conversion Rules:

>   **(parent-TO-originator)**
>   If it is being pretended that person X is the parent of an idea Y then X is the originator of Y
>   (presumed)
>
>   **(NOT-parent-TO-NOT-originator)**
>   If it is being pretended that idea Y is a creature and person X is not the parent of Y then X is not the originator of Y
>   (presumed)

Reasoning:

Given the above rules, it is possible to deal with examples such as (11). If ATT-Meta creates a pretence cocoon where Max Planck is literally seen to be the father of quantum theory, i.e.:

$$\text{in-pretence-cocoon(father(MaxPlanck, QuantumTheory))}$$

then ATT-Meta can conclude that Max Planck was the originator of quantum theory. This is by first applying the **father-parent** rule within the cocoon and then the **parent-TO-originator** conversion rule. In addition, given the **child-born** rule, ATT-Meta can infer that Quantum Theory has been born and is therefore, by the **born-alive** rule in the Living domain, now alive. Then using the conversion rule **living-TO-believed** for BELIEFS ARE BEINGS WITH A LIFE CYCLE, ATT-Meta can infer that the idea in question is now believed by a typical relevant person.

UNDERSTANDING IS SEEING / IDEAS ARE PERCEPTIONS

Synopsis

In the metaphorical view "UNDERSTANDING IS SEEING," ideas or situations that can be "seen" are understood. Obstacles to vision result in a lack of understanding.

Examples

12. "You see, it works." (indy/03 N1000950927)
13. "Those of us who saw through the lies and rhetoric of the time remember the hostile stance to the Courier-Mail towards our protests." (oznews/16 N5000950420)

Illustrative Implementation

Our implementation deals with the informational contributions of example (13). Specifically, utterances such as "I saw through his lie" imply that despite the lie interrupting the visual field of the understander, the lie was "transparent".

Seeing domain:

> **(seeing)**
> If X is in person Y's field of view at time T then Y can see X at T
>   (presumed)
> **(front-view)**
> If X is in front of person Y at time T then X is in Y's field of view at T
>   (presumed)
> **(interrupting1)**
> If Z interrupts Y's view of X at time T then X and Z are in Y's field of view at T
>   (presumed)
> **(interrupting2)**
> If Z interrupts Y's view of X at time T then Y cannot see X at T
>   (presumed)
> **(transparency)**
> If Z interrupts Y's view of X at time T and Z is transparent then Y can see X at T
>   (presumed)
> **(see-through1)**
> If Y can see through Z at time T then Z is transparent.
>   (presumed).
> **(see-through2)**
> If Y can see through Z at time T then Z is in Y's field of view.
>   (presumed).

Conversion Rules:

(seeing-TO-understanding)
If it is being pretended that Y can see an idea/situation X at time T then Y understands X at T
  (presumed)

(NOT-seeing-TO-NOT-understanding))
If it is being pretended that idea/situation X is in person Y's field of view & that Y cannot see X at time T then Y does not understand X at T
  (presumed)

(interrupting-view-TO-lying)
If it is being pretended that utterance Z interrupts the hearer's view of situation S at time T then Z is a lie about S at T
  (presumed).

(lying-TO-interrupting-view)
If utterance U is a lie about situation S at time T and it is being pretended that U is in the field of view of the hearer of U at T then it can be pretended that U interrupts the hearer's view of S at T
  (presumed).

The second conversion rule is the converse of the first. In the other sections of this report, we do not show such converses although they are included in the implementation. Reality-to-pretence rules, which effectively provide target-to-source information transfer, are a distinctive feature of ATT-Meta. The general desirability of target-to-source transfer is argued in Barnden (in press).

The two conversion rules here also have negative versions, on the lines of the negative versions elsewhere in the report.

