

FORCE DYNAMIC GESTALT, METAPHOR, AND SCIENTIFIC THOUGHT

Structures of Figurative Thought in Science

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**Invited Talk at the Conference “Innovazione nella didattica delle scienze
nella scuola primaria: al crocevia fra discipline scientifiche e umanistiche”**

Università degli studi di Modena e Reggio Emilia, 12–13 Novembre 2010

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Part 1

INTRODUCTION: FIGURATIVE THOUGHT

Human perception does not work like a movie camera, and the human mind does not produce literal representations of an objectively given outside world.

The human mind is **embodied**. Our bodies give us schemas with which we understand the world and express ourselves.

We do not find an understanding of the world out there in nature but within ourselves. Explanations are representations or reflections of our imagination.

Examples of schemas are balance, container, path, substance, scale and verticality, and many more...

The schemas are projected metaphorically onto phenomena. This means that our **understanding** is largely **metaphorical**.

Metaphors are reflections of thought, not embellishments of language.

An important structure of human understanding is the **Force Dynamic Gestalt** of complex phenomena. We use the schemas of **substance** (quantity), **verticality** (quality and intensity), and **causation** (force or power) to metaphorically elaborate the main aspects of this gestalt.

Examples of phenomena that are experienced in the form of this gestalt are justice, pain, music, food, fluids, heat, and many more... Since we use the Force Dynamic Gestalt on different phenomena, these phenomena become similar to each other in the human mind (analogy).

Metaphorical thought is assembled and expressed in **narratives**. These form the large scale structures of our embodied figurative mind. If we can tell good stories using schemas and metaphors well, we create the basis of good understanding and of good theories.

Part 2

A WINTER STORY

A small town called Little Hollow lay in a hollow surrounded by a high plain. People had settled in that place because small streams collected on the plain and flowed down into the hollow and through their town as a nice gentle river. This the people of Little Hollow liked a lot. But there was something they liked a lot less: Winters in Little Hollow were harsh.

As the last of the warmth of late Fall left the plain surrounding Little Hollow, cold found its way into the area and spread out. Because the plain was so wide, the cold of winter had to spread pretty thinly, so it was not all that cold up there. Moreover, even in the midst of winter, the Sun managed to send some warming rays onto the plain. The



snow that fell on the plain was not so cold either, but it was plenty, and the people of Little Hollow loved to go up to the plain for cross country skiing. The little kids went there to build beautiful snowmen.

But in Little Hollow, things were different. The cold of winter knew a good place where it could do its job much more easily of making everything and everybody cold. It could flow into the hollow where the town had been built. It could collect there and it knew it would not be driven out so easily by a little bit of wind as could happen on the plain. And the Sun could not reach the town that easily, also because of fog that often lay over Little Hollow and made everything gray. More and more cold could collect in Little Hollow, and it got colder and colder as the winter grew stronger. The temperature fell and fell.

The people of Little Hollow cursed winter and its cold. They knew that the cold would find its way into their homes if they were not careful to close windows and doors. The cold could even sneak in through tiny cracks between walls and windows, so the people had learned to build their homes well to make it hard for cold to flow in. Still, without the sophisticated and strong heaters in their homes, people knew they could never survive winter. At times when much cold had collected in their town, when it had become terribly cold



and the temperature was very, very low, the fires in the furnaces had to work very hard to fight the cold. The people in their homes made sure that the heat produced by the furnaces would always balance the cold so that their homes felt comfortably warm.

For the children of Little Hollow, the cold of winter was not so bad. They dressed warmly so their body heat would be conserved, and played hard when they were outside. But even for them, the thick cold of winter had mischief in mind. It went into the snow lying on the ground to make it very cold as well and this made the snow drier and harder to work with. The children could not form snowballs, and it was much more difficult to build snowmen. They had to wait until winter had grown somewhat tired, and the cold was slowly driven out of Little Hollow. When there was less cold and the temperature was a little higher, the snow became warmer and much more fun to play with.

