

# Asymmetry and Reverse Transfers in Metaphor

**John A. Barnden, Sheila R. Glasbey, Mark G. Lee & Alan M. Wallington**

School of Computer Science; University of Birmingham  
Birmingham, B15 2TT, United Kingdom

J.A.Barnden@cs.bham.ac.uk

Tel: (+44)(0)121-414-3816      Fax: (+44)(0)121-414-4281

## Abstract

Metaphor involves the use of a source domain (vehicle domain) to affect a target domain (tenor domain) in some way. For instance, the source domain may be used to generate hypotheses about the target domain or to highlight parts of the target domain. Typically these effects can be cast as the transfer of pieces of information or other items from the source domain to the target domain. Such transfer is extensively addressed in the literature. However, transfer in the reverse direction is rarely discussed in any detail, and then only for limited purposes. This article argues that “reverse” transfer from target to source is of much more widespread, fundamental importance than seems to have been realized. One of the conclusions is that it is often more effective, during discourse understanding, to translate information from literal sentences into prevailing metaphorical terms than to translate the information from metaphorical sentences into literal terms. The issues have been obscured by failure to distinguish between different notions of direction in metaphor: intuitive directions of static source/target mappings; directions of individual transfers; and direction of main intended transfer. In particular, clarifying these different notions of direction throws new light on what the asymmetry of metaphor amounts to. The article also briefly explains the support for target-to-source transfer in an AI program for metaphorical reasoning called ATT-Meta, implemented in an AI project. However, the issues discussed are relevant to all disciplines concerned with metaphor.

# 1 Introduction

In metaphor research there is usually some notion of features, relations, propositions, etc. being transferred, perhaps with modifications, from the source domain (vehicle domain) to the target domain (tenor domain). This is how a metaphorical utterance is used to produce information about the target domain, insight into it, or highlighting of parts of it. The intuitive direction of a metaphor is from source to target in that the source is predominantly used to illuminate the target, not the other way round.

However, transfer in the opposite direction, from target to source, is occasionally discussed. It features to an extent in interaction accounts (Black, 1979; Waggoner, 1990) and the blending-based account (Fauconnier & Turner, 1998; Coulson, 1996; Coulson & Matlock, 2001; Turner & Fauconnier, 1995). Thus, in general, the intuitive direction of a metaphor may not be the same as the direction of all transfers involved in processing it. A major task of this article is to show that this point is of more general and fundamental importance than previously realized.

We will consider a number of different types of “reverse” transfer (transfer from target to source). Our most radical claim is that it is often more effective, during discourse understanding, to metaphorize literal information—i.e., to translate information given by literal segments of discourse into prevailing metaphorical terms—than to translate the information from metaphorical segments into literal terms. Metaphorization can aid the task of integrating different parts of discourse. As an example of what we mean by metaphorization, consider the following passage from a magazine article (Gross, 1994):

(1)“In the far reaches of her mind, Anne knew Kyle was having an affair, but ‘to acknowledge the betrayal would mean I’d have to take a stand. I’d never be able to go back to what I was familiar with,’ she says. Not until eight months had passed and she finally checked the phone bill did Anne confront the reality of her husband’s deception.”

The beginning of the passage relies on a metaphorical view of “MIND AS PHYSICAL SPACE,” because of the mention of “far reaches” of Anne’s mind. We claim that it is beneficial to translate the acknowledgment and confrontation mentioned literally in the passage into the terms of the source domain (PHYSICAL SPACE). In that domain, it becomes an act by Anne’s conscious self of deliberately travelling to the far reaches of the mind-space to interact with the idea of the affair. We claim this target-to-source translation

is desirable for the purposes of obtaining a coherent and appropriately rich understanding of the discourse. This is despite the fact that the main transfer of information must ultimately be from source to target. The argument is given later in the paper.

We will also make less radical claims that two further forms of target-to-source transfer can often be desirable in the course of understanding metaphorical discourse: transfer of information about the certainty of propositions arising during the understanding process, and transfer of internal queries, foci or expectations arising during the process.

The issues have previously been obscured by implicit confusion in the literature between several different notions of direction: intuitive direction of static source/target mappings; direction of individual transfers based on those mappings; and direction of main intended transfer. Thus, another important goal of the article is to dispel the confusions. In the course of doing this, we will throw new light on the asymmetry of metaphor. Indeed, the reanalysis of directionality in metaphor, resulting in particular in increased emphasis on target-to-source transfer, makes it incumbent upon us to explain what the asymmetry consists in.

A computer system (program) called ATT-Meta has been implemented for the task of performing some of the reasoning needed for metaphor understanding (Barnden, 1998a, 2001; Barnden *et al.*, 1994, 1996; Barnden & Lee, 1999, 2001; Lee & Barnden, 2001a). ATT-Meta allows for the types of target-to-source transfer discussed in this article, and indeed the considerations in this article arose in part from the process of implementing the system. However, the issues are general ones, not peculiar to our system.

The plan of rest of the article is as follows. Sections 2, 3 and 4 present some background and terminology. Section 4 shows the desirability of the three types of target-to-source transfer mentioned above (reverse query transfer, reverse certainty transfer, and metaphorization). Section 5 explains why mappings should often be seen as mapping items from the target domain to the source domain, rather than vice versa. Section 6 re-analyzes the asymmetry of metaphor in the light of preceding sections. Section 7 links the considerations of previous sections to the ATT-Meta system. Section 8 concludes. A companion technical report (Barnden *et al.*, 2002) provides a detailed account of how ATT-Meta operates on examples strongly related to some of those used in section 4. The present article, however, can be read independently of that report.

The article will be geared ostensibly to analogy-based accounts of metaphor, but the observations to be

made generalize to other accounts as long as they can be construed as involving notions of transfer between source and target domains involved in metaphor.

## 2 Teacher as Midwife

To illustrate various points, we will be mainly be using the above Anne/Kyle example, (1), and some examples that rely on a metaphorical view of “[SOCRATIC] TEACHER AS MIDWIFE.” This view is based on the “SOCRATES AS MIDWIFE” view that is extensively developed in Plato’s *Theaetetus* (Plato, 1973). That view has been discussed in detail by Kittay (1989), and also by Holyoak & Thagard (1989) through the application of their ACME approach to it.

The view allows one to talk of students giving “give birth” to ideas, teachers helping students who are “pregnant” with ideas, and so on. In more detail, the metaphorical view “TEACHER AS MIDWIFE” involves regarding

- the teacher AS an Ancient Greek midwife
- the teacher’s students (even if male) AS mothers
- the teacher introducing the student to an enabling intellectual partner AS the midwife serving a match-making function for the mother
- ideas AS babies (before or after birth)
- initial idea-formulation AS conception of the embryo
- subsequent idea-development before production (see next item) AS pregnancy
- producing an idea—i.e., completing the development to one’s satisfaction and presenting it to the world—AS giving birth to the idea
- developing the idea after production AS nurturing the baby
- checking the worth of a just-produced idea AS checking whether the baby should be reared (because not the result of a “false pregnancy”)

- the teacher helping with any aspect of the above treatment of ideas AS the midwife helping with corresponding aspect of the above treatment of babies

and so forth.<sup>1</sup>

Our examples rely on information about the particular roles of midwives in Ancient Greek society, according to Theaetetus, notably that

- a midwife can serve a matchmaking function in bringing the parents together in the first place
- a midwife generally helps the mother in some period after birth
- a midwife therefore generally helps (the mother to) tend the baby in some period after birth (unless the midwife has deemed that the child should not be reared<sup>2</sup>).

The reader should bear in mind that we assume that the understander is familiar with such information and is understanding the utterances on that basis, rather than thinking in terms, say, of modern Western midwives.

The metaphorical view is an elaboration of a much more general, pervasively-used view of “IDEAS AS CHILDREN”, which is itself an elaboration of “IDEAS AS BEINGS WITH A LIFE CYCLE.” These two views are mentioned in the Master Metaphor List (Lakoff, 1994) and considered also by Lee & Barnden (2001b).

Our considerations in the present article are intended to be completely general and not to rely on special features of those two metaphorical views or of “TEACHER AS MIDWIFE.” We pick on the teacher/midwife view merely because it is considered in detail in the literature and because it is vivid and memorable.

<sup>1</sup>Kittay (1989) and Holyoak & Thagard (1989) in following her claim that the mother’s giving birth corresponds to the student’s coming to know the truth or falsity of the idea. This is different from our correspondent above for giving-birth, namely producing the idea in developed form to the world. However, the relevant passages in Theaetetus do not support Kittay’s interpretation (which is strange anyway, because which teacher, let alone which student, would know the truth/falsity of the idea?) Rather, it is clear from Plato (1973), around segment 161a, that the midwife assesses the newborn baby after birth, and the segment round 157d1 compares giving-birth to bringing the idea “but to light,” i.e. for the world to inspect.

<sup>2</sup>Kittay (1989) seems to imply that the midwife does not make this judgment, but our reading of Theaetetus, notably in segment 160e5–161e4 in Plato (1973), is that she does. What is implied by the segment Kittay cites is that the philosopher can have diffi culty in distinguishing between a worthwhile idea and a worthless one, whereas with a newborn baby it is not diffi cult to distinguish between a the product of a good pregnancy and that of a bad one.

### 3 Some Concepts and Terminology

#### 3.1 Metaphorical Views

We use the term metaphorical view to mean much the same as conceptual metaphor in the work of Lakoff (e.g., Lakoff, 1993). For an example of a view different from those in section 2, consider the following clause taken from (1):

(2) “In the far reaches of her mind, Anne knew Kyle was having an affair”

Anne’s mind is being seen as a physical space that has “far reaches,” so we analyze the utterance as relying on a metaphorical view of “MIND AS PHYSICAL SPACE.” We use the term “metaphorical view” rather than Lakoff’s term “conceptual metaphor” partly because Lakoff and others make claims about conceptual metaphors that do not affect the present article, such as that (many) conceptual metaphors arise naturally from bodily experience.

#### 3.2 Mappings and Domain Aspects

We will refer to aspects of the source and target domains in metaphor (e.g. the domains of mind and of physical space/objects, in “MIND AS PHYSICAL SPACE”). An aspect is any entity, property, relationship, proposition, ... that features in (information about) that domain. By a mapping we mean a linking, in the mind of the utterer or the understander of the metaphorical discourse, that relates aspects of one domain to aspects of another. A mapping generally links several aspects of the former domain to aspects of the latter domain. We call a part of the mapping that is concerned with one specific aspect a mapping link. Thus, in the case of the “SOCRATES AS MIDWIFE” view in section 2, the mapping contains, amongst others, a mapping link between a hypothetical midwife and Socrates, and a mapping link between the property of being a baby and the property of being an idea.

Following standard mathematical practice, each mapping link can just be denoted as an ordered pair  $(s, t)$  where  $s$  is the source-domain aspect mapped and  $t$  is the target-domain aspect it maps to. For instance, in “SOCRATES AS MIDWIFE,” a source-domain scenario containing a particular midwife  $\mathbf{mw}_1$  is

assumed, and we have the mapping links ( $mw_1$ , **Socrates**) and (**being-baby**, **being-idea**) amongst others. Mathematically, therefore, a mapping is simply a set of such ordered pairs.

We will not in general assume that mappings are one-to-one. Hence, there can be two different mapping links  $(s, t_1)$  and  $(s, t_2)$  for the same  $s$ , or two different mapping links  $(s_1, t)$  and  $(s_2, t)$  for the same  $t$ .

Crucially, mappings and mapping links are not actions or processes. They must be distinguished from actions that are related to them, such as transfers along them between source and target, and acts of creating the links.

### 3.3 Non-Declarative Metaphorical Utterances

Questions can be metaphorical—metaphoricity is not confined to declarative sentences. This point will play a significant role later in the article.