Reasoning:
The above rules are capable of dealing with examples such as "John can see through Mike's lie [about some situation Sitn]." We have:

  hearer-of(utterance-of-Mike, now)) = John
  is-lie-about(utterance-of-Mike, Sitn, now)
  in-pretence-cocoon(can-see-through(John, utterance-of-Mike, now))

Using the **see-through2** domain rule, ATT-Meta can infer within the cocoon that Sitn is in John's field of view now. This enables ATT-Meta to use the **lying-TO-interrupting-view** conversion rule to add to the cocoon the proposition that Mike's utterance interrupts John's view of Sitn now. But using the **see-through1** domain rule ATT-Meta can infer within the cocoon that Mike's utterance is transparent. Hence, by the **transparency** domain rule and the **seeing-TO-understanding** conversion rule ATT-Meta can infer that John understands Sitn now.

IDEAS ARE LIGHT SOURCES

Synopsis

In the metaphorical view "IDEAS ARE LIGHT SOURCES", mental entities emit light causing themselves and other objects to be visible. Often this metaphorical view is linked with the metaphorical view UNDERSTANDING IS SEEING so that an idea which is "lit" can be understood. Somewhat independently of this, ideas that are bright light sources are important and powerful. At least part of the importance and power comes from lighting up situations, but we do not deal with this here.

Examples

14. "An examination of the numbers involved sheds light on the development described by Sir Patrick as "significant and real"". (Indy/03 N1000950826)
15. "... but it gave the former sailor a brilliant idea." (today/UK N6000920117)

Illustrative Implementation

The implementation captures the point that ideas can shed light on other ideas, allowing them to be understood. In the description below, illumination and sight are to be understood to be of the basic, physical, variety.

Illumination domain (extension of Seeing domain above):

(see-illum)
If X is illuminated to some degree at time T and in Y's field of view at T
then Y can see X to at least that degree at T
  (presumed)
(illuminated)
If X illuminates Y at time T then Y is illuminated at T
  (certain)
(illuminating)
If X illuminates Y at time T then X is a light source at T
  (certain)
(shed-light)
If X sheds light on Y at time T then X illuminates Y at T
  (certain)
(proximity)
If X is close to Y at time T and X is a light source at T then X illuminates Y at T
  (presumed).
(source-illuminated)
If X is a light source at time T then X illuminates itself at T
  (presumed).

The mention of degrees in rule **see-illum** reflects the fact that seeing-ability and illumiinatedness are graded properties. This has been suppressed elsewhere in our descriptions in accordance with the general comment about gradedness in section 2.

Conversion rules:

Only the conversion rules from UNDERSTANDING IS SEEING (see above) are needed here.

Reasoning:

The above rules allow us to deal with examples such as (14). A pretence cocoon is set up where the examination physically shed light on the development, i.e.:

in-pretence-cocoon(shed-light(examination, development)).
in-pretence-cocoon(physically-in(development, field-of-view-of(speaker)), now))

The Illumination domain rules allow ATT-Meta to infer within the cocoon that the speaker can see the development now. Thus, the conversion rule **seeing-TO-understanding** from UNDER-STANDING IS SEEING allows ATT-Meta to infer that the speaker understands the development now.

The need for the second in-pretence-cocoon statement above reflects the lack in the current experiments of any general theory of what can be inferred from an utterance act about the relationships the speaker has to entities mentioned in the utterance.

THEORIES ARE BUILDINGS

Synopsis

In the metaphorical view "THEORIES ARE BUILDINGS," the structure of a theory (or approach, account, etc.) is viewed as parts of a building. For example, a theory rests on assumptions, which can be identified with the foundations of a building.

Examples

16. With this he, together with his friend, the Nobel Prize-winner Leonid Kantorovich, laid the foundations of the theory of optima in socialist economics. (usbooks/12 B9000000484)
17. But there is growing recognition that the whole basis of the uncritical check list approach to testing is on scientifically shaky foundations. (newsci/UK N4019920502)

Illustrative Implementation

Physical-Construction domain:

We wish to deal with examples like "the foundations of the theory are shaky," where a problem with the foundations of a building maps to instability of the building (Grady, 1997). To deal with this we include the following rules for the domain of physical constructions (of which buildings are a special case).