When that happened the cold of winter knew its time had come. The warmth of early Spring would grow stronger and drive the cold out of the hollow. The cold knew it had to accept its defeat but it also knew very well it would be back...



KIERAN EGAN ON THE MEANING OF STORIES...

[...] one may explain the impulse toward stories as a reflection of some fundamental structure of the mind. [...] We know that things generally become meaningful within contexts, within boundaries and limits. [...] The story is the linguistic unit that, as it were, brings its boundaries with it. (*) [...] a story is the linguistic unit that can ultimately fix the affective meaning of the events that compose it. (Egan, 1988, p. 100)

A crucial aspect of stories, then, is that they are narratives that orient our affective responses to events. [...] As long as we remain unsure how to feel about the events, we know we have not reached the completion of the larger unit. [...] If we are to try to separate out the kind of meaning proper to the story, then, it is something that involves our emotions. (Egan, 1988, p. 101)

The kind of meaning that is unique to stories, and that stories are uniquely responsible for organizing, is what I am calling “affective meaning.” [...] One reason why stories provide affective meaning is that, unlike the complexity of everyday events, they end. [...] What makes them stories is that their ending completes and satisfies whatever was raised in their beginnings and elaborated in their middles. (Egan, 1988, p. 102)

The story is the archetypical form in which bits are organized together into a greater coherent whole. (Egan, 1988, p. 113)

(*) This is in contrast to “Life is just one damn thing after another.” (Elbert Hubbard, 1856 – 1915)

STORY FORM, STORY GRAMMAR, STORY SCHEMA

Important elements of such stories [...] include a **beginning** that sets up an **expectation**; this expectation has an **affectively engaging quality**, and such a quality is most commonly achieved by setting **binary opposites into conflict** with one another. The **central** part of the story involves the **elaboration** of this binary conflict, and the **end** comes with its satisfaction or resolution or **mediation**. (Egan, 1988, p. 116)

Our beginning then, **needs to set up some binary conflict** or problem and our end needs to resolve it in some way, if we are to take advantage of stories' power to be affectively engaging. (Egan, 1986, p. 31)

My point here is simply to stress that underlying stories there are **abstract forms, plots, sets of rules** that determine the structuring and organization of events to **create** a particular kind of **meaning**. (Egan, 1988, p. 108)

As our **story-sense**, our sense of the grammar of stories, becomes more sophisticated, fed by many stories, so the **conceptions of causality** inherent in such stories become more sophisticated. That is to say, following increasingly sophisticated stories is among other things, the development of one's conception of causality. [...] It is, again, in the enrichment and sophistication of this **affective causality** that **logical and scientific conceptions of causality** are hatched. (Egan, 1988, p. 121)

STORIES: SUMMARY

- Stories reflect a **form of human thought**. They have an underlying grammar (schema) that is used for understanding/thinking.
- Stories organize **affective meaning**. They are **explanatory narratives** that let us know **how to feel about the events** that make them up.
- Stories deal with **human affairs**.
- **Polarities** (binary opposites) are central to setting up the scene for a story. In our example, **COLD** is structured by the polarity HELPER <—> DESTROYER.

QUESTIONS

- Does **COLD** have a meaning as a **character of nature** in our stories?
- If so, **what kind of meaning** does it have?
- Can this meaning lead to **good formal science**?

THE WINTER STORY: COLD AS A CHARACTER

Actually, in our story **COLD** appears as a character having several clear and distinct properties:

- The character develops as a consequence of the **polarity** **HOT** \longleftrightarrow **COLD**.
- **Differences** of hot–cold are the driving force for the processes that let **COLD** act.
- Changes in **degrees** of **COLD** are the main manifestations of **COLD**.
- **COLD** is contained / **stored** in bodies.
- There can be **more or less COLD**.
- **COLD** can **flow** (sneak, force its way ...).
- We can **obstruct** or help the flow of **COLD**.
- **COLD** is **powerful**. **COLD** is the **cause** of many other phenomena (freezing hands, cold homes, dry snow...).
- Heat can counteract / **balance COLD**.

