LANGUAGE AND LINGUISTICS 6.4:523-538, 2005
2005-0-006-004-000159-1

Compression and Emergent Structure*

Gilles Fauconnier
University of California, San Diego

Compression in conceptual integration networks gives rise to a variety of mental patterns which include counterfactuals, metaphor, and grammatical constructions. Novel dynamic structure is emergent in such networks. The present paper explores the notion of emergence. Data from mathematics, advertising, everyday metaphorical reasoning, and grammar is used to contrast the simplicity and familiarity of blended mental spaces with the complexity of emergent structures in full networks.

Emergent structure does not reside primarily in blended spaces but rather in the overall networks. This accounts for the paradox that novel mathematical concepts (e.g. complex numbers) may have a straightforward organization, or that complex meanings (e.g. causatives) may be encoded by "simple", familiar grammar.

Key words: conceptual integration, emergent structure, compression, mental spaces, blending, grammar

Thinkers have always been fascinated by mental patterns that are commonly classified under labels such as analogy, category extension, metaphor, framing, counterfactuals, and grammatical constructions. Typically, they are considered part of distinct disciplines: counterfactuals in philosophy and logic, metaphor in literature, analogy in psychology, framing in sociology and artificial intelligence, grammatical constructions in linguistics. We have recently discovered, however, that the mental principles behind all of these patterns are uniform. The patterns are all products of conceptual integration networks.

A central feature of integration networks is their ability to compress diffuse conceptual structure into intelligible and manipulable human-scale situations in a blended space. These compressed blends are memorable and can be expanded flexibly to manage their integration networks. Compressions have been studied in great detail. They operate on a set of twenty or so vital conceptual relations, such as Cause-Effect,

* What follows assumes some familiarity with conceptual integration (also called "blending"). A useful website for learning about this area of research is http://blending.stanford.edu/. Please consult the appendix to this paper for a short analysis of the Bypass and Titanic examples, taken from the book *The Way We Think*.

Analogy and Disanalogy, Time, Space, Change, Identity, Part-Whole, and Representation. Relations can be compressed into a human-scale version of themselves, or into different vital relations. As an example of compression, consider a statement like "Dinosaurs changed into birds," used to suggest the new theory according to which birds are descendants of dinosaurs. At one level, this evolutionary story spans millions of years, in which many organisms lived and died, none of them actually "changing" into anything. These organisms are connected by Cause-Effect (progeneration), Analogy and Disanalogy (offspring are analogous and disanalogous to their ancestors), and Time. In the blend, the Analogy is compressed into Identity (a single dinosaur becomes a single bird) and the Disanalogy is compressed into Change. Time is compressed into the lifetime of an animal, which at the beginning is a dinosaur and at the end is a bird. There are many standard patterns of compression, and this is one of the most common. In ordinary language, we say "My tax return gets longer every year." A number of analogous tax returns at the end of every year, no one of which gets longer, but each of which is longer than the previous one, are compressed in the blend into a single tax return that changes. Conceptual integration networks with useful compressions are the rule in human thought and action, as has been shown for domains as different as material anchors (Hutchins 2005, sign language (Liddell 1998), and magic and religious practices (Sørensen 1999)).

Clearly, a remarkable feature of integration networks is the emergence of novel dynamic structure that they enable. From a traditional compositional point of view, emergence is paradoxical. How can we start out with input mental spaces and end up with more than we started out with? Equally remarkable is the fact that emergent structure within blended spaces is often "simpler" than structure in the inputs. So for example, the blended space in the Bypass (see appendix) has three children performing a medical operation on one patient; this is a simple scene compared to the complexity in the inputs of linking the quality of education in the entire population to competence and social efficiency in the future.

The paradox of simple, and yet conceptually creative, emergent structure is resolved when we understand that emergent structure is not confined to the blended mental spaces, but instead resides in the entire integration network and the compressions that operate within that network. In other words, what is novel and powerful in the emergent structure is the way in which blended spaces remain linked to the network as a whole. The present paper will be devoted to illustrating this notion of emergence and its interaction with compression of vital relations.