(part-construction)
If C is a physical construction and P is a part of C then P is a physical construction
  (presumed)
(building-construction)
If B is a building then B is a physical construction
  (certain)
(foundations-part)
If F is the foundations of B then F is a part of B
  (certain)
(foundations-building)
If F is the foundations of B then B is a building
  (presumed).
(foundations-support)
If F is the foundations of B then F supports B
  (presumed)
(instability)
If Y is a physical construction and Z supports Y and Z is not stable
then Y is not stable
  (presumed)
(shaky)
If Y is a physical construction and Y is shaky then Y is not stable
  (presumed).

Conversion Rules:

We need two metaphorical mappings from the physical-construction domain to the domain of theories. The stability of a physical construction is analogous to the plausibility of a theory and the foundations of a building are analogous to the basic assumptions of a theory.

(stable-TO-plausible)
If X is a body of ideas and X is being pretended to be a stable physical construction then X is plausible
(presumed)

(NOT-stable-TO-NOT-plausible)
If X is a body of ideas and is being pretended to be a non-stable physical construction then X is implausible
(presumed)

(foundations-TO-assumptions)
If it is being pretended that a theory X is a building and that F is the foundations of X then F is the basic assumptions of X.
(presumed)

(NOT-foundations-TO-NOT-assumptions)
If it is being pretended that a theory X is a building and that F is not the foundations of X then F is not the basic assumptions of X.
(presumed).

Reasoning:

We can deal with "the foundations of the theory were shaky" by creating a pretence cocoon where the theory has foundations, f, and they are shaky:

$$\text{in-pretence-cocoon(foundations-of(f, theory))}$$
$$\text{in-pretence-cocoon(shaky(f)).}$$

Using the **foundations-support, shaky** and **instability** rules, ATT-Meta can infer within the cocoon that the foundations f are unstable and therefore that the theory is unstable. Then, using the **NOT-stable-TO-NOT-plausible** conversion rule, together with a domain rules saying that a theory is a body of ideas, ATT-Meta can infer that the theory is implausible. The system can also use that conversion rule and the conversion rule **foundations-TO-assumptions** to infer that the basic assumptions of the theory are themselves implausible, as long as there is a domain rule that says that the basic assumptions of a theory are a body of ideas.

BELIEFS ARE GUIDES / BELIEFS ARE LOCATIONS

Synopsis

Beliefs are often viewed as guides that lead the believer to various courses of action or other beliefs. This metaphorical view is often mixed with BELIEFS ARE LOCATIONS in which beliefs are viewed as locations or especially destinations. Arriving at a belief implies that the person believes the belief. In our implementation we deal with both metaphorical views in the same framework.

Examples

18. "This belief led him to write lines such as "Biting off'" (oznews/16 N5000950301)
19. "How did you arrive at this idea?" (bbc/01 S1000910819)

Illustrative Implementation

Locations & Journeys domain:

(guide)
If G is a guide to going to location L and person P has followed G then P has arrived at L
   (presumed)
(arrival)
If physical-object O has arrived at location L then O is now located at L
   (presumed).

Conversion Rules:

The metaphorical correspondences between the domain of locations and journeys and the domain of beliefs must capture that being at a location maps to believing a proposition.

(presence-TO-belief)
If X is a person and Y is a propositional idea and it is being pretended that Y is some location and that X is at Y at time T then X believes Y at T
   (presumed)

(NOT-presence-TO-NOT-belief)
if X is a person and Y is a propositional idea and it is being pretended that Y is a location and that X is not at Y at time T then X fails to believe Y at T.
   (presumed).

Reasoning:

The above rules allow ATT-Meta to deal with examples such as (18) and (19). For example, "This belief led him to the idea" could be dealt with by stipulating:

in-pretence-cocoon(has-followed(John,the-belief))
in-pretence-cocoon(is-guide-to(the-belief, the-idea)).