STORY SCHEMA AND CHARACTER SCHEMA: TWO PARALLEL STRUCTURES IN STORIES

Created by different **polarities**, we have two **parallel schematic structures** in our Winter Story:

1. **COLD** as an evil force: **Polarity of SUFFERING/PAIN <—> WELL-BEING/PLEASURE.**

- Initial tension
- Elaboration, dilemma, goal, path
- Mediation, balance, resolution

—> leads to a story following the typical **story schema** (—> affective meaning)

2. **COLD** as a natural phenomenon: **Polarity of COLD <—> HOT.**

- Difference between hot and cold as driving force
- Quantity of cold, stored, flowing
- Force/power of cold (influencing, causing...)

—> creates the nature of a character in the story following the typical **character schema** (—> affective meaning that readily leads to logical meaning)

THE SAME QUESTIONS ONCE MORE, AND SOME ANSWERS...

- Does **COLD** have a meaning as a **character of nature** in our stories?

COLD does indeed appear as a character on the stage of stories. It is created by the polarity **COLD** \longleftrightarrow **HOT**.

- If so, **what kind of meaning** does it have?

COLD has the meanings given to it by the aspects of its character listed further above (intensity / degrees of cold, quantity of cold, power of cold)

- Can this meaning lead to **good formal science**?

My answer is an emphatic yes. This will be shown in the remainder of the talk...

NOTE: The polarity used to set up the general form of the story (following the story schema...) leads to a possible character such as pain (created by **PAIN** \longleftrightarrow **PLEASURE**) that has the same structural aspects as **COLD**.

Part 3

GESTALTS, SCHEMATIC STRUCTURES, AND METAPHORS

The human mind is **embodied**. Our bodies give us **schemas** with which we understand the world and express ourselves, i.e., our thought is **figurative**.

One of the most basic structures of figurative thought are **image schemas**. Image schemas are projected metaphorically onto phenomena. This means that our **understanding** is largely **metaphorical**. We live by the metaphors we create... (see Lakoff and Johnson, 1980).

FROM PERCEPTUAL GESTALTS TO REASONING

Gestalts: The act of perception is one of abstraction, products of **perception** are **abstractions** (gestalts, patterns, configurations) where the whole is simpler than the sum of its parts.

The power of the human mind is in part due to our ability to **differentiate the gestalts** of complex phenomena, i.e., to elaborate on the **aspects** of gestalts by using schemas (which are themselves gestalts) and their metaphoric projections.

In this way we fill the phenomena with embodied meaning. The schemas applied are simple yet they have internal structure and this structure can be made use of in **reasoning**.

IMAGE SCHEMAS ARE GESTALTS

Image schemas constitute abstract knowledge (gained in every-day life) that is applied metaphorically. (M. Johnson, 1987; W. Croft and D. A. Cruse, 2004; V. Evans and M. Green, 2006)

POLARITY	light-dark, warm-cold, female-male, good-bad, just-unjust, slow-fast, high-low
SPACE	up-down, front-back, left-right, near-far, center-periphery. Other: contact, path
PROCESS	process, state, cycle
CONTAINER	containment, in-out, surface, full-empty, content
FORCE / CAUSATION	balance, counterforce, compulsion, restraint, enablement, blockage, diversion, attraction
UNITY / MULTIPLICITY	merging, collecting, splitting, iteration, part-whole, mass-count, link
IDENTITY	matching, superimposition
EXISTENCE	removal, bounded space, object, substance, fluid substance

PROTOTYPICAL CAUSATION: THE GESTALT OF DIRECT MANIPULATION

The **gestalt of direct manipulation**

Lakoff (1987, p. 54), Lakoff and Johnson (1980, p. 70)

Aspects of the gestalt

1. There is an **agent** that does something.
2. There is a **patient** that undergoes a change to a new state.
3. Properties 1 and 2 constitute a single event; they overlap in time and space; the agent comes in contact with the patient.
4. Part of what the agent does (either the motion or the exercise of will) precedes the change in the patient.
5. The agent is the **energy source**; the patient is the **energy goal**; there is a **transfer of energy from the agent to patient**.
6. ...