However, almost all examples of metaphorical language discussed in the literature are of declarative utterances rather than questions, commands, ejaculations, etc. But just as one can state “John is a steamroller” one can ask “Is John a steamroller?”. Just as one can state “The champion knocked the cream-puff out” one can issue the command “Knock that cream-puff out!”. One passage we found was:

“Have you arranged your ideas in a logical order? Does one idea lead naturally to the next? Does your essay ‘flow,’ or does it just jump around from one thing to the next?”<sup>3</sup>

All four of these questions are arguably metaphorical, most vividly the last two. We also looked for metaphorical questions involving the word “steamroller” and found the following example amongst others:

“Can’t an auteur find a less obvious way to make 100 million bucks than backing his steamroller over the same tired corpse?”<sup>4</sup>

The relevance of metaphorical questions will become clear in section 4.1.

<sup>3</sup>from <http://www.extend.indiana.edu/hs/pdf/ENG21E.PDF>, Independent Study Program, School of Continuing Studies, Indiana University, Indiana, USA, dated 2001, accessed on 4th July 2002.

<sup>4</sup>from <http://www.suck.com/fi sh/97/09/22/fi sh.html>, “The Fish” webcolumn for 22nd September 1997, accessed on 4th July 2002.

### 3.4 Transfers

Because metaphorical utterances can be non-declarative, the point of a metaphorical utterance is not necessarily to make a claim about the target domain. Rather, we make a more general assumption: that, normally, the understanding of a metaphorical utterance will involve using some aspects of the source domain to generate some effect on (the understander's view of or engagement with) the target domain, such as creating a new piece of information about entities within that domain, confirming existing information about such entities, asking a question about them, highlighting parts of the domain, commanding action to be taken in the domain, etc. For convenience, we will use the term transfer from source to target to cover all these source-to-target effects. Also, in principle, there is the reverse notion of target-to-source transfer, using aspects of the target domain to exert some effect on the source domain.

We will use the word “transfer” both as a mass noun similar in meaning to “flow” and as a count noun describing an individual action of taking something from source to target or target to source.<sup>5</sup> The overall transfer resulting from understanding a metaphorical utterance involves one or more individual transfers. At least in analogy-based accounts of metaphor (e.g., SME: Falkenhainer *et al.*, 1989; ACME: Holyoak & Thagard, 1989), transfers are strongly related to mapping links. For instance, transfer in SME, ACME and similar systems is a matter of actions of copying-with-substitution that are applied to propositions or other structured items in the source domain. The substitution is done on the basis of mapping links. Thus, consider a source-domain proposition that could be expressed in English as

(3a) **Socrates helped Theaetetus give birth to a baby.**<sup>6</sup>

Given that the baby maps to a specific idea J, and that giving-birth maps to idea-production, proposition (3a) translates under copying-by-substitution into the target-domain proposition that

(3b) **Socrates helped Theaetetus produce J.**

Here we also assume that the helping maps over. We touch on this again near the end of section 4.1.

---

<sup>5</sup>Because we allow the “something” to be something other than a feature or proposition, our notion of transfer may be broader than that of some other authors.

<sup>6</sup>We use bold-face for English glosses of propositions that are assumed to be couched in some internal-representation format in the mind of a person or in the innards of a computer program. Items in bold-face are not incoming English sentences being processed by a language understander.

Transfer in some form is also central in accounts of metaphor that are not presented as based on analogy, such as feature-transfer accounts (e.g., Ortony, 1979) and the categorization account (Glucksberg & Keysar, 1990). In “Billboards are warts on the landscape” as analyzed in a feature-transfer approach, the feature of ugliness could be transferred from warts to billboards. In “My job is a jail” as analyzed under the categorization approach, the constraining and other qualities of jails could guide the search for the suitable more-general category that includes both the speaker’s job and jails, and then the inclusion of the job in that category causes information to be asserted about the job, such as that it is constraining (in some way that our job in this article does not constrain us to go into).

Henceforth we will abbreviate “source-to-target” as  $S \rightarrow T$ , and “target-to-source” as  $T \rightarrow S$ . We also say that  $S \rightarrow T$  transfers are forward ones and  $T \rightarrow S$  transfers are reverse ones.

### 3.5 Various Directions

We conceptually distinguish four types of directionality involved in metaphor:-

- (D1a) direction of a whole metaphorical view
- (D1b) direction of main transfer in understanding a metaphorical utterance
- (D2) directions of individual transfers
- (D3) direction of a mapping link used by a transfer.

In the following two subsections we comment briefly on some of the distinctions inherent in this list: the distinctions between D1a, D1b and D2 (although we will soon retreat to regarding D1a and D1b as normally being the same) and that between D2 and D3. The distinction between D1 and D3 will be discussed in section 5.

### 3.6 Direction of View versus Direction of Transfer (D1a vs. D1b and D2)

Metaphorical views are directed in a natural and intuitive way. A view of midwives as teachers is clearly distinct from a view of teachers as midwives. This is the asymmetry of metaphor. In a view of A as B,

we stipulate that the direction of the metaphorical view is from B to A, on the intuition that we are looking through B towards A, or that we are using B to illuminate A.

As is conventional, we will assume that the main point, and in fact usually the whole point, of a metaphorical utterance (in mundane discourse) is to affect or examine the target domain in some way, for instance by telling us something about that domain or asking a question about the domain. Because of this, we are happy with the sense of direction inherent in the very terms “source” and “target.” So, at least the main transfers are from source to target, and we can regard D1a and D1b above as the same. However, given that reverse transfers are sometimes discussed in the context of interaction theories of metaphor and blending theory, as noted in the Introduction, it is important to prevent our terminology prejudging the issue of whether D1a and D1b are the same, and also to allow for the possibility that some subsidiary or supplementary transfer (D2) can be from target to source.

### **3.7 Link Direction versus Use Direction (D2 vs. D3)**

Mapping links are usually described as going from source domain to target domain. (Some discussions, e.g., that of Holyoak & Thagard, 1989, occasionally depart from this). We will turn in section 5 to whether this is always the best description, but for now will go along with it. Mathematically, we reflect an intuition that a mapping link goes from  $s$  to  $t$  by using the ordered pair  $(s, t)$  rather than  $(t, s)$ .

Now, it is normally also assumed that the use of a mapping link  $(s, t)$  to accomplish a transfer is in the direction from  $s$  to  $t$ . At one point in processing, a source-domain structure involving  $s$  may be being worked on; and then, as a result of a transfer, a target-domain structure involving  $t$  instead will be considered.

But, in principle, the direction of use is not constrained by the direction of the link, because the direction of the link is just a matter of how we choose to describe the association between two items for our own theoretical convenience. An analogy would be arrows on trees marking a walk through a forest: the directionality of the arrows does not of itself prevent their being followed in reverse. Indeed, mathematically, given a mapping from one domain to another, the inverse mapping automatically exists: it is just the set of links  $(t, s)$  for each link  $(s, t)$  in the original mapping. Hence, it would be misguided to claim that the sheer existence of a mapping constrained the direction of use.

Of course, in a particular understander the realization of a mapping link may be such that it can, in fact, only be used in one direction, or that it cannot, in fact, be used in both directions with equal ease. As a simplistic illustration, a link might be implemented in someone's brain by a group of neural fibres that can conduct activation in only one direction, or by a pointer in computer memory. But, although it might be natural methodologically in such a system to stipulate that the mapping-link direction is the same as the use direction, that equation is not forced upon us.

## 4 Usefulness of Reverse Transfers

As we have said, some accounts of metaphor allow for  $T \rightarrow S$  transfers (see citations in section 1). However, in those accounts, attention is focused on cases where the ultimate effect is to make some relatively long-term change in the understander's appreciation of the source domain. In contrast, the present article argues that  $T \rightarrow S$  transfers can be useful even when there is no effect on the source domain that outlives the short-term purposes of the current processing (e.g., understanding a sentence), and where the original and main goal of the processing—and perhaps the only goal—is to have some effect on the target domain.

The general argument is that  $T \rightarrow S$  transfers lead to source-domain effects that feed into within-source-domain processing that in turn ultimately feeds back into at least one  $S \rightarrow T$  transfer. We therefore have the distinction between direction of main transfer (D1b), which is normally  $S \rightarrow T$ , from direction of individual transfers (D2), which can be  $T \rightarrow S$ , although there must be at least one  $S \rightarrow T$  transfer if main transfer is to be in this direction. The following subsections look at different types of  $T \rightarrow S$  transfer.

### 4.1 Reverse Transfer of Reasoning Queries, Focus or Expectation

This subsection concerns the issue of transferring internally-generated queries between domains, as opposed to transferring features or propositions. We will also liken transfer of focus and expectation to transfer of queries.

We noted above that questions in ordinary language can be metaphorical. Their understanding is likely to involve some sort of transfer from source to target. Plausibly, the result will be a query being posed in target-domain terms. For instance, if the question is

(4a) “Is John a bulldozer?”

the effect of understanding might be to create a query in target-domain terms such as

(4b) **Does John very strongly eliminate problems?**<sup>7</sup>

Thus, transfer of queries from source to target is something that needs to be part of a full account of metaphor.

But the current subsection is about the reverse direction, where, moreover, the queries may arise not from questions in ordinary language but from the process of understanding non-question utterances. Forms of the T→S query transfer in this subsection have been proposed previously by metaphor and analogy theorists (e.g., Markman, 1997), but the issue deserves further emphasis and elaboration than it has previously been given.

Reverse transfer of queries is helpful in metaphor understanding because it is one way of allowing context to be exploited, by focusing metaphorical processing fruitfully. This is especially important given the notorious indeterminacy of the significance of metaphorical utterances. (See, e.g., Stern, 2000, on this indeterminacy.) Suppose discourse contains the sentence

(5) “John is a tank”

and the understander does not yet know any metaphorical significance for the word “tank.” Let us simplify the discussion by assuming that the understander only considers the military-tank meaning of “tank” in attempting to work out the metaphorical significance of the sentence. What is the understander to take the discourse to be claiming about John?

In particular, does the present reader have any clear idea what (5) is intended to convey, in the absence of any guiding context?

One approach to understanding (5) would be blindly to take qualities of tanks, such as size, heaviness, inexorableness, ability to withstand attack, and powerfulness, and transfer them in some form to apply potentially to John, in the hope finding one or more that do appear to apply to him, or that help explain

---

<sup>7</sup>This sentence may sound stilted. The reader should recall that bold-face sentences are merely paraphrases of putative internal representations, and are not intended to be idiomatic chunks of English in their own right.

why the sentence was uttered in the particular context at hand. This approach seems to be assumed in much writing on metaphor. But it is the more wasteful the more qualities that could potentially be transferred, because it seeks to transfer without having a handle in advance on possible relevance to the discourse.

The converse approach is to examine the context surrounding the sentence, and existing knowledge about the situation being described, for issues that are raised there about John. After all, it is hardly likely that in everyday discourse sentence (5) would be uttered in a context that gave no clue as to whether it was physical size, emotional inexorableness or whatever that was relevant. Suppose therefore that (5) were to appear in context as follows:

(5') Most of my colleagues get upset when they're criticized. But John is a tank.

The first sentence here raises the issue of the ability to tolerate criticism. The "But" suggests a connection (probably one of contrast) between the claims made by the two sentences. The understander can therefore, on encountering (5), internally pose a query such as one of the following:

- (6a) (i) **To what degree D is John able to tolerate criticism?**  
(ii) **Is John able to tolerate criticism well?**

where D in the former is a variable whose value is intended to become set as the result of investigating that query. Let us assume for the sake of example that the understander, on noticing that a tank is a military object, and deploying prior knowledge of the "ARGUMENT AS WAR" metaphorical view (Lakoff & Johnson, 1980), has ready access to a mapping link from military attack-withstanding to criticism-tolerating. Then, on the basis of a target-domain query such as in (6a), the understander can internally pose a corresponding source-domain query such as one of the following:

- (6b) (i) **To what degree D is John able to withstand military attack?**  
(ii) **Is John able to withstand military attack well?**

using a T→S form of copying-with-substitution. We can say therefore that a target-domain query has been transferred to become a source-domain query, by going backwards across the mapping link just mentioned.