Using the **guide** and **arrival** rules (together with a rule saying a person is a physical object) and the **presence-TO-belief** conversion rule, ATT-Meta can infer that John now believes the idea.

BELIEFS ARE LOVE OBJECTS

Synopsis

In the metaphorical view "BELIEFS ARE LOVE OBJECTS," beliefs are objects which can be loved, and personal relationships between beliefs and their believers can be formed. Generally speaking, loving a belief involves believing that belief to be true. This is a systematic correspondence since beliefs can be dumped or later rejected.

Examples

20. "When bands first set out they're in love with the idea of being cool and rebellious." (today/ 06 N6000950711)
21. "Rommel still cherished the idea that if only Hitler could hear from him directly he would understand." (brbooks/04 B0000001141)
22. "The Communists have also flirted with the idea of alliance with one or other of the pro-reform parties." (indy/03 N1000951219)
23. "Tim Miller says they reject the idea that their application were turned down for artistic reasons and believed the denial had more to do with their sexual position." (npr/US S2000900928)
24. "Bosnia's Serbs spurned the idea of a loose alliance with the Muslims and Croats." (econ/uk N3019940402)

Illustrative Implementation

In the implementation, being-in-love-with is a type of positive personal relationship, and having a positive personal relationship with a belief implies believing the belief. Ending a positive personal relationship with a belief lor avoiding the start of one implies not having the belief. Also, being-in-love-with implies liking to a high degree. Liking within the pretence cocoon is mapped over to liking within reality.

Relationship/love domain:

(love-relate)
If X is in love with Y at T then X is in a positive personal relationship with Y at T
  (certain)
(inlove-loves)
If X is in love with Y at T then X loves Y at T
  (certain)
(love-likes)
If person X loves Y at T then X likes Y at T to a high degree
  (presumed)
(relationship-object)
If person X is in a positive personal relationship with Y at some time then Y is a person
  (presumed)
(reject1)
If X has personally-rejected Y then X is not now in a positive personal relationship with Y
  (presumed)

(reject2)
If person X has personally-rejected Y then Y is a person
  (certain).

Conversion Rules:

(relating-TO-believing)
If X is a person and Y is a propositional idea and it is being pretended that X is in a positive personal relationship with Y at time T then X believes Y at T
  (presumed).

(NOT-relating-TO-NOT-believing)
if X is a person and Y is a propositional idea and it is being pretended that Y is a person and that X is not in a positive personal relationship with Y at time T then X fails to believe Y at T
  (presumed).

We omit here the rules that map within-pretence liking to within-reality liking.

Reasoning:
The above rules can deal with examples such as "Percy rejected the idea" and "John loved the idea". For example the former can be dealt with by stipulating:

$$\text{in-pretence-cocoon(has-personally-rejected(Percy, idea)).}$$

Using the **rejection1** and **rejection2** rules, ATT-Meta can infer within the cocoon that the idea is a person and that Percy and the idea are not now in a positive personal relationship. Therefore, using the **NOT-relating-TO-NOT-believing** conversion rule, ATT-Meta can infer that Percy now fails to believe the idea.

Flirting with an idea (cf. example 22 above) could be dealt with by taking it to imply taking steps towards believing the idea. In the full ATT-Meta approach (Barnden & Lee, 2001), the step-taking could be mapped over by suitable "view-neutral mapping adjuncts." However, these are only implemented in ATT-Meta in a highly partial and ad hoc way, so that flirting would require ad hoc treatment in the current system.

4. Conclusion

We have shown in embryo how the ATT-Meta system could handle metaphorical utterances based on the main mental metaphorical views in the Master Metaphor List. That list was, of course, compiled independently of our work. In addition, we have been careful not to create examples out of nothing, but instead to motivate the implemented examples by conducting searches in a well-known large corpus, given that the Master Metaphor List itself does not provide attested examples.