CONCEPTUAL METAPHOR

Z. Kövecses: *Metaphor* (p. vii and viii)

Traditional view...	Conceptual metaphor theory...
Metaphor is a property of words, a linguistic phenomenon	Metaphor is a property of concepts
Metaphor is used for artistic or rhetorical purpose	The function of metaphor is to better understand certain concepts
Metaphor is based on a similarity between two entities that are compared	Metaphor is often NOT based on similarity ; it creates similarity
Metaphor is a conscious and deliberate use of words; you need a special talent for metaphor	Metaphor is largely unconscious ; it is used effortlessly in everyday life by ordinary people
Metaphor is a figure of speech that we can do without; we use it for special effects; it is not a part of human thought and reasoning	Metaphor is an inevitable process of human thought and reasoning

EXAMPLES OF CONCEPTUAL METAPHORS






ORIENTATIONAL METAPHORS	Linguistic metaphoric expression
MORE IS UP	The number of books printed each year keeps going up Prices went up His income went down last year
HAPPY IS UP	I'm feeling up You're in high spirits I fell into a depression
HIGH STATUS IS UP	He has a lofty position She'll rise to the top We're at the bottom of the social hierarchy
SIMILARITY IS CLOSENESS	These colors aren't quite the same, but they're close
STATES ARE LOCATIONS	I'm close to going crazy, and a little more will send me over the edge
TIMES ARE LOCATIONS	Just before the first of August
PROGRESS IS MOTION FORWARD	I'd like to take this a step further

CONCEPTUAL METAPHORS IN THE WINTER STORY

METAPHORS	LINGUISTIC METAPHORIC EXPRESSIONS
COLD IS A (FLUID) SUBSTANCE	<p><i>The cold found its way into the area and spread out.</i></p> <p><i>Because the plain was so wide, the cold of winter had to spread pretty thinly,...</i></p> <p><i>It could flow into the hollow... it could collect there...</i></p> <p><i>The cold could even sneak in through tiny cracks between walls and windows...</i></p>
THE DEGREE OF COLD IS A (VERTICAL) SCALE	<p><i>Winters in Little Hollow were harsh.</i></p> <p><i>So it was not all that cold up there.</i></p> <p><i>And it got colder and colder as the winter grew stronger. The temperature fell and fell.</i></p> <p><i>When it had become terribly cold and the temperature was very, very low...</i></p>
COLD IS A POWERFUL AGENT	<p><i>The cold of winter knew a good place where it could do its job of making everything and everybody cold...</i></p> <p><i>It went into the snow lying on the ground to make it very cold as well and this made the snow drier and harder to work with.</i></p> <p><i>It knew it would not be driven out so easily by a little bit of wind...</i></p> <p><i>The fires in the furnaces had to work very hard to fight the cold.</i></p>

CONCEPTUAL METAPHORS ARE OLD...

An example from Old Egyptian (R. Fuchs): The word *long*

Hieroglyphs	Direct translation	Meaning
	long	long (literal meaning)
		in long (eternal) misery
	long of heart	happy, glad, joyful
	long of face, long view	far sighted
	long of hand	generous

Part 4

FORCE DYNAMIC GESTALT AND ANALOGY

Gestalts of phenomena that have the potential to become rich concepts appear to be **differentiated** with the help of a few basic schematic structures, and the same schemas are applied to vastly different realms of experience. First among the **schematic structures** that are used recurrently are **quantity** or size, **quality** or intensity, and **power** or force.

If the same aspects are used to structure different phenomena, these become similar for us: we can employ **analogical reasoning**.