The source-domain query can then be answered within the source domain using the datum that John is a tank. In the case of (6b)(i) the value of D found can then be transferred back to the target domain across the mapping link to become, or at least to constrain, the value of D in (6a)(i).<sup>8</sup>

For our argument to carry through, it is not necessary for the context to raise the issue of toleration of criticism in quite such an explicit or precise fashion as (5') does. Rather, we make the general assumption that context provides relatively determinate information about what issue the utterer is addressing, in those cases where the metaphorical utterance itself is indeterminate about that. In essence, there are likely to be more potential S→T transfers suggested by the metaphorical utterance (the majority of which will be irrelevant) than there are T→S transfers suggested by context.

But in very unhelpful cases, context might (i) not raise the issue at all, or (ii) only very implicitly raise it, or (iii) raise many issues, so that it was not clear which one(s) the understander should address. However, given the indeterminacy of the meaning-in-isolation of utterances such as (5), the situation for us theoretically is no worse than it is for theorists who do not have any account at all of how context could help with metaphor understanding. In any case it is possible that under conditions such as (i)–(iii) a human understander might be genuinely puzzled as to the meaning-in-context of the metaphorical utterance.

Barnden and Lee (2001) and Lee and Barnden (2001a) also make the point that the existence of particular mapping links can itself provide guidance as to what a metaphorical utterance is about, on the assumption that utterances based on familiar metaphorical views will predominantly exploit the existing links rather than require the creation of new ones. In that sense, mapping links themselves constitute a sort of default context.

Barnden and Lee (2001) discuss the Anne/Kyle example given in the Introduction, and partially repeated here:

(7) “In the far reaches of her mind, Anne knew Kyle was having an affair, but ‘to acknowledge the betrayal would mean I’d have to take a stand ...,’ she says.”

Barnden and Lee (2001) argue that the segment about acknowledgment can readily give rise to a target-

---

<sup>8</sup>Degrees with which things hold must be mapped somehow in metaphor. This point is rarely addressed in metaphor theories. A start is made in Barnden & Lee (2001).

domain query such as

**(8a) To what degree was Anne able to operate in a conscious mental way on the idea of Kyle having an affair?**

We claim that the discourse not only rather directly suggests the involvement of the metaphorical view of “MIND AS PHYSICAL SPACE” but also that of “IDEAS AS PHYSICAL OBJECTS.” We claim that the latter view maps physical operation on ideas, by the agent’s conscious self, to conscious mental operation on them by the agent. On this basis, (8a) can be reverse-transferred to create the query

**(8b) To what degree was Anne’s conscious self able to operate physically on the idea of Kyle having an affair?**

This query then guides the understanding, within the source domain, of the significance of the qualifier “In the far reaches of her mind,” which indicates indirectly a very low level of ability by Anne’s conscious self to operate physically on the idea. This result is forward-transferred to the target domain to become the conclusion that Anne only had a very low degree of ability to operate in a conscious mental way on the idea.

The reason the qualifier “In the far reaches of her mind” indicates a very low level of ability by Anne’s conscious self to operate physically on the idea is as follows. In applications of “MIND AS PHYSICAL SPACE,” the conscious self of the person is implicitly viewed as being a person located in a main part of the physical space, presumably distant from “far reaches.” The distance implies a very low degree of ability of the conscious self to physical interact with the idea. The process of reasoning here, which is fully implemented in the ATT-Meta system, is described in more detail in Barnden & Lee (2001).

Somewhat similar examples could arise from uses of “TEACHER AS MIDWIFE.” Imagine that a discourse has been using this view. Suppose now the understander meets the following passage, where the phrase “this one” refers to a particular idea, K, that is under discussion:

(9) “Many good ideas are immediately forgotten. But Socrates himself fed and clothed this one.”

Let us assume that the metaphorical view does not involve any mapping links for feeding and clothing someone, but that it maps the state of affairs of an idea-child being alive to the state of affairs of the idea being

remembered in society. (This mapping relationship is a component of the view of “IDEAS AS BEINGS WITH A LIFE CYCLE” that we mentioned in section 2: recall that “TEACHER AS MIDWIFE” is a just an elaboration of that view.) What sense is the understander to make of the second sentence in (9)? As in the tank example, discourse context can provide guidance in the form of target-domain queries. One query that could arise from processing of the first sentence and of the “But” is

(10a) **Was K remembered for at least some while?**

Then, by T→S transfer, query (10a) could become the following query in the source domain:

(10b) **Did K live for at least some while?**<sup>9</sup>

The feeding and clothing actions in the second sentence in (9) could then be used to answer (10b) in the affirmative. This result can be forward-transferred to become an affirmative answer to (10a).

Other inferences that could be made in principle from Socrates feeding and clothing someone (e.g., that Socrates bought the food and clothes) may be irrelevant to answering (10b) and hence to answering (10a), and therefore may not actually be made. Notice that we do not even assume that the understanding process finds a target-domain parallel for the actions of feeding and clothing themselves. See section 7 for a little more on this stance and Barnden & Lee (2001) for further explanation and justification.

That article also posits that, in metaphor generally, relationships such as helping, causing and enabling carry over automatically between source and target domains. Hence, if there were some discourse-based reason to do so, the understander could also conclude that Socrates helped the idea to be remembered, from the source-domain hypothesis that Socrates helped the idea to live.

Finally, the issue of reverse-transferring queries translates naturally also into the notion of transferring focus or expectations, rather than queries, from target to source. Consider again sentence (5), where in the discourse context the issue being attended is people’s ability to tolerate criticism. By renaming this issue as the current “focus” of the discussion (or at least one of several foci), or by saying that the discourse

---

<sup>9</sup>In Barnden & Lee (2001) we claim that an understander should by default carry over qualitative, situation-relative time durations and other temporal matters between source and target domains in metaphor generally. Thus, (10a) can be reverse-transferred to become (10b) even though the relevant mapping link merely maps living to being-remembered.

sets up an “expectation” that this issue will continue to be addressed, we can think in terms of reverse-transferring this focus or expectation to the source domain via the linking between withstanding physical attack and tolerating criticism, to become a focus on or expectation about withstanding physical attack in the source domain. This focus or expectation then leads the understander to use the information in the source domain that tanks are good at withstanding physical attack and John is a tank. Thus, the basic issues in this subsection can be clothed in terms of reverse transfer of focus or expectation, rather than of queries. Reverse transfer of focus, expectation or queries is what needs to be at play in accounts of metaphor that allow for contextual effects to guide the process of understanding (e.g., Peleg, Giora & Fein, 2001).

## 4.2 Query-Directed Reasoning

Reverse query transfer is merely an application to metaphor understanding of the general technique of query-directed reasoning (or goal-directed reasoning). Query-directed reasoning, also called goal-directed reasoning, is a powerful technique, much used in AI (see, e.g., Russell & Norvig, 1995). In this form of reasoning, the process of reasoning starts with a query—an internally or externally presented question as to whether something holds. Queries are compared to known propositions and/or used to generate further queries by some means. (One means will be explained in a moment.) These further queries, which can be called sub-queries, are investigated in the same way. When all the sub-queries directly arising from a query are given a positive answer, then so is the latter query, unless there are strong enough arguments against. In sum, queries are unrolled down to given facts, and then answers roll upwards towards the initial query.

There are a number of ways in principle whereby a query could generate a sub-query, but one typical one is by a type of backwards consideration of rules (called backwards chaining). For instance, suppose the system possesses a (defeasible) rule to the effect that

(11)           **IF X is a student AND X is young THEN X is untidy.**

Suppose also that the query **Is Peter untidy?** is being entertained. Then the sub-query **Is Peter a student?** and/or the sub-query **Is Peter young?** could arise. These would be compared to known facts and to THEN parts of rules.

In the reverse query transfer of the previous subsection, the generation of sub-queries is done by T→S

use of mapping links rather than by backchaining across rules. However, in section 7 we will see that mapping links can be implemented as rules, so the two modes of sub-query generation become identified.

### **4.3 Reverse Transfer of (Un)certainty: Introduction**

In our work on metaphor and the ATT-Meta system we have paid much attention to uncertainty, believing that neglect of it can severely distort theories of metaphor. Uncertainty arises in metaphor in several forms, including: uncertainty about what metaphorical views underlie a given utterance; uncertainty about what to transfer between domains; and uncertainty of inferential connections within both the source domain the target domain, given that the domains involved in metaphor in mundane discourse are generally common-sense domains of knowledge.

When conflicting hypotheses supported by uncertain lines of reasoning (“arguments”) compete, there is the matter of conflict resolution—the attempt to resolve the conflict by determining whether one hypothesis has stronger support than the others. Conflict resolution can arise within domains, but can also occur in metaphor understanding between arguments arising from different domains: notably between an argument residing entirely within the target domain and one that involves a transfer from the source domain.

When an argument rests on some hypotheses that are uncertain, that uncertainty generally has some influence on the levels of certainty attached to conclusions of the argument. As a special case, when an argument includes an  $S \rightarrow T$  transfer of a source-domain proposition, the certainty level of that proposition can affect the certainty level of the target-domain proposition created by the transfer. We will also argue for the reverse effect: that influences on the certainty of the target-domain proposition should be transferred back to the source-domain proposition, even when it was the target proposition that was created from the source one and the not the other way round. We will now deal with a positive version and a negative version of this reverse-transfer point, in that order.

### **4.4 Reverse Transfer of (Un)certainty: Positive Influences**

Consider the following hypothetical dialogue fragment, which uses the “TEACHER AS MIDWIFE” metaphorical view, and exploits in particular the role of midwives in Ancient Greek society in helping the mother to look after a baby once it is born:

(A) Electra gave birth to an interesting idea the other day. I must say, Socrates really is an excellent midwife. It was he who helped her come up with the idea in the first place.

(B) So I suppose he helped her develop it too.

It is reasonable for B to use the first two sentences of A's speech-turn to give a relatively weak degree of certainty to the following source-domain proposition, SP, where K is the mentioned idea:

(12a) **[SP] Socrates helped Electra give birth to K**

If, in a given situational context, someone gives birth and someone else is mentioned as being a midwife, then there is a suggestion that the latter person is the midwife in that particular birth. From this, one of course obtains the suggestion that the latter person helped during the birth. Now consider the target-domain proposition

(12b) **[TP] Socrates helped Electra produce K.**

This proposition is stated in the third sentence of A's speech turn. But, aside from that, it could arise by a forward transfer step from SP. Whether or not this is how TP is actually created, any degree of certainty that SP gets should be transferred in some way to TP. (See Figure 1.) Thus, TP should presumably get from SP some relatively low level of certainty, because SP itself does not have high certainty—it is merely a suggestion.

But TP is also strongly supported by processing the third sentence of A's speech-turn. This "reasoning" (by B) within the target-domain leads to an enhanced level of certainty for TP.

