MAPPING

"Mapping" in what follows is used in the general mathematical sense of a partial or total correspondence between elements, relations, and structures in two sets.

Much of the theoretical thinking in modern linguistics has been strongly linked to the development since the 1950s of cognitive science, artificial intelligence, and neuroscience. The first wave of cognitive science looked upon the brain as a sophisticated symbol processing digital computer, and linguistic models in the fifties and sixties took a largely algorithmic approach, with a strong focus on *SYNTAX* and logic.

In the 1970s and 1980s, there was a sharply different second wave of thinking that launched a rigorous, empirically based study of conceptual mappings: *ANALOGY*, *FRAMES*, *METAPHOR*, *METONYMY*, grammatical constructions, and *MENTAL SPACE* projections. This original and ambitious research program revisited from a modern point of view some fundamental issues that have been known since antiquity. It drew on a powerful multidisciplinary mix of psychology, linguistics, computational modeling, and philosophy. Names associated with pioneering efforts in the new field of conceptual mappings include Douglas Hofstadter, Melanie Mitchell, Dedre Gentner, Keith Holyoak, for analogy; George Lakoff, Mark Johnson, Mark Turner, for metaphor and *IMAGE-SCHEMAS*; Erving Goffman, Charles Fillmore, for frames and *FRAME SEMANTICS*; Ronald Langacker, Charles Fillmore, Adele Goldberg, for cognitive and *CONSTRUCTION GRAMMAR*; Gilles Fauconnier, Eve Sweetser, John Dinsmore, for mental space projections; Geoffrey Nunberg for metonymic mappings ("pragmatic functions").

In the 1990s and up to the present (2006), there was substantial further evolution of our thinking on these issues. The creative dimension of conceptual mappings was explored through

the study of *CONCEPTUAL BLENDING* and compression (Fauconnier and Turner 2002; Coulson 2001) and through the modeling of emergent structure in analogy (Hofstadter et al. 1995; Hummel and Holyoak 1997). The role of primary metaphors was discovered by Joe Grady (1997), constraints on mappings were proposed within metaphor theory and within blending theory.

Metaphor was once commonly viewed as literary, figurative, poetic—something exotic that we add to ordinary language to make it more colorful, vivid, emotional. But since the inception of *CONCEPTUAL METAPHOR* theory, it is widely acknowledged that metaphor is in fact central to thought and language and necessary for human language in its many forms. In order to talk and think about some domains (target domains) we use the structure of other domains (source domains) and the corresponding vocabulary (see *SOURCE AND TARGET*). Some of these mappings are used by all members of a culture, for instance, in English, TIME as SPACE. We use structure from our everyday conception of space and motion to organize our everyday conception of time, as when we say *Christmas is approaching*, *The weeks go by*, *Summer is around the corner*, *The long day stretched out with no end in sight*. Rather remarkably, although the vocabulary often makes the mapping transparent, we are typically not conscious of the mapping during use unless it is pointed out to us. Although cognitively active, such mappings are opaque: the projection of one domain onto another is automatic. Metaphoric mappings may also be set up locally, in context, in which case they are typically perceived not to belong to the language but rather to be "creative" and part of the ongoing reasoning and discourse construction. Creative metaphors are often elaborations of conventional ones, as in the following typical literary example:

Perhaps time is flowing faster up there in the attic. Perhaps the accumulated mass of the past gathered there is pulling time out of the future faster, like a weight on a line (McDonald)

Thought and language are *EMBODIED*. Conceptual structure arises from our sensorimotor experience and the neural structures that give rise to it. The properties of grammars are the properties of humanly embodied neural systems. Inference inherently built into a source domain will be transferred by projection to an abstract domain. For example, the conventional metaphors of SEEING as TOUCHING (e.g., *I couldn't take my eyes off her*) and KNOWING as SEEING (e.g., *I see what you're saying*) combine with one *SCHEMA* for the English preposition *over* to motivate *overlook*: the line of sight travels "over" (i.e., above) the object; hence, there is no contact; hence, it is not seen; hence, it is not noticed or taken into account. In contrast, *look over* (*she looked over the draft*) uses a related but different schema for *over*, a path covering much of a surface, as in *she wandered over the entire field*. This sense combines with the same mappings to produce a very different abstract meaning—the object this time is seen and noticed.