THE PHENOMENON OF PAIN

Concepts such as **pain** are abstracted from experience in the form of a preconceptual structured gestalt having the aspects of

substance (quantity) / intensity (quality) / force or power

Linguistic expressions for pain:

- I hadn't felt this much pain in a while, I was hurting all over.
- The pain slowly moved up my leg.
- Today, my headache was particularly strong.
- My pain made me moody.


Entailments of the conceptualization

Having a headache and a broken toe means more pain than just having a headache. More pain in a spot means higher intensity. More pain means it is more powerful. Higher intensity of pain increases its power.

THE PHENOMENON OF MUSIC

Here is a structure (a schema or image-schema) well known in everyday life...

Slowly with expression



mf

Some - where o - ver the rain bow way up high,

there's a land that I heard of once in a lull - a - by.

Johnson (2007, p. 240): “So, there was a buildup of tension, a longing that points you toward some as-yet-unrealized state but then brings you gradually back home.”

Johnson (p. 243): “...when we talk about meaning in music, it will be in terms of the way auditory images and their relations evoke feeling-thinking responses in us.”

THE METAPHORIC STRUCTURE OF MUSIC (1)

Johnson (p. 248): “Here comes the recapitulation.” “The strings slow down now.” “The music goes faster here.” “The manner of the motion is marked by words like creep, crawl, rush, fly, slow down, speed up, walk, float, stumble, etc..” (p.249)

The MOVING MUSIC Metaphor

<i>Source domain (physical motion)</i>		<i>Target domain (musical motion)</i>
Physical object	→	Musical event
Physical motion	→	Musical motion
Speed of motion	→	Tempo
Location of observer	→	Present musical event
Objects in front of observer	→	Future musical events
Objects behind observer	→	Past musical events
Path of motion	→	Musical passage
Starting/ending point of motion	→	Beginning/end of passage
Temporary cessation of motion	→	Rest, caesura
Motion over same path again	→	Recapitulation, repeat
Physical forces (e.g., inertia, gravity,...)	→	“Musical forces” (e.g., inertia, gravity,...)

THE METAPHORIC STRUCTURE OF MUSIC (2)

Johnson (p. 250): “We’re coming to the coda.” “When we get to measure 57...” “Let’s see where we are in the second movement?” “The melody rises up ahead.” “Once you reach the refrain, the dissonant part is behind you.”

The MUSICAL LANDSCAPE Metaphor

<i>Source domain (physical space)</i>		<i>Target domain (musical space)</i>
Traveler	→	Listener
Path travelled	→	Musical work
Traveller’s present location	→	Present musical event
Path already travelled	→	Music already heard
Path in front of traveller	→	Music not yet heard
Segments of the path	→	Elements of musical form
Speed of traveller’s motion	→	Tempo

THE METAPHORIC STRUCTURE OF MUSIC (3)

Johnson (p. 254): “On the basis of this generic metaphor for causation, musical forces are conceived as acting on listeners to move them from one state-location to another along some path of metaphorical motion. You can actually feel yourself being *pushed*, *pulled*, and generally *moved* by the music. When music is a *moving* experience, it can *bowl you over*, *blow you away*, *carry you along*, *transport you*, *give you a lift*, and *take you on a roller-coaster ride*.”