Now, within the source domain, B can infer from SP the proposition

(12c) **[SQ] Socrates helped Electra tend K.**

because of the role of midwives in helping to look after a baby once it is born. From this, a forward transfer step gives B the target-domain conclusion that is expressed in her speech-turn

(12d) **[TQ] Socrates helped Electra develop K.**

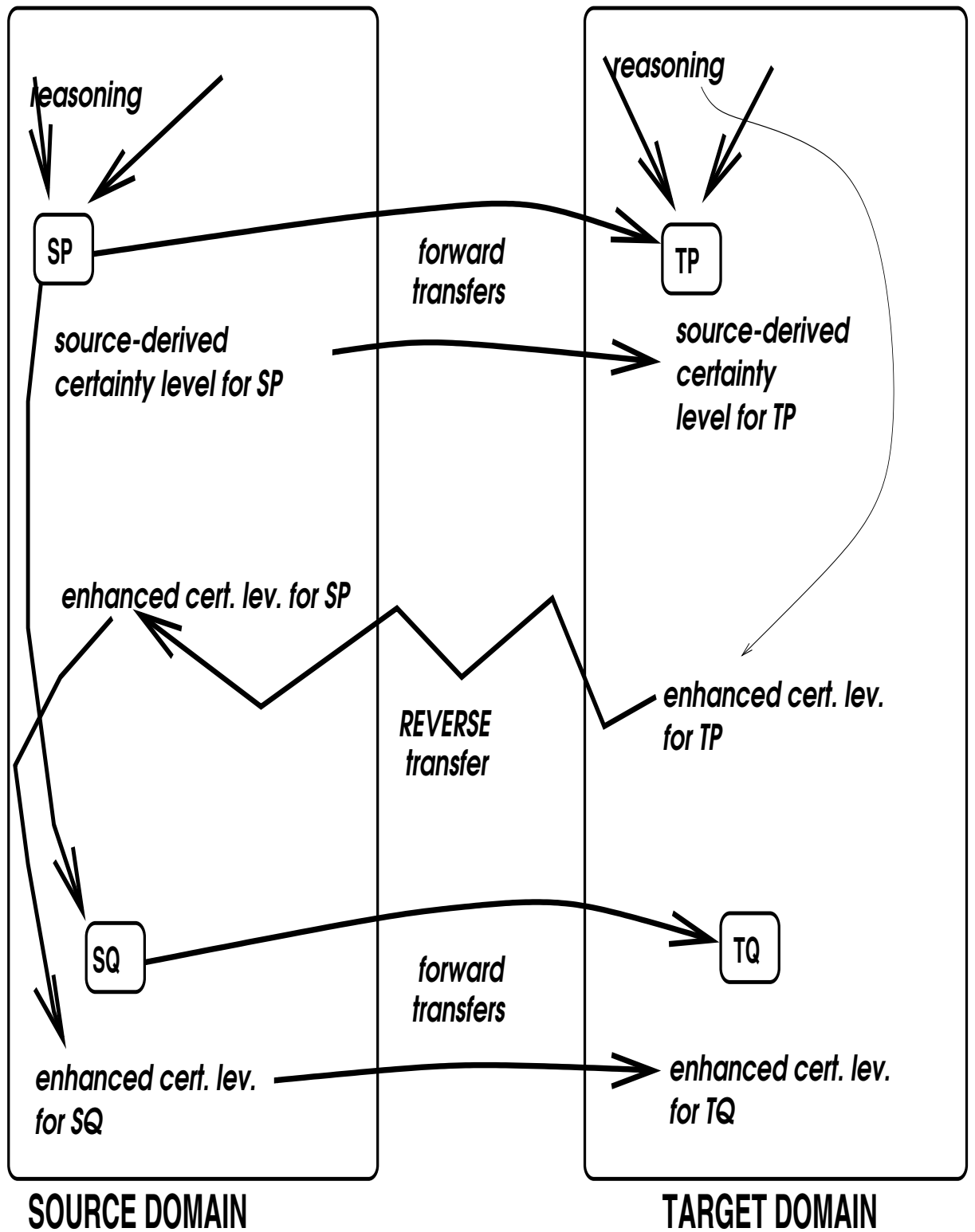


Figure 1: Showing S→T and T→S transfer of certainty information. SP, TP, etc. are explained in the text.

It is intuitively reasonable that TQ should end up with a high level of certainty. This can only happen, in the absence of any target-domain reasoning link from TP to TQ, through SP acquiring an enhanced level of certainty from TP. Without that, not only SP but also SQ and TQ would only have been relatively weakly supported.

Thus, we see that positive influences on certainty should be transferred from target to source as well as source to target. In effect, levels of uncertainty should be aligned as much as possible between the two domains. (However, we do not exclude the possibility that sufficiently strong influences within the two domains can force the certainty levels to be disparate. We do not insist on perfect alignment between the relevant aspects of the domains.)

Of course, in the above example, a system that transferred reasoning links themselves from source to target could give TQ a high certainty level without doing reverse transfer. This is because the link between SP and SQ could be transferred to become a link between TP and TQ. However, the approach we have outlined does not need the considerable extra complication of transferring networks of reasoning links, which can be complex. There may be more than one source-domain proposition supporting SQ, and the connections to SQ may be much more indirect than just the single link suggested by Figure 1.

#### **4.5 Reverse Transfer of (Un)certainty: Negative Influences**

We now turn to reverse transfers of negative influences on certainty levels. Consider the following dialogue fragment:

(A) Electra gave birth to another interesting idea the other day. Once again, Socrates was the midwife, but they soon quarrelled.

(B) Hmm, this may not be good for the idea's further development.

See Figure 2. Propositions SP, TP, SQ, TQ are as before (12a,b,c,d respectively). However, we now assume that SP has a high level of certainty because of the first two sentences of A's speech-turn.

Let SR be the proposition that the idea is growing well (as a baby), and TR be the proposition that the idea is developing well. Assume that there is a mapping link from the growing of babies to the developing

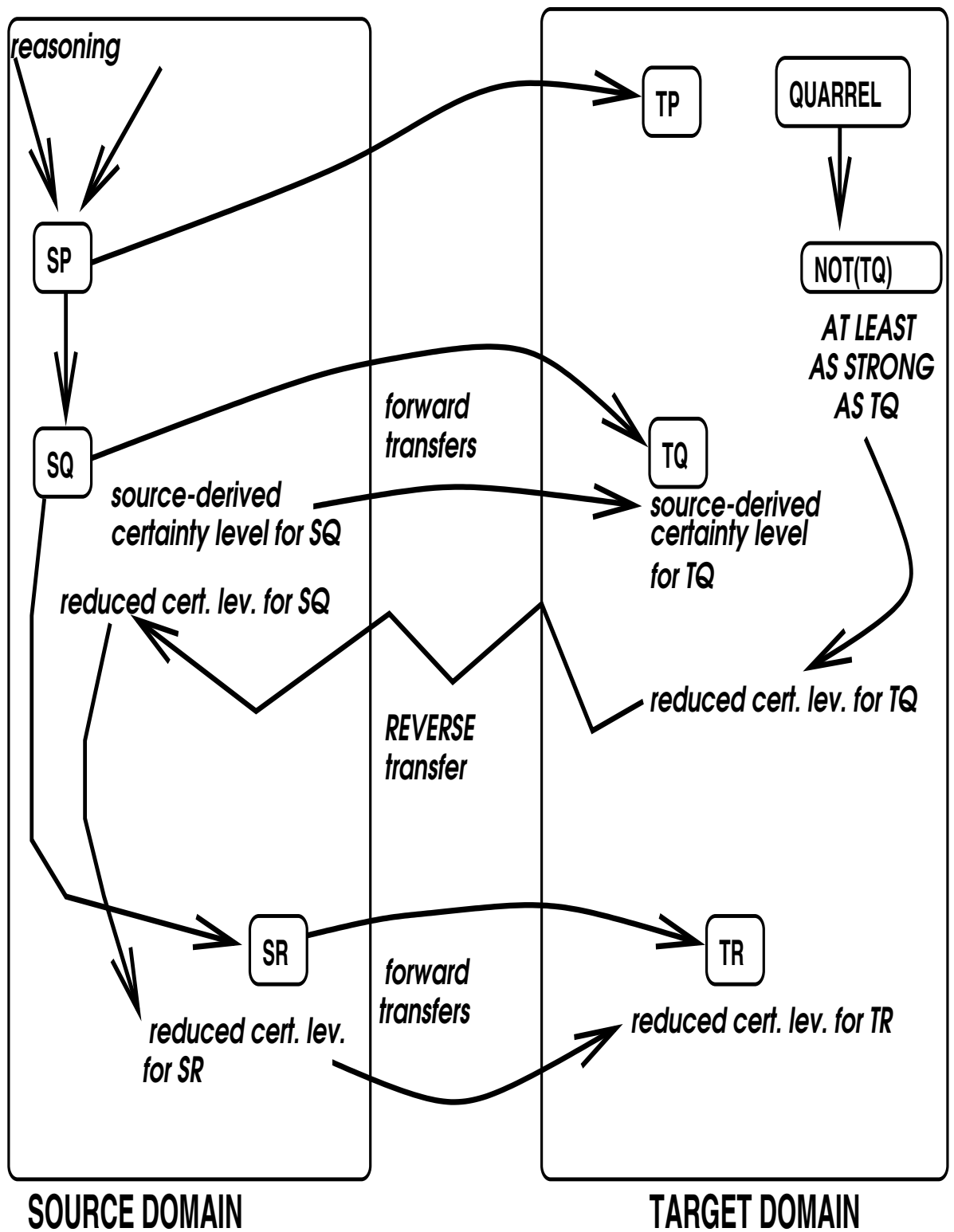


Figure 2: Showing T→S transfer of inhibitions on certainty. SP, TP, etc. are explained in the text

of ideas, with quality of growing also mapping to quality of developing (so that growing well maps to developing well). Hence SR supports TR by forward transfer.

Assume also that, in the source domain, when a midwife helps tend the baby then one can infer that the baby grows well, with a high level of certainty. Therefore, in the absence of other indications B could infer SR with a high level of certainty in the source domain from SP (via SQ). Then, B could infer TR with a high level of certainty.

But now let us assume that, in the target domain, there is the rule that if someone helps someone else produce an idea, but they subsequently quarrel, then it is unlikely that the former person will help the latter develop the idea. Thus, B can use the “but they soon quarrelled” clause of A’s speech-turn to greatly reduce the certainty level of proposition TQ.

It surely be anomalous to keep SQ at a high level of certainty but to put TQ at a low level, given that the actions of tending a baby and developing an idea are meant to correspond in the metaphorical view. Therefore, SQ should have its certainty greatly reduced. As a result, the same should happen to SR and TR, because of the dependence of SR on SQ. This is why B’s statement is a reasonable one.

This example has therefore shown that T→S transfer of negative influences on certainty levels is sometimes needed, as a result of considerations in the target domain that bear against propositions that correspond to propositions in the source domain.

In both the present subsection and the previous one, exactly how and when the flow of influence on certainty occurs is finely dependent on the overall organization of reasoning. For instance, in the scenario of Figure 2 it could be that SR and TR are inferred from SP before the argument for NOT(TQ) is found. Therefore, the flow of negative influence does amount to a flow of changes in already-established tentative uncertainty levels (of SQ, TQ, SR, TR). Or, it could be that TQ’s and SQ’s certainty levels have already been set at a low level by the argument for NOT(TQ) before SR and TR are inferred, in which case SR and TR get the “reduced” certainty levels shown in Figure 2 as soon as they are created. But in all cases the limitation on the certainty of TQ must be transferred back to SQ.

## 4.6 Metaphorization of the Literal

Our final type of T→S transfer arises from advocacy of a radical proposal about the way in which metaphorical discourse should be treated. The proposal amounts to a thesis about the combination of information from a discourse that at least intermittently maintains a metaphorical view of some target domain. The thesis is that the combination may best be done in the source domain, not the target domain. In particular, we claim that non-metaphorical, information-providing segments of the discourse may profitably be converted into metaphorical terms during understanding (this is “metaphorization”). Metaphorical segments “conspire” with each other and with non-metaphorical segments to create an overall source-domain scenario. S→T transfers can then operate on parts of this scenario, to create a target-domain scenario.

For a real-discourse example of the naturalness and benefits of metaphorization, consider again the Anne/Kyle example from the Introduction:

(13a) “In the far reaches of her mind, Anne knew Kyle was having an affair, but ‘to acknowledge the betrayal would mean I’d have to take a stand. I’d never be able to go back to what I was familiar with,’ she says. Not until eight months had passed and she finally checked the phone bill did Anne confront the reality of her husband’s deception.”

We observed in section 4.1 that the metaphorical segment

“In the far reaches of her mind”

serves to imply that Anne had a very low degree of ability to operate in a conscious mental way on the idea of Kyle’s having an affair. The crucial point, in the source-domain reasoning, was the large physical distance between the idea and Anne’s conscious self. Now, the segment

(13b) “Not until eight months had passed and she finally checked the phone bill did Anne confront”

is explicable on the basis that Kyle’s betrayal coming to her consciousness required considerable, deliberate mental effort on Anne’s part. Also, the segment

(13c) “to acknowledge the betrayal would mean”

fits well with the notion that the coming to consciousness would require a deliberate act by Anne. Now, just because somebody has very low conscious awareness of something X does not generally imply that its coming to consciousness is a deliberate, effortful act on the part of that person. After all, her consciousness of X could be weak because she happens to be only momentarily distracted by something else, for instance, with no implication that switching attention back to X would need a deliberate, effortful act. So, if a coherent view of the discourse were sought within the target domain by the “traditional” method of Figure 3, there would be little support for the deliberation and effort suggested by (13b,c).