Metonymic mappings link two relevant domains, which may be set up locally. They typically correspond to two categories of entities, which are mapped onto each other by a pragmatic function. For example, authors are matched with the books they write, or hospital patients are matched with the illnesses they are being treated for. Metonymic mappings allow an entity to be identified in terms of its counterpart in the projection. So, when a nurse says *The gastric ulcer in room 12 would like some coffee*, (s)he uses the illness (*the gastric ulcer*) to identify the patient who has it. Metonymy allows information to be compressed. If Jack is the patient and if the nurse is addressing a physician, her statement simultaneously conveys that Jack wants coffee and that he has a gastric ulcer, which could be further intended to ask

if coffee is permitted under the circumstances. *I'm in the phone book* uses a metonymic mapping from people to names. It says not only that my name is written in the phone book, but that the number linked to my name is indeed my phone number. So it really says something about "me," not just about my name: how to reach me, that I don't mind making my number publicly available, etc.

Metonymic and metaphoric mappings can combine to provide even greater compression, as in *Martina is three points away from the airport* said by a sports announcer of the tennis star Martina Navratilova, who was about to lose a tournament match. The "points" stand metonymically for the events of losing a point. Three such events would lead to defeat. The events are on a metaphorical spatial scale to which the tennis player gets mapped. On that scale, the player is metaphorically at a spatial distance of "three points" from the end of the match which would mean defeat. A metonymic chain takes us from the end of the match to defeat, then to exclusion from the rest of the tournament, then to returning home. The airport (a place) stands metonymically for an event (flying home) that starts in that place. Through the metonymic chaining, "flying home" links to "leaving the tournament" which links in turn to "losing the match," itself caused by "the three lost points." Strikingly, very little of this is indicated by the linguistic structure itself. It is constructed by means of the cognitive models that we have for games, tennis, tournaments, travel and by applying to them the appropriate mappings. The same sentence can take on completely different meanings if we bring in different cognitive models.

Mental space projections link elements and relations in connected mental spaces. For instance, in saying *Liz thinks her husband is tired*, we build a mental space for Liz's reported beliefs, with a counterpart for "her husband" and properties within that space ("tired") that

may or may not be satisfied in connected spaces: *Liz thinks her husband is tired, but actually he's in great shape.* In saying *Last year, Liz's husband was tired*, we build a mental space for "last year," and in saying *Liz thinks that last year, her husband was tired*, we build a space for last year embedded in a belief space, itself embedded in a base space. *PRESUPPOSITIONS* (such as Liz's having a husband) can spread across spaces: in the last example, we infer that Liz has a husband, that she thinks she has a husband, and that last year, she also had this husband. But any of these presuppositions can be prevented from projecting by an explicit overriding entailment.

In mental space projection, the Access principle allows a description of an element to identify its counterpart in another mental space. For example, if Liz got married to Bob yesterday, we can say *Last year, Liz's husband was tired*, identifying Bob in the mental space "last year" by means of his counterpart (*Liz's husband*) in the mental space "now."

Conceptual Blending generalizes the notion of conceptual mapping to arrays of multiple mental spaces with the creation of new "blended" spaces and the emergence of novel structure. Such arrays of connected spaces are called *integration networks*. Partial mappings link the mental spaces in such networks and selective projection maps the spaces onto novel blended spaces. The mappings are supported by a small number of *vital relations*, such as analogy, change, identity, role-value, cause-effect. Compression is systematic in integration networks: a vital relation in one part of the network can be compressed into a different (or a scaled down) vital relation in another part of the network. Take, for example, *My tax bill gets longer every year*. The inputs are the mental spaces corresponding to different years. In each one, there is a tax bill. These input spaces are linked by the vital relation of *analogy*: each one is structured by the frame of paying taxes in a particular year,

and each tax-paying situation is analogous to the others. The inputs are also linked by *disanalogy*: each tax bill is different (longer than the "previous" one). The analogous input spaces are integrated into a single blended space, in which all the tax bills are fused into one: *analogy* is compressed into *identity*. *Disanalogy* is compressed into *change*. In the blended mental space, there is a *single* tax bill which *changes* over time.

Metaphors typically result from double-scope integration networks while metonymy turns out to be the compression of one vital relation into another.

Conceptual mappings are not prompted only by spoken or *SIGNED LANGUAGE*. They are part of human thought, communication, and interaction quite generally and are signaled through multiple modalities (Alac 2005) and anchored by human cultural artifacts as part of *SOCIALLY DISTRIBUTED COGNITION* (Hutchins 2005).

Biologically, it is currently widely assumed that mappings are effected by means of neural binding (Shastri 1996). Computational models of such binding have been proposed within the neural theory of language (Feldman 2006). Experimental techniques to show the psychological reality of various mappings have been devised by Lera Boroditsky (2000), Ray Gibbs (Gibbs et al. 1997), and Seana Coulson (2001), among others.

--Gilles Fauconnier

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