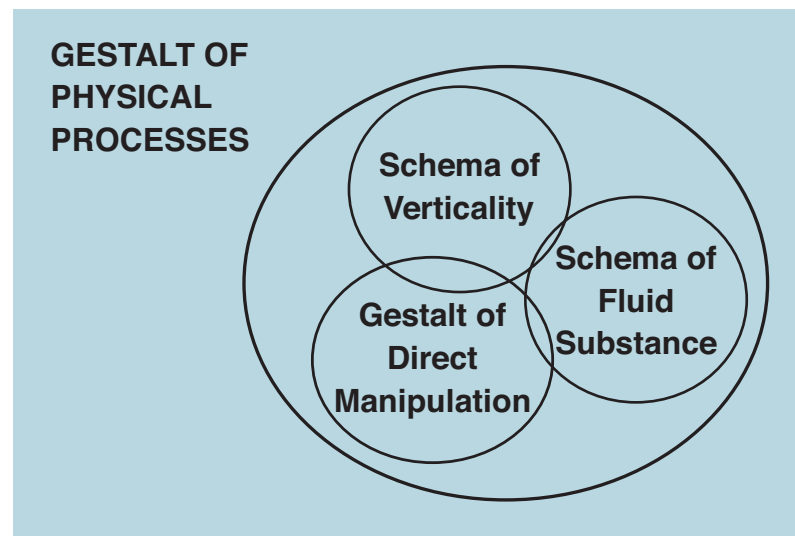
The MUSIC AS MOVING FORCE Metaphor

<i>Source domain (physical motion)</i>		<i>Target domain (musical experience)</i>
Location	→	Emotional states
Movement (from place to place)	→	Change of emotional state
Physical forces	→	Causes
Forced movement	→	Causation
Intensity of force	→	Intensity of musical impact

THE PHENOMENON OF COLD

Clearly, the gestalt of cold in the Winter Story has the same figurative structure. There is a **quantity** of cold, cold can be more or less **intense**, and cold has **power**. This is how the Experimenters of the Accademia del Cimento (1667) explained their experiments.

I call experiential gestalts having these aspects **Force Dynamic Gestalts**. Physical processes are experienced as FDGs and conceptualized in this form:



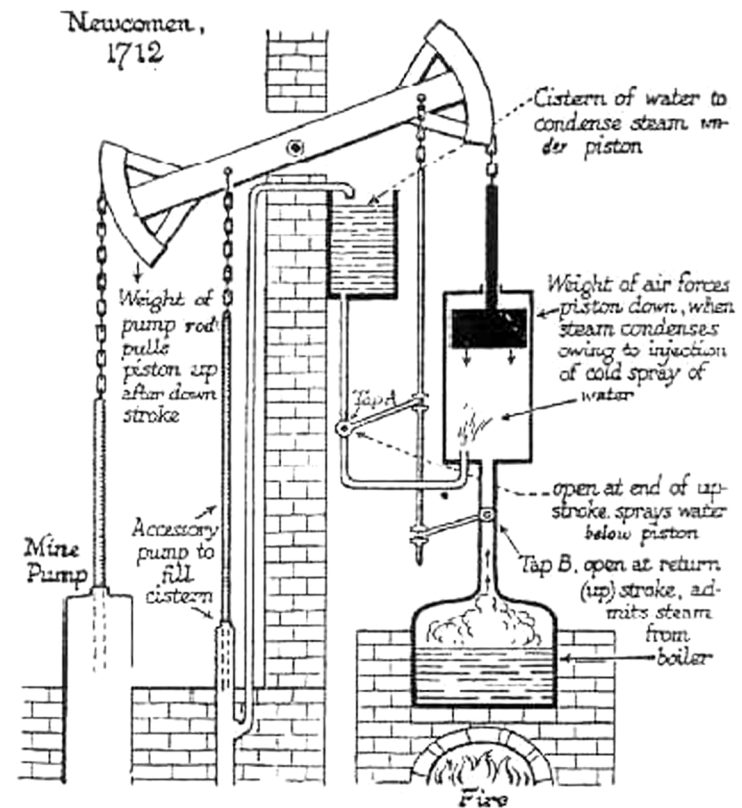
THE FORCE DYNAMIC GESTALT OF HEAT



Sadi Carnot (1796-1832)