On the other hand, by seeking a coherent view of the discourse within the source domain by the metaphorization method of Figure 4, coherence is established more naturally and strongly. The confrontation and acknowledgment in (13b,c) can be metaphorized to become an act by Anne’s conscious self of going to the far reaches of the mind-space to interact with the affair idea. This requires deliberate effort by Anne’s conscious self because of the physical distance between it and the affair idea. All that is left is to transfer the deliberateness and effort to Anne herself, which is a plausible step. We then have coherence between the “In the far reaches” segment and the rest.

Most existing accounts of metaphor, in not properly dealing with the role of metaphorical utterances in discourse, leave one with the impression that the traditional method of Figure 3 would have to be used. But it is highly impoverished compared to the method of Figure 4, as it does not fully access the richness of the source-domain scenario.

But we are not saying that it is impossible to establish coherence somehow in the target domain—just that this would be more difficult and less well guided. In the target domain, deliberateness and effort implied by (13b,c) could in principle lead by reverse transfer to a suggestion of (or query about) deliberateness and effort in source domain, and then confirmation of deliberateness and effort would arise in the source domain from the far-reaches segment. This confirmation is then transferred to the target domain, to provide a basis for establishing coherence there. However, in the target domain there would be no reason in the first place to suppose that deliberateness and effort were the key to the coherence between the far-reaches segment and the rest: recall that the mere, above-mentioned fact that the affair-idea is only weakly present to Anne’s consciousness does not imply deliberateness and effort. In contrast, in the source domain it is much more obvious that the scenario implies deliberateness and effort.

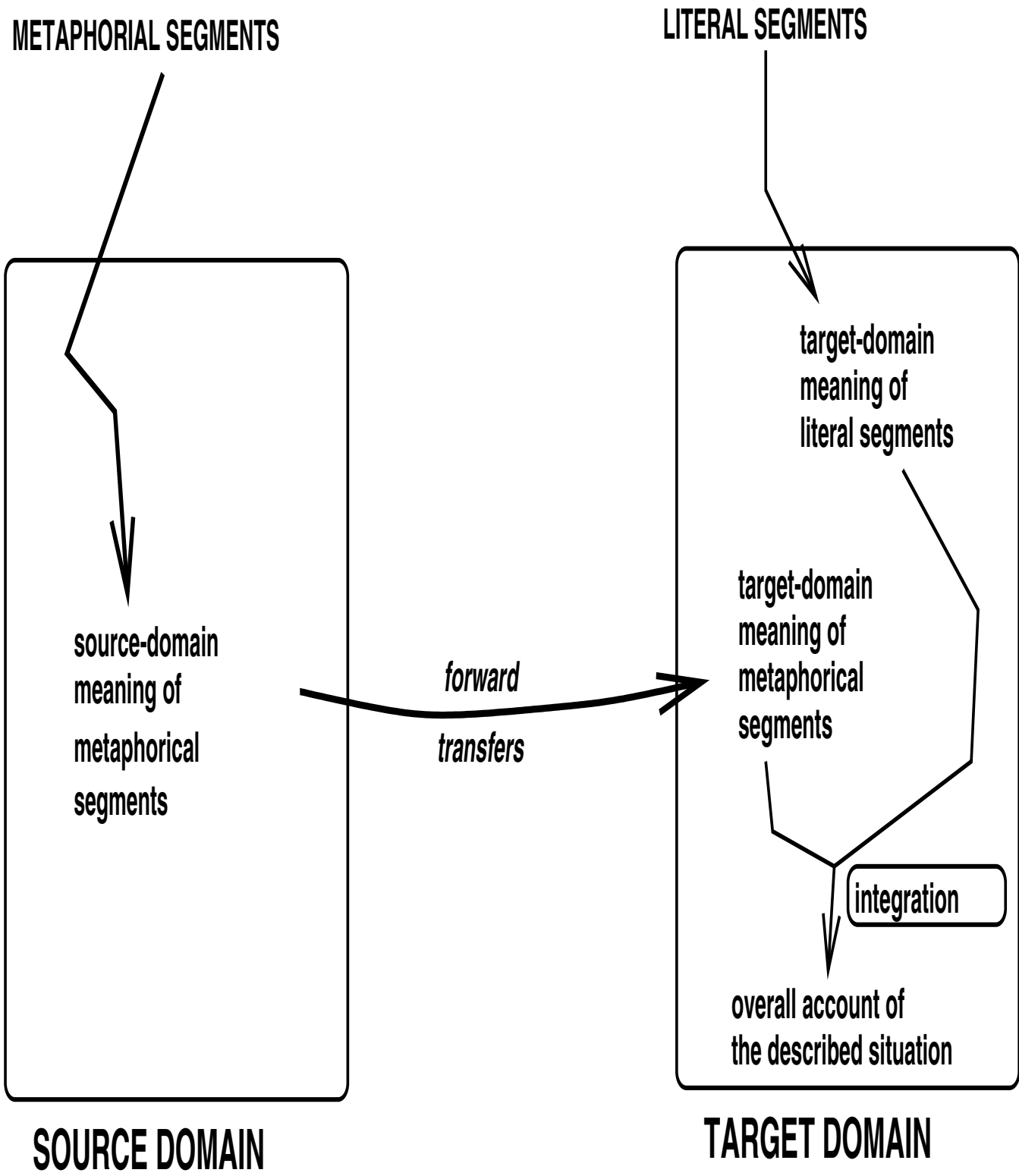


Figure 3: Traditional approach to coherence, not using metaphORIZATION.

**METAPHORICAL SEGMENTS**

**LITERAL SEGMENTS**

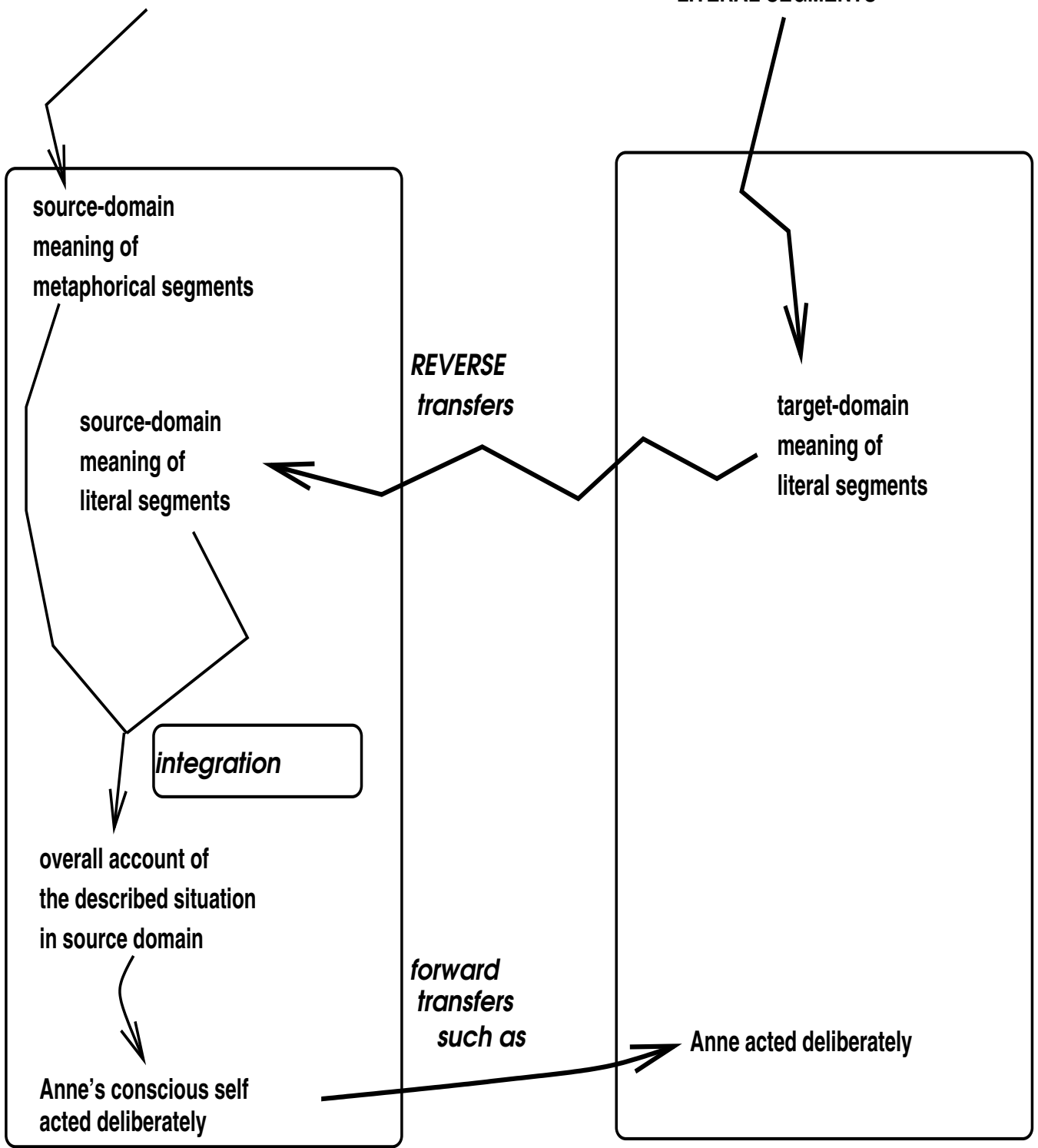


Figure 4: Metaphorization approach to coherence.

By way of further illustration, we can consider the following hypothetical discourse fragment (14). It uses the “TEACHER AS MIDWIFE” metaphorical view. In our discussion we will make some use of the matchmaking function of midwives in Ancient Greece, which is explicit in Theaetetus.

(14) “Socrates helped Theaetetus give birth to [some idea K].”

Similarly, Peter helped Veronica produce [some idea L].

It would surely be natural to take Peter’s help to be metaphorically a matter of helping a birth, given that the context is already viewing idea production as birth. Indeed, we suggest that the understander can profitably reverse-transfer the target-domain proposition that

(15a) **Peter helped Veronica produce L**

to become the source-domain proposition that

(15b) **Peter helped Veronica give birth to L.**

Then, the rich resources of the source-domain scenario are available to make further inferences. One such inference, albeit an uncertain one, could be that Peter acted as a midwife for Veronica. There could then be a further inference that Peter was instrumental in introducing Veronica to the responsible sexual partner. This inference exploits the matchmaking function of midwives in Ancient Greece. Such further propositions could then lead by ordinary S→T transfer to new propositions in the target domain, for instance that Peter introduced Veronica to someone who stimulated her ideas. Of course, there is no guarantee that this proposition is true, but that is always the case with the results of metaphorical understanding anyway.

The traditional method of Figure 3 would allow room to infer that Peter is Socratic, partly because of the word “similarly”; but once the metaphor used in the first sentence has been left behind there is no strong impetus to make that inference, rather than simply interpreting the word to be pointing out that Peter is like Socrates purely and simply in having helped someone produce an idea.

The argument somewhat relies on the source domain scenario not having a complete, equally rich and extensive correspondent in the target domain. That is, reasoning in the source domain uses knowledge about midwives and their role in (Ancient Greek) society, where that knowledge is not all mapped to corresponding

knowledge in the target domain. That this lack of mapping is common in metaphor is argued further in (Barnden et al., 1996; Barnden & Lee, 2001), but is also linked to common themes in metaphor research such as the relative unparaphrasability of many metaphorical utterances (see, e.g., Goodman, 1979; Katz, 1996; Waggoner, 1990) and the relative familiarity, richness and accessibility of source domains as opposed to target domains (see, e.g., Lakoff, 1993).