The illustrative implementations were small, but capture the following essential point about the ATT-Meta approach. In the case of metaphorical utterances based on familiar metaphorical views, information about the target domain can often (and perhaps usually) be inferred from the utterances by a combination of inferences within the source domain of the metaphorical view and use of *existing* mapping relationships between source and target, without any extension of the existing mapping to cover source-domain concepts it does not deal with. For example, in the BELIEFS ARE GUIDES case, the property of being a guide is not mapped to the target domain.

However, some aspects of the examples we have tackled in this paper are not handled by the current ATT-Meta system, although an account that could handle these aspects is provided in the overall theoretical approach (Barnden & Lee, 2001). For example, in the discussion of IDEAS ARE LIGHT SOURCES, we sketched how the conclusion that the speaker understands the development can be obtained. However, we did not discuss how to obtain the desirable conclusion that this understanding was *caused by* the examination. The problem is that the causation in the scenario as it stands is entirely within the source domain (the illumination of the development by the examination causes the speaker to be able to see the development). In Barnden & Lee (2001) we explain that the overall theoretical approach postulates that causation links are mapped over in any metaphorical view (by default). However, such "view neutral" mapping principles are so far largely unimplemented in the ATT-Meta system.

The examples in this paper also suggest that time and change are important aspects of metaphorical utterances. ATT-Meta provides as yet only very primitive support for handling such aspects. Improving this support is a major goal for future research.

References

Barnden, J.A., Helmreich, S., Iverson, E., and Stein, G.C. (1996) Artificial intelligence and metaphors of mind: within-vehicle reasoning and its benefits. Metaphor and Symbolic Activity 11(2).

Barnden, J.A. (1997) Consciousness and common-sense metaphors of the mind. In S. O'Nuallain, P. McKevitt, and E. Mac Aogain (Eds.), Two Sciences of the mind: Readings in Cognitive Science and Consciousness. pp.311-340. Amsterdam/Philadelphia: John Benjamins.

Barnden, J.A. (1998). Combining uncertain belief reasoning and uncertain metaphor-based reasoning. In Procs. Twentieth Annual Meeting of the Cognitive Science Society, pp.114-119. Mahwah, N.J.: Lawrence Erlbaum Associates.

Barnden, J.A. (in press). The utility of reverse transfers in metaphor. Appearing in Procs. Twenty-Third Annual Meeting of the Cognitive Science Society (Edinburgh, August 2001). Mahwah, N.J.: Lawrence Erlbaum Associates.

Barnden, J.A. (n.d.). ATT-Meta Project Databank. At http://www.cs.bham.ac.uk/~jab/ATT-Meta/Databank, The University of Birmingham, U.K.

Barnden, J.A. and Lee, M.G. (1999) An implemented context system that combines belief reasoning, metaphor-based reasoning and uncertainty handling. In P. Bouquet, P. Brezillon, L. Serafini (Eds), Modelling and Using Context, Lecture Notes in Artificial Intelligence, No. 1688, pp. 28-41, Springer-Verlag.

Barnden, J.A. and Lee, M.G. (2001). Understanding open-ended usages of familiar conceptual metaphors: An approach and artificial intelligence system. Technical Report CSRP-01-05, School of Computer Science, The University of Birmingham, U.K.

Grady, J.E. (1997). THEORIES ARE BUILDINGS revisited. Cognitive Linguistics 8, (4), pp.267-290.

Lakoff, G. and Johnson, M. (1980) Metaphors We Live By. The University of Chicago Press, Chicago.

Lakoff, G. (1994) The Master Metaphor List. http://cogsci.berkeley.edu/, University of California, Berkeley.

Lee, M.G. and Barnden, J.A. (2001). Reasoning about mixed metaphors within an implemented ai system. Metaphor and Symbol 16, 1&2, pp.29-42.