**Réflexions sur la puissance
motrice du feu (1824)**

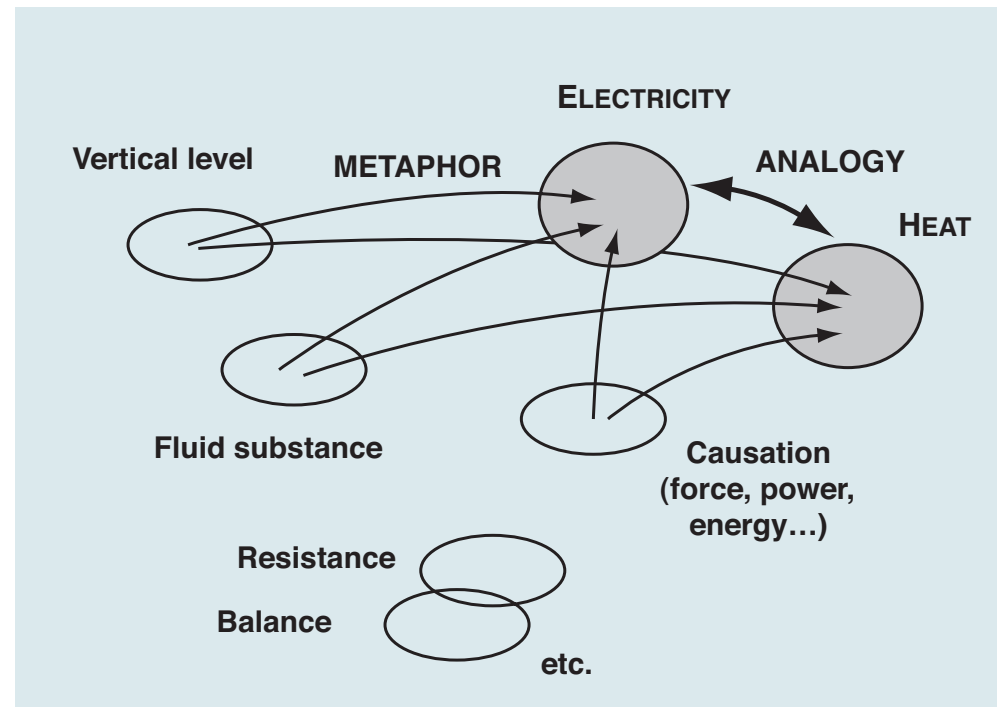
D'après les notions établies jusqu'à présent, on peut comparer avec assez de justesse la *puissance motrice de la chaleur* à celle d'une *chute d'eau* [...]. La puissance motrice d'une chute d'eau dépend de sa hauteur et de la quantité du liquide; la puissance motrice de la chaleur dépend aussi de *la quantité de calorique* employé, et de ce qu'on pourrait nommer, de ce que nous appellerons en effet *la hauteur de sa chute*, c'est-à-dire de *la différence de température* des corps entre lesquels se fait l'échange du calorique.



DIAGRAMMATIC VIEW OF NEWCOMEN'S ATMOSPHERIC OR
FIRE ENGINE (1712)

FORCE DYNAMIC GESTALT IN PHYSICS AND ANALOGICAL REASONING

If we use the same schemas and metaphoric projections to understand different phenomena, these phenomena attain a degree of similarity in our mind. This can be used in a form of analogical reasoning (analogy as structure mapping).



Part 5

SPEAKING AND WRITING WELL ABOUT NATURE

Narratives of natural processes make use of the Force Dynamic Gestalt of phenomena.

Learning about and using the **Force Dynamic Gestalt** of natural processes will lead to **good science**. Indeed, not being able to distinguish between quantity and intensity, or between quantity or intensity and power, leads to bad science.

NARRATIVE AND GOOD SCIENCE

- “Narratives describe ... **agents**, acting in a setting in a way that is relevant ... and they describe how these agents relate to each other.” (Dautenhahn, 2002).
- The **Force Dynamic Gestalt** of natural, social, and psychological phenomena creates such agents. Using the FDG means mainly three things. We learn that **differences** (intensities or tensions) make the world go round, that physical characters can be visualized as fluid **substances**, and that a combination of differences and flows of quantities leads to the **power** of a phenomenon.
- Stories integrate two parallel structures. First, there is the episodic structure identified in studies of story grammar (**episodic or story schema**, see Mandler, 1984). Second, the characters in the *Winter Story* (heat and cold) behave in a way we might readily call “natural.” This naturalness of the behavior is the result of the use of figurative structures found in human thought, particularly in the Force Dynamic Gestalt of phenomena. We might call this second structure a **character schema**.
- The modern theory of the dynamics of heat is an example of good science that is created on the basis of concepts that underlie the **Force Dynamic Gestalt of heat**: quantity, intensity, and power, and the associated schematic structures of containment, flow, letting, hindering, forcing, balancing, etc. (Fuchs, 2010).