Even if the metaphorical mapping did capture all the richness of facts in the source domain, that might still not be enough for a non-metaphorization approach to match a metaphorization one because methods of reasoning peculiar to the source domain may profitably be accessed through metaphorization. For instance, imagistic/diagrammatic reasoning might be used to good effect in a source domain that prominently featured physical space and objects. Metaphorization allows such reasoning to be used indirectly to illuminate the target domain without needing to have an analog of the reasoning method couched directly in target-domain terms. Also, if familiarity of subject matter can affect the facility of people's reasoning even if the pattern of reasoning is kept constant (see, e.g., Johnson-Laird, 1983:29–34), source-domain reasoning stands to have an advantage just from this factor.

In addition, metaphorical discourse sometimes portrays situations that are relatively exceptional. This is true of the Anne/Kyle example, (7, 13a), which is exceptional if we assume that knowledge about infidelity is normally not suppressed by the betrayed partner. It is also true of examples of “TEACHERS AS MIDWIVES,” assuming that most teachers are not Socratic. It may be relatively difficult to reason about exceptional situations in the target domain, compared to using the resources of the source domain, precisely because knowledge of target domains in metaphor is often sparse and impoverished in comparison to knowledge of the source domains. In discussing the mental states of an agent, for example, verbs such as “think” and “forget” are sufficient in standard situations. However, the more exceptional a situation is, the less likely is it that standard target-domain words will be sufficient to capture the complexities and nuances effectively and efficiently, and the more likely it is to need metaphorical description and source-domain reasoning.

Also, it is a mistake to think that, if there is an extended use of a metaphor across a stretch of discourse, then target-domain information has to be derived from each metaphorical patch in the stretch. It may only be necessary to switch to the target-domain once some source-domain conclusion has been obtained from within-source-domain reasoning that the stretch stimulates. Thus it may not only be fruitful but also much

more economical to metaphorize intervening literal segments than to literalize the metaphorical ones, depending partly on the relative numbers of literal and metaphorical segments.

Finally, the considerations about query-transfer from the previous subsection can be extended to bring in a type of metaphorization. Suppose that the argument for NOT(TQ) in Figure 2 is in fact deemed strictly stronger than the SQ-based argument for TQ, so that NOT(TQ) is established in preference to TQ. As before, the certainty level of TQ will need to be reduced (assuming it is not already low), with consequences as before for SQ, SR and TR. However, it is now also appropriate to create and affirm NOT(SQ) in the source domain, in order to to maximize the partial match between the two domains.<sup>10</sup> NOT(SQ), which is the result of metaphorizing NOT(TQ), could have important consequences in the source domain, and hence important consequences in the target domain by virtue of further forward transfer. In our example (recalling that SQ was the proposition that **Socrates helped Electra tend K**), one (uncertain) conclusion from NOT(SQ) together with other information, such as that there are no other midwives in the scenario, could be that **Electra felt especially insecure while tending K**. Hence, provided that mental/emotional attitudes such as insecurity map over from source to target, we can conclude in the target domain that **Electra felt especially insecure while producing K**.<sup>11</sup> There would have been no reason to conclude this in the target domain simply on the basis of the hypothesis that Socrates did not help Electra produce K.

The metaphorization approach appears to be a radical departure from other research on metaphor, even discourse-sensitive research such as in Hobbs (1990). Hobbs' approach does not preclude metaphorization, but he does not appear to have argued for it. Much more investigation needs to be done into metaphorization, including into the question of when it is beneficial for the understander.

Reverse transfer of queries and of certainty can be viewed as a form of metaphorization. However, the distinctive element of the metaphorization discussed in the present section is that propositions in the target domain are used to create propositions in the source domain that would not otherwise be there.

<sup>10</sup>Barnden & Lee (2001) claim that when a proposition is transferable, then so is its negation.

<sup>11</sup>Barnden & Lee (2001) argue that mental/emotional attitudes generally do carry over in metaphor, irrespective of what the particular metaphorical view is. It is similar to a claim of Carbonell (1982).

## 5 Direction of Mapping Links versus Direction of Metaphor

If the intuitive direction of a metaphorical view of “A AS B” is from B to A (direction D1a in section 3.5), and the main transfer is also from B to A, it seems natural for the intuitive direction (D3) of the mapping links involved in the metaphor to be the same. However, this is at best simplistic and may even be generally misguided.

In fact, it is interesting to note that T→S mapping links are what are actually suggested by the very naming of metaphorical views. Take the name “IDEAS AS PHYSICAL OBJECTS,” referring to a metaphorical view that is very commonly used in discourse. The name itself suggests that, in the current discourse context, ideas are in general to be taken as physical objects, but it does not ostensibly indicate that physical objects are in general to be taken to be ideas. This suggests that, if anything, it is more intuitive to think of the **being-idea** property in the target domain as mapping to the **being-physical-object** property in the source domain, rather than the other way round as would be conventional.

We will flesh out this point by looking at some examples. Metaphorical views of “IDEAS AS PHYSICAL OBJECTS” and “MIND AS PHYSICAL SPACE” are used in the following discourse segments, where we have emphasized some words of interest by capitalizing them:

(16a) “Sara read the letter over, knew that it would be filed in one of the bottom DRAWERS of her psyche”  
[Davis, 1994:p.147]

(16b) “She paced around her dark living room for nearly an hour, trying to force him away, to will him out of her mind. ... She'd gotten it down to a formula—sending a man down a long ROAD in her mind, over some HILLS, into the next COUNTY, ...” [Davis, 1994:p.48]

(16c) “Why the sudden irrational change? ... if only she could find the key to open the DOOR of his mind, unlock the logic, discover the real reasons for this sudden incomprehensible change.” [From magazine My Story, May 1995, Editions Press limited, Gibraltar.]

(16d) “stirring up layers of MUD-encrusted memories” [Heard in conversation.]

In these examples, some ideas are being viewed as physical objects, which are located in minds viewed as physical regions. The ideas so viewed are an idea of the letter in (16a), an idea of the man in (16b), the reasons in (16c), and the memories in (16d).<sup>12</sup> Therefore, the source-domain scenarios presented by the segments do indeed contain physical objects that correspond to ideas in the target-domain situations being described. However, other physical objects in the source-domain scenarios should presumably not be taken to correspond to ideas—or at least there is little evidence that they should be mapped to ideas. These physical objects are or include the ones referred to by the capitalized words in the segments.

If, therefore, one takes the property **being-physical-object** to map to the property **being-idea**, one would have to say that, nevertheless, not all applications of **being-physical-object** in the source-domain scenario map to **being-idea** in the target domain. This is an unfortunate incoherence between the property and its applications, and brings into question the idea that the **being-physical-object** property maps to **being-idea** after all. Quite apart from conceptual inelegance, it means that an attempted transfer act that works on a proposition in the source domain that involves **being-physical-object** cannot safely assume that this property can be replaced by **being-idea**. One could, of course, say that the **being-physical-object** property does not map at all, and that it is only particular physical objects that map. But that is surely less intuitively appealing than having some sort of mapping of a property, and the idea that properties should map is commonplace in the metaphor literature.

It is evidently simpler and more elegant to take the following, reverse, stance: the property **being-idea** maps to the property **being-physical-object**. This is a natural mapping link because it is a reasonable assumption that, given that discourse is using the “IDEAS AS PHYSICAL OBJECTS” view, if one idea in the specific target-domain scenario at hand is being viewed as a physical object then others are too. Consider for instance the following hypothetical discourse segment:

(17) “Many ideas had already been whizzing around inside Mary’s mind.” John’s question made her think of even more.

This again uses both “IDEAS AS PHYSICAL OBJECTS” and “MIND AS PHYSICAL SPACE,” in the first

---

<sup>12</sup>In (16a) and (16b), we take the references to the letter and the man respectively to be metonymically referring to ideas of the letter and man. This “THING FOR IDEA OF IT” type of metonymy occurs very commonly in combination with “MIND AS PHYSICAL SPACE,” and elsewhere. It is discussed in Barnden (n.d.) and Barnden (2000). It is strongly related to the “THING FOR DEPICTION OF IT” type of metonymy evident in a sentence like “God is near the left hand edge of the painting.”

sentence. It would be natural to assume that the further ideas implied by the second can also be viewed as physical objects inside Mary's mind-space, and indeed whizzing around in it. (This is another example of metaphorization.) Thus, it is plausible that the mapping of **being-idea** to **being-physical-object** has uniform application to all ideas mentioned in the local discourse context. (This may be a less safe assumption in the case of a less standard mapping link.)

It may even be the case that all mapping links for properties, and similarly for relations, should go from target to source. However, we cannot currently justify such a strong claim, and will therefore assume that in a metaphorical view some mapping links may need to go from target to source and some from source to target. To accommodate this possibility we can replace the single mapping by two mappings, one consisting of  $S \rightarrow T$  links and the other of  $T \rightarrow S$  ones.

As we stressed in section 3.7, the direction of mapping links is purely a mathematical matter with no intrinsic operational consequences, and transfers using  $T \rightarrow S$  links can be  $S \rightarrow T$  (see D2/D3 distinction in section 3.7). The issues we have discussed in this subsection are merely matters of theoretical convenience and coherence.

## 6 Asymmetry of Metaphor

The reanalysis of directionality in metaphor, resulting in particular in increased emphasis on reverse transfer, makes it incumbent upon us to explain what the asymmetry of metaphor consists in, and simultaneously allows us to clarify it.

It is frequently pointed out that metaphor is asymmetric (e.g., Way, 1991; Gentner & Bowdle, 2001), in the sense that a view of "MIDWIVES AS TEACHERS" is clearly distinct from a view of "TEACHERS AS MIDWIVES." The present article complicates the nature of asymmetry, as it claims that the direction of the metaphor does not completely determine the direction of individual transfers or even the intuitive direction of mapping links. Thus, the difference between "A AS B" and "B AS A" is not a simple matter of what direction the links or transfers go in. So, what does asymmetry amount to? There are two sides to the answer.

The observations to be made show in particular that criticisms of comparison theories of metaphor on

the grounds that comparison is symmetrical whereas metaphor is asymmetrical (see, e.g., Way, 1991) are in part misguided. In this context Stern (2000:p149) also makes the point that similarity is not necessarily symmetrical.

## 6.1 Asymmetry of Main Transfer and of Role of Subsidiary Transfers

We stressed that main transfer is in our account still from source to target. So, uses of “A AS B” and “B AS A” differ as to direction of main transfer, and that alone constitutes a type of asymmetry. It is obviously very different to conclude, say, that in reality certain teachers help certain students from concluding, say, that in reality certain midwives help certain pregnant mothers.

Also, non-main transfers in understanding a usage of “A AS B,” if they are of the reverse types described in section 4, will just be aids to the transfers that constitute the main transfer. Suppose that a use of “A AS B” involves a reverse transfer of a proposition  $P_A$  from A to B in the spirit of metaphorization (section 4.6), to generate a proposition  $P_B$  in domain B. Suppose that the same proposition  $P_A$  is forward-transferred from A to B in some use of “B AS A” to become  $P_B$ . Although  $P_A$  is transferred to become  $P_B$  in both cases, the status of  $P_B$  is different in the two. When  $P_A$  is forward-transferred,  $P_B$  is at least a tentative claim about the target situation the discourse is describing; but when  $P_A$  is reverse-transferred,  $P_B$  is merely an aid to building a source-domain scenario that could illuminate that situation by other, forward, transfers.

## 6.2 Asymmetry of Aspects or Links Used

Contrary to the example of the previous subsection, just because  $P_A$  reverse-transfers to become  $P_B$  in a use of an “A AS B” view does not generally mean it has to forward-transfer to become  $P_B$  in a use of a “B AS A” view, or vice versa.