HERE ARE SOME CHALLENGES...

We should not be deceived by this simple picture into thinking that physics is simple. The aspects of the gestalt stressed here are not commonly differentiated at a conscious level. Preconceptually, they are intertwined so strongly that a conscious differentiation takes some effort.

- Quantity and intensity (level) are metaphorically linked (MORE IS UP)
- The force (power) of the gestalt is intimately related to the intensity. We do not easily differentiate between intensity, strength, force...
- Some conceptualizations based on “good thinking” cannot be integrated directly into science (an example is provided by the FDG of *cold*).

Nevertheless, there is some hope...

If we wish good (physical) science to take place in school, we can help children create an awareness of the structure of our concepts of natural processes early on by developing their **power of using good language** and good qualitative thinking. Interestingly, this may lead to a pedagogy that unites rather than divides the humanities and the sciences. Speaking and writing well about natural phenomena will be the first step toward a useful conceptualization of the processes of nature.

LITERATURE

Accademia del Cimento (Magalotti, Lorenzo, 1667): *Saggi di naturali esperienze fatte nell'Accademia del Cimento sotto la protezione del serenissimo principe Leopoldo di Toscana e descritte dal segretario di essa Accademia*. Electronic Edition: Istituto e Museo di Storia della Scienza, Firenze, <http://www.imss.firenze.it/biblio/esaggi.html>

Carnot S. (1824): *Réflexions sur la puissance motrice du feu*. Édition critique avec Introduction et Commentaire, augmentée de documents d'archives et de divers manuscrits de Carnot, Paris : Librairie philosophique J. Vrin (1978). English: *Reflections on the Motive Power of Fire*. E. Mendoza (ed.), Peter Smith Publ., Gloucester, MA (1977). Deutsch: *Betrachtungen über die bewegende Kraft des Feuers*, in Ostwald, Willhelm, Ostwalds Klassiker der exakten Wissenschaften, Frankfurt am Main: Verlag Harri Deutsch (2003).

Croft W. and D. A. Cruse (2004): *Cognitive Linguistics*. Cambridge University Press, Cambridge, UK.

Dautenhahn K., 2002: The origins of narrative. *International Journal of Cognition and Technology*, 97-123.

Egan K. (1986): *Teaching as Story Telling*. The University of Chicago Press, Chicago, Ill.

- Egan K. (1988): *Primary Understanding. Education in Early Childhood*. Routledge, New York.
- Evans V. and M. Green (2006): *Cognitive Linguistics. An Introduction*. Edinburgh University Press, Edinburgh.
- Fuchs H. U. (2010): *The Dynamics of Heat. A Unified Approach to Thermodynamics and Heat Transfer*. Springer, New York, 2010.
- Fuchs R. (2005): Private communication.
- Gibbs R. W. (1994): *The Poetics of Mind. Figurative Thought, Language, and Understanding*. Cambridge University Press, UK.
- Johnson M. (1987): *The Body in the Mind. The Bodily Basis of Meaning, Imagination, and Reason*. University of Chicago Press, Chicago.
- Johnson M. (2007): *The Meaning of the Body. Aesthetics of Human Understanding*. The University of Chicago Press, Chicago.
- Kövecses Z. (2002): *Metaphor. A Practical Introduction*. Oxford University Press, Oxford, UK.
- Lakoff G. and Johnson M (1980): *Metaphors We Live By*. University of Chicago Press, Chicago (with a new Afterword, 2003).
- Mandler J. M. (1984): *Stories, Scripts, and Scenes: Aspects of Schema Theory*. Psychology Press, New York, NY.