Here we first observe an important complication that we suspect the discussion of asymmetry in the literature has neglected. Several different views could all be given the same name “A AS B”: that is, there could be different mappings between any two given domains, useful for different purposes. Also, two different mappings between A and B could be compatible, so it is arbitrary whether we regard the two mappings as defining different views as opposed to defining different parts of the same view. In the same vein, two

different uses by discourse of the same overall mapping could use somewhat different subsets of the set of mapping links constituting the mapping. Thus, to discuss asymmetry properly, we need to concentrate on the question of what mapping links are being used in particular discourse uses of metaphorical views, rather than on names of form “A AS B.”

In particular, while it is possible that some use of an “A AS B” view for a given A and B involves the same aspects of A and B as some use of a “B AS A” view, there may equally be some use of an “A AS B” view that involves a different set of aspects of A and B from some use of a “B AS A” view. And even when the same aspects are used, the linking could in principle be different. A similar point is made by Stern (2000:p.153).

For example, a view of “INDUSTRIAL COMPANY AS ANIMAL” might be used to talk about the company as an entity taking actions in the world, eating other companies, etc. The same mapping links (up to inversion) might be involved in using a view of “ANIMAL AS INDUSTRIAL COMPANY” to discuss eating activity and other external actions by animals. But, equally, a view of “ANIMAL AS INDUSTRIAL COMPANY” might be used rather to talk about the internal biological organization of animal bodies. It all depends on context.

Having said all this, if there is a viable “A AS B” view then we suggest that it is plausible that there will also be a viable “B AS A” view using the same mapping links (or their inversions), provided that A is sufficiently rich to serve as a useful domain for illuminating B. In such a case the two directions of view can act symmetrically with respect to each other, in the sense that they use the same mapping up to inversion. (Of course, they are still asymmetrical in the sense of section 6.1.) But the previous paragraphs establish that the two directions may also be able to act asymmetrically with respect to what is mapped to what.

## **7 The ATT-Meta System**

The ATT-Meta system has been described most recently in Barnden (2001) and Barnden & Lee (1999, 2001). The present section briefly sketches the nature of the system and summarizes how it is related to the issues in previous sections. Barnden et al. (2002) provides a detailed account of an ATT-Meta implementation of teacher/midwife examples that involve these types of transfer. These examples are closely related to those

used in section 4.

## 7.1 Introductory Description of ATT-Meta

ATT-Meta is aimed at performing the reasoning needed for understanding a broad class of metaphorical utterances that we call map-transcending utterances based on familiar metaphorical views. In the general approach of which ATT-Meta is a specific instance, the understander (e.g., ATT-Meta) already knows the metaphorical views used, and therefore possesses source/target mappings underlying those views; however, the utterance is map-transcending in that it uses aspects of the source domains(s) that are not mapped by the mappings to the understander. For example, consider again the phrase (16d), “mud-encrusted memories.” This rests on “IDEAS AS PHYSICAL OBJECTS”—which is likely to be familiar to typical understanders. The utterance is map-transcending for the understander if the understander does not possess mapping links that connects mud or encrustation to some aspects of mind.

As we have just implied, we take a radically relative view of metaphor, respecting the likelihood that different language-users, even if individually typical, may (a) be familiar with somewhat different metaphorical views, (b) roughly share a particular metaphorical views and yet link source and target aspects together somewhat differently, and (c) have different lexicons and hence different distribution of word-senses over domains. Therefore, there is no objective fact of the matter about whether an utterance is metaphorical, about what metaphorical view(s) it rests on (and therefore about what mapping links exist), or about what counts as map-transcending. These matters are all language-user-relative.

ATT-Meta is designed on the principle that the understander should, by default, not try to create new mapping links to handle map-transcending aspects of utterances. This is the principle of Map-Extension Minimization. Rather, the system should try to do source-domain reasoning that links the map-transcending aspects to source aspects that are already mapped by the mappings possessed by the understander.

An allied principle is that source-domain knowledge used in understanding a metaphor may not itself need to be transferred or be usefully transferrable. An example of this is the proposition that Socrates lived in Athens in the example at the end of section 4.4.

ATT-Meta handles the Anne/Kyle sentence as follows, given knowledge of “MIND AS PHYSICAL

SPACE” and “IDEAS AS PHYSICAL OBJECTS,” and assuming that “far reaches” only has a spatial sense and that this notion is not mapped to the mental domain. The most important knowledge about the metaphorical views is the following mapping link:

degree of (in)ability to operate physically on an idea, in the source domain (physical objects)  
maps to degree of (in)ability to operate in a conscious mental way on the idea, in the target domain (someone’s mind).

ATT-Meta can reason, mainly using commonsense knowledge about physical spaces and objects, that Anne’s conscious self has only a very low ability to operate physically on the idea that Kyle was having an affair. This is because the far reaches of a physical region are very distant from the main part of the region, and Anne’s conscious self is taken in the metaphorical view to be in that main part. The reasoning is conducted in the terms of the source domain. Then, using the known mapping link displayed above, ATT-Meta can create in the target domain the hypothesis that Anne has only a very low ability to operate consciously on the idea. This example is treated in much more detail in Barnden & Lee (2001). A variety of other examples are also treated in that report and in other reports cited in it.

Both ATT-Meta’s long-term knowledge of individual domains and its knowledge of metaphorical views is couched in terms of IF-THEN rules. One crucial rule about the domain of physical objects and space can be glossed in English as follows:

**IF O is a physical object AND P is a person  
AND O is not physically accessible to P to degree D (at least)  
THEN presumably P cannot physically operate on O to degree D (at least).**

One rule about midwives that is used in the implementation in Barnden *et al.* (2002) is

**IF S is a person  
AND S is the midwife for P giving birth to B  
THEN presumably S helps P give birth to B.**

The “presumably” annotations make these rules into default rules: even if it is certain that some particular

person P cannot physically access some particular object O to some particular degree D, it is only presumed (as a default) that P cannot physically operate on O to degree D. Propositions as well as hypotheses are annotated with one of a small set of qualitative certainty measures. These include “certain” and “presumed.” The first rule also illustrates that ATT-Meta can handle degrees to which states of affairs can hold. There is a small set of qualitative degrees going from “very low” up to “absolute.” Matters of degree are important in metaphor.

A given metaphorical mapping link is implicit in either one or two transfer rules capturing the two different directions of transfer that the link could in principle support.<sup>13</sup> For instance, a mapping link between physical operation and mental operation within the view of “IDEAS AS PHYSICAL OBJECTS” is implicit in the following pair of rules:

(19a)

**IF in reality X is a person and K is an idea  
AND K is being viewed as a physical object  
AND person X’s conscious self is being viewed as being able to operate physically on K to at least degree D  
THEN presumably in reality X can mentally operate consciously on K to degree at least D.**

(19b)

**IF in reality X is a person and K is an idea  
AND K is being viewed as a physical object  
AND in reality person X can mentally operate consciously on K to at least degree D  
THEN presumably X’s conscious self is being viewed as being able to operate physically on K to degree at least D.**

The first rule would be used for forward transfer of propositions about X’s conscious self operating physically on ideas, whereas the second would be used for reverse transfer of propositions about X operating mentally on ideas.

For “TEACHER AS MIDWIFE,” one crucial mapping link is implicit in the following pair of rules, used

---

<sup>13</sup>We have elsewhere called such rules conversion rules.

in the implementation in Barnden et al. (2002):

(20a)

**IF in reality X is a person and K is an idea  
AND K is being viewed as a child  
AND X is being viewed as giving birth to K  
THEN presumably in reality X produces K.**

(20b)

**IF in reality X is a person and K is an idea  
AND K is being viewed as a child  
AND in reality X produces K  
THEN presumably X is being viewed as giving birth to K. .**

## **7.2 Reverse (and Forward) Transfer of Queries in ATT-Meta**

ATT-Meta's reasoning is entirely query-directed. So, for instance, in the Anne/Kyle example the reasoning steps mentioned arise from a backwards-going process of query construction, proceeding backwards through rules. In particular, a query in target-domain terms about the degree of ability of Anne to mentally operate consciously on the Kyle-affair idea in reality leads, via rule (19a), to the creation also of a query in source-domain terms about the degree of ability of Anne to operate physically on the idea, under the metaphorical view. Thus, the system exhibits  $T \rightarrow S$  transfer of queries. Note carefully that such reverse transfer occurs by backchaining over forward transfer rules.

The system also performs  $S \rightarrow T$  transfer of source-domain sub-queries that arise in the course of reasoning, by backchaining over reverse transfer rules such as (19b, 20b).

## **7.3 Reverse (and Forward) Transfer of Certainty Influences in ATT-Meta**

The system's metaphor-based reasoning is thoroughly integrated into a general-purpose framework for uncertain reasoning using qualitative uncertainty measures. Reasoning in source-domain terms and in target-domain terms is generally uncertain. Rules and propositions are annotated with qualitative certainty levels.

There is a heuristic conflict-resolution mechanism that attempts to adjudicate between conflicting arguments, by considering their relative specificity. As a result of conflict-resolution, the certainty of one or more propositions is downgraded. Reasoning leaves behind a record of dependency links between propositions, so certainty-up/downgrading of a proposition often leads to up/downgrading also of propositions dependent on it.

This applies just as much to reasoning that crosses between domains via transfer rules as to reasoning within domains. Because mapping links are generally clothed in reverse-transfer rules such as (19b, 20b) as well as in forward-transfer rules such as (19a, 20a), ATT-Meta performs reverse transfer of certainty up/downgrades when reverse-transferable target-domain propositions are up/downgraded.

Because of the extensive within-source reasoning that ATT-Meta often performs, up/downgrades within the source domain can lead to other up/downgrades in that domain, and hence to up/downgrades in the target domain by virtue of forward transfer via rules such as (19a,20a).

The handling of negative influences is actually stronger than just by reverse transfer of certainty downgrades. Generally, transfer rules are accompanied by negative versions. For example, corresponding to (20a,b) there are rules allowing not-giving-birth to be forward transferred to become non-producing, and not-producing to be transferred to become not-giving-birth. In this way, NOT(TQ) in Figure 2 would be reverse-transferred to become NOT(SQ).

#### **7.4 Metaphorization of Literal Information in ATT-Meta**

Because of the reverse transfer rules such as (19b, 20b), ATT-Meta can metaphorize literally-stated information, and such metaphorization steps are seamlessly mixed in with other reasoning steps. However, only limited experimentation on this has been done so far using ATT-Meta. A simple case of it in a teacher/midwife example is reported in Barnden et al. (2002). The reverse-transfer of NOT(TQ) in the previous subsection is itself a kind of metaphorization (assuming TQ derives from target domain premises obtained from literal statements), and allows the type of reasoning described towards the end of section 4.6.

## 7.5 Asymmetry of Metaphor in ATT-Meta

Asymmetry of metaphor is fully supported in ATT-Meta on the lines of section 6. It is instructive to look at the following situation that could hold in ATT-Meta. Consider again the reverse-transfer rule (19b) for “IDEAS AS PHYSICAL OBJECTS.” It has the overall form:

**IF K is in reality an idea AND K is being viewed as a physical object AND ...  
THEN ... .**

Now consider forward-transfer rules for a hypothetical reversed view of “PHYSICAL OBJECTS AS IDEAS.” These would have the overall form:

**IF O is in reality a physical object AND O is being viewed as an idea AND ...  
THEN ... .**

These two rule-forms differ crucially in their first two conditions, and may also differ arbitrarily in the remaining condition parts. Thus, reverse-transfer rules for “IDEAS AS PHYSICAL OBJECTS” will act under entirely different circumstances from forward-transfer rules for “PHYSICAL OBJECTS AS IDEAS.” This is true even when the source and target aspects mapped are the same or similar. However, the THEN parts of the above two rule skeletons can also be arbitrarily different, so that what aspects are mapped can be arbitrarily different.

## 7.6 Pretence vs. Reality Rather Than Source vs. Target

The account so far of ATT-Meta oversimplifies in that it is merely an approximation to say that ATT-Meta’s transfer rules such as (19a,b) map between source and target domains. Rather, a rule like (19a) or (20a) maps from a metaphorical pretence context to the reality context, while a rule like (19b) or (20b) does the reverse. A metaphorical pretence context<sup>14</sup> is a special computational environment where the normally-absurd situation described the metaphorical utterance taken at face value can be reasoned about. This situation is, for instance, one in which Theaetetus gives birth to babies that are also ideas. The rule elements in (19a,b,

<sup>14</sup>We also call this a metaphorical pretence cocoon.

20a,b) qualified by “being viewed as” are about the contents of the pretence context and could be glossed as “being taken in the pretence context as.”

However, in practice, most information and operations in the pretence context are in source-domain terms, while most target-domain information and operations are in the reality context. Thus, it is roughly true to say that rules like (19a,b, 20a,b) map between source and target domains.<sup>15</sup>

In fact, ATT-Meta does not impose any restrictions on the domain of information used in the pretence context, because domains have no explicit existence in the system. There is just an undifferentiated set of rules that are applied uniformly by the system. In particular, target-domain information can be used in the pretence context, which is useful in particular when the source and target domains overlap. Moreover, entities are shared between the pretence space and the reality space: for example, the idea of Kyle’s affair exists in the pretence context as well as in the reality context. In the pretence context it is categorized both as a physical object and as an idea. This is in contrast to approaches to metaphor in which there is a physical object that is separate from the idea, and a mapping link between them. In effect, in the ATT-Meta approach some mapping links are collapsed to identity links.

Because of the mixing of domains in the pretence context, this context can be viewed as a “blend space” roughly on the lines of (Fauconnier & Turner, 1998; Coulson & Matlock, 2001). Indeed, Barnden (1998b) applied ATT-Meta without modification to implement the reasoning in the virtual-ship-race example discussed in papers on blending theory (e.g., Fauconnier & Turner, 1998), even though this example need not be described as involving metaphor. Thus ATT-Meta can be seen as a technically worked-out realization of some aspects of blending theory. See also the application of the ATT-Meta approach to blending and counterfactuals in Lee & Barnden (2000, 2001c).

## 8 Conclusions

The main conclusions are that (a) reverse (i.e., target-to-source) transfers of several distinctly different types are desirable in metaphorical discourse understanding; (b) in particular, metaphORIZATION of literal utterances

---

<sup>15</sup>Rules (19a,b, 20a,b) are themselves oversimplified in this article: there can be multiple, nested pretence spaces (Lee & Barnden, 2001a), and transfer rules can work between two pretence contexts where one is nested within the other. Such nesting is used to handle chaining of metaphorical views: “A AS B AS C.”

can be desirable; (c) several different notions of direction in metaphor need to be distinguished; (d) the directions of mapping links are sometimes or often the wrong way round in accounts of metaphor; and (e) asymmetry of metaphor does not arise from having mapping links or transfers going in any one particular direction.

Although we have, for definiteness, couched our considerations in terms of mappings, which might seem to make the article relevant only to analogy-based accounts of metaphor, in fact the crucial considerations carry over to other accounts. All accounts must ultimately involve some notion of flow of information, emphasis, etc. from one domain to another.

To continue point (e), asymmetry arises for four reasons: (i) the direction of main transfer is switched, (ii) a particular transfer that happens to be involved both in a use of a metaphorical view and in a use of a reversed view will have different roles in the two cases, (iii) uses of “A AS B” and “B AS A” views in particular discourses can deal with different aspects of A and B, and (iv) even when they deal with the same aspects, the way aspects of A are linked to aspects of B can differ.

Reverse transfers of all the sorts that have been discussed in this article are supported in a routine way by the ATT-Meta system, and asymmetry is fully supported. Blending theory also allows transfers into and out of the blended space, including transfers from the blended space back into a source domain. The LISA model for analogy (Hummel & Holyoak, 1997) allows transfer to go from target to source, though the relationship to the considerations in the present article is unclear. Thus, a small number of approaches are beginning to allow effects such as those in this article. However, the topic appears to have seen little theoretical analysis, psychological experimentation or computational realization, and is a fertile ground for future study.

## **9 Acknowledgments**

This research is supported by grant GR/M64208 from the Engineering and Physical Sciences Research Council of the UK.

## NOTE TO REFEREES/EDITOR: Shortening the Paper

If necessary the paper could easily be shortened by removal of the material on asymmetry (sections 6 and 7.5) and/or the description of ATT-Meta (section 7). We believe the rest of the paper could stand on its own, though strengthened further by those sections.

## 10 References

- Barnden, J.A. (1998a). 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.
- Barnden, J.A. (1998b). ATT-Meta, conceptual blending and an implemented metaphor system. Poster presented at The Fourth Conference on Conceptual Structure, Discourse, and Language, Emory University, Atlanta, Georgia, USA, 10–12 October, 1998.
- Barnden, J.A. (2000). Metonymy considerations arising from a metaphor project. In J. Meyer-Fujara & H. Rieser (Eds), BI-Metonymy 6th to 8th of October, 2000 Proceedings (no page numbers), Report - Situerte Künstliche Kommunikatoren, SFP360, University of Bielefeld, Germany, 2000/01.
- Barnden, J.A. (2001). Uncertainty and conflict handling in the ATT-Meta context-based system for metaphorical reasoning. In V. Akman, P. Bouquet, R. Thomason & R.A. Young (Eds), Procs. Third International Conference on Modeling and Using Context, pp.15–29. Lecture Notes in Artificial Intelligence, Vol. 2116. Berlin: Springer.
- Barnden, J.A. (n.d.). ATT-Meta Project Databank.  
<http://www.cs.bham.ac.uk/~jab/ATT-Meta/Databank>.
- Barnden, J.A., Glasbey, S.R., Lee, M.G. & Wallington, A.M. (2002). Application of the ATT-Meta metaphor-understanding system to examples of the metaphorical view of TEACHERS AS MIDWIVES. Technical

Report CSRP-02-10, School of Computer Science, The University of Birmingham, U.K.

- Barnden, J.A., Helmreich, S., Iverson, E. & Stein, G.C. (1994). An integrated implementation of simulative, uncertain and metaphorical reasoning about mental states. In J. Doyle, E. Sandewall & P. Torasso (Eds), Principles of Knowledge Representation and Reasoning: Proceedings of the Fourth International Conference, pp.27-38. San Mateo, CA: Morgan Kaufmann.
- Barnden, J.A., Helmreich, S., Iverson, E., & Stein, G.C. (1996). Artificial intelligence and metaphors of mind: within-vehicle reasoning and its benefits. Metaphor and Symbolic Activity, 11(2), 101-123.
- Barnden, J.A., & 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), Second International and Interdisciplinary Conference on Modeling and Using Context, pp.28-41. Lecture Notes in Artificial Intelligence, Vol. 1688. Berlin: Springer.
- Barnden, J.A., & Lee, M.G. (2001). Understanding usages of conceptual metaphors: An approach and artificial intelligence system. Tech. Rep. CSRP-01-05, School of Computer Sci., University of Birmingham, UK.
- Black, M. (1979). More about metaphor. In A. Ortony (Ed.), Metaphor and Thought. Cambridge, UK: Cambridge University Press.
- Carbonell, J.G. (1982). Metaphor: an inescapable phenomenon in natural-language comprehension. In W. Lehnert & M. Ringle (eds), Strategies for Natural Language Processing, pp.415-434. Hillsdale, N.J.: Lawrence Erlbaum.
- Coulson, S. (1996). Menezes Brothers Virus: Blended spaces and internet humor. In A.E. Goldberg (Ed.), Conceptual Structure, Discourse and Language, pp.67-81. Stanford, CA: CSLI Publications.
- Coulson, S. & Matlock, T. (2001). Metaphor and the space structuring model. Metaphor and Symbol, 16(3&4), pp.295-316.
- Davis, P. (1994). Bondage. New York: Pocket Books (Simon & Schuster).

- Falkenhainer, B., Forbus, K.D., & Gentner, D. (1989). The Structure-Mapping Engine: algorithm and examples.  
Artificial Intelligence, 41(1), pp.1–63.
- Fauconnier, G. & Turner, M. (1998). Conceptual integration networks.  
Cognitive Science, 22(2), pp.133–187.
- Gentner, D. & Bowdle, B.F. (2001). Convention, form and figurative language processing.  
Metaphor and Symbol, 16(3&4), pp.223–247.
- Glucksberg, S. & Keysar, B. (1990). Understanding metaphorical comparisons: beyond similarity.  
Psychological Review, 97(1), pp.3–18.
- Goodman, N. (1979). Afterthoughts on metaphor: Metaphor as moonlighting. In S. Sacks (Ed.),  
On Metaphor, pp.175–180. U. Chicago Press.
- Gross, L. (1994). Facing up to the dreadful dangers of denial.  
Cosmopolitan, 216(3), USA ed.
- Hobbs, J.R. (1990).  
Literature and cognition. CSLI Lecture Notes, No. 21, Stanford University.
- Holyoak, K.J. & Thagard, P. (1989). Analogical mapping by constraint satisfaction.  
Cognitive Science, 13(3), pp.295–355.
- Hummel, J., & Holyoak, K. (1997). Distributed representation of structure: A theory of analogical access and mapping.  
Psychological Review, 104(3), pp.427–466.
- Johnson-Laird, P.N. (1983).  
Mental models: towards a cognitive science of language, inference and consciousness. Cambridge, MA: Harvard University Press.
- Katz, A.N. (1996). Experimental psycholinguistics and figurative language: Circa 1995.  
Metaphor and Symbolic Activity, 11(1), pp.17–37.

Kittay, E.F. (1989).

Metaphor: its cognitive force and linguistic structure. (Paperback ed.) Oxford, UK: Clarendon Press.

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.),

Metaphor and Thought, 2nd ed. Cambridge, UK: Cambridge University Press.

Lakoff, G. (1994). The Master Metaphor List. <http://www.cogsci.berkeley.edu>. Consulted in 2001. University of California, Berkeley, USA.

Lakoff, G. & Johnson, M. (1980).

Metaphors we live by. Chicago: University of Chicago Press.

Lee, M.G. & Barnden, J.A. (2000). Metaphor, pretence and counterfactuals. Presented at

Fifth Conference on Conceptual Structure, Discourse, and Language (CSDL-2000), 11-14 May 2000, University of California, Santa Barbara, California, U.S.A.

Lee, M.G., & Barnden, J.A. (2001a). Reasoning about mixed metaphors with an implemented AI system.

Metaphor and Symbol, 16(1&2), pp.29–42.

Lee, M.G. & Barnden, J.A. (2001b). Mental metaphors from the Master Metaphor List: Empirical examples and the application of the ATT-Meta system. Technical Report CSRP-01-03, School of Computer Science, The University of Birmingham, UK.

Lee, M.G. & Barnden, J.A. (2001c). A computational approach to conceptual blending within counterfactuals. Technical Report CSRP-01-10, School of Computer Science, The University of Birmingham, U.K., Sept 2001.

Markman, A.B. (1997). Constraints on analogical inference.

Cognitive Science, 21(4), pp.373–418.

Ortony, A. (1979). The role of similarity in similes and metaphors. In A. Ortony (Ed.),

Metaphor and Thought. Cambridge, UK: Cambridge University Press.

Peleg, O, Giora, R. & Fein, O. (2001). Salience and context effects: Two are better than one.

Metaphor and Symbol, 16(3&4), pp.173–192.

Plato (1973).

Theaetetus / translated (from the Greek) with notes by John McDowell. Oxford: Clarendon Press.

Russell, S. & Norvig, P. (1995).

Artificial intelligence: A modern approach. Englewood Cliffs, N.J.: Prentice-Hall.

Stern, J. (2000).

Metaphor in context. Cambridge, MA and London, UK: Bradford Books, MIT Press.

Turner, M., & Fauconnier, G. (1995). Conceptual integration and formal expression.

Metaphor and Symbolic Activity, 10(3), pp.183–204.

Waggoner, J.E. (1990). Interaction theories of metaphor: psychological perspectives.

Metaphor and Symbolic Activity, 5(2), pp.91–108.

Way, E.C. (1991).

Knowledge representation and metaphor. Dordrecht: Kluwer.