In order to apply these general cognitive notions to specific linguistic issues, we have found it helpful to look at non-linguistic domains where it may be easier to see exactly what is going on. Mathematics is a fruitful area in this respect, because

mathematicians have often spelled out for us in great detail crucial aspects of novel mathematical conceptual structure. I will illustrate this informally by revisiting the example of complex numbers studied early on in research on conceptual integration (Fauconnier & Turner 2003, 1998, Lakoff & Núñez 2000).

The conceptual framework of complex numbers was developed over a long period of mathematical work stemming from the apparent paradox that square roots of negative numbers, although proved not to exist, could be used consistently and insightfully in mathematical proofs and formulas. Kline (1980) discusses the discovery of Cardan and Bombelli in the 16th century, and the adamant insistence by Bombelli himself and illustrious mathematicians like Descartes, Leibniz and Euler that such numbers were "sophistic," "imaginary," and "impossible." The modern concept of complex numbers resolves this paradox by having numbers be points in a two-dimensional space. A number can be defined by its distance to the origin (magnitude) and a rotation from the horizontal axis to the number-point in the two-dimensional space.

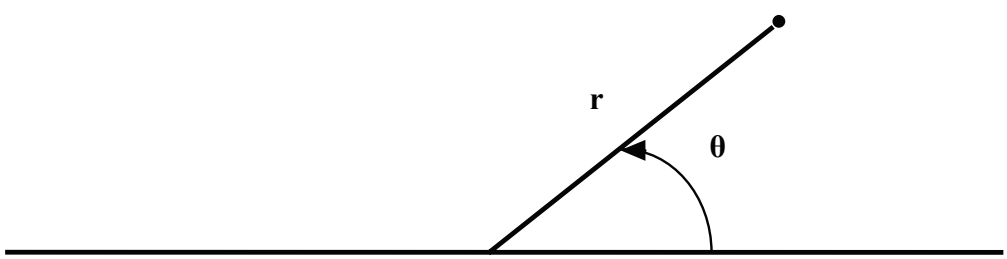

Figure 1: Complex number (r, θ)

Under this conception, addition of numbers is vector addition and multiplication of two numbers is multiplication of their magnitudes and addition of their rotations.

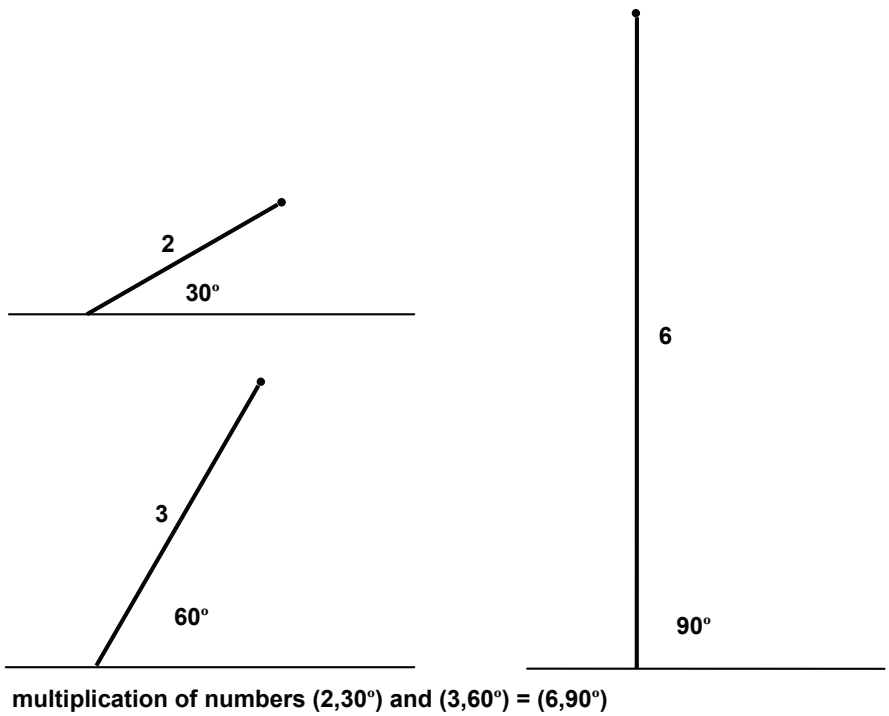

Figure 2

As outlined in Fauconnier & Turner (1998, 2003), Lakoff & Núñez (2000), this is achieved conceptually through a conceptual integration network where the input mental spaces are two-dimensional space on one hand and real numbers on the other. We can see very clearly in such an example how the emergent structure comes about:

1) New elements: The blended mental space of complex numbers contains an infinity of numbers that were not in the original input mental space of real numbers. This is achieved by projecting points from the 2D-space into the blended space. The counterparts of the projected points are new "numbers". Because angles are projected from the 2D-space, numbers in the blended space now have "angles", a nonsensical notion in the original input mental space of real numbers. Angles (equivalently rotations) as features of numbers are new elements conceptually.

2) Emergent operations: Multiplication of numbers in the blended space includes the sum of their angles (equivalently the composition of their rotations). This is a completely emergent property of the blended mental space: in one of the inputs (the 2D space) there is no multiplication at all because you cannot multiply geometric points. In the other input (real numbers) there are no angles, and so multiplication cannot include any operation

on angles. By the same token, square roots of number *n* in the blended space are obtained by taking the square root of the magnitude of *n* and half of the angle of *n*. This is an emergent operation, impossible in either one of the inputs. A direct consequence is that all numbers now have square roots, including negatives. There was no way to conceptualize this in the original input mental space of real numbers. In fact, a true theorem in the original input, "negatives don't have square roots" becomes false in the blended space.

3) Compressions: The mapping between points in one input and numbers in the other is compressed within the blended space into Uniqueness. This is fusion, the strongest possible form of compression: Points are numbers and numbers are points.

We can see with great precision in cases like this how emergent structure is created. In mathematics, conceptual change of this kind is the rule, not the exception. We can easily show how conceptual shifts from whole numbers to rationals and then to irrationals and transcendentals work according to the same principles. Similarly important new elements in mathematical thought such as zero or infinity are constructed cognitively through conceptual blending (Núñez 2005).

The reason to go over such mathematical ideas in the present context is to illustrate principles that apply very generally in other areas. Once a blend such as the complex number blend has been achieved, humans (in this case mathematicians) will "run the blend." Running the blend will bring out additional emergent structure. For example in the mathematical case, mathematicians will prove theorems within the new conceptual system of complex numbers. All these theorems in turn are additional emergent properties of the conceptual system.

A striking feature of blended spaces, their simplicity, is apparent in the mathematical example of complex numbers. If we only look at the blended space, its structure is remarkably simple, and can easily be taught to young children. One way to think about it is that we start with a rubber band of length **1** in horizontal position. Then we stretch it to length **3** and rotate it by **30**° to obtain the number (magnitude **3**, angle **30**°). To multiply this number by another one, say (**2**, **60**°), we stretch again 2 times and rotate by 60° to get the number (**6**, **90**°). In themselves, these are very simple operations that do not bring in complex notions such as polynomial roots or negative vs. positive. So why is this conception of numbers viewed as complex, and why did it take three centuries to discover? Clearly not because of the structure of the blended space by itself, which is not complex at all. The complexity lies in the construction of the entire network, i.e. in building links, projections and compressions from familiar inputs to novel but simple ones. This shows in turn that when we speak of "emergent structure" we do not mean the structure of the blended space by itself, but rather the dynamic structure of the entire

network, and in particular the compressions and projections that link the input mental spaces to the novel blended spaces.

In other words, what makes the blended space of complex numbers mathematically valuable is not its structure in isolation but rather its rich links within the integration network to pre-existing conceptual spaces of arithmetic and geometry. Therein lies the paradox of creativity: it is the very simplicity of the blended space that allows powerful operations to be performed directly on its elements and at the same time have deep consequences for mathematics as a whole.

Complex numbers are a superb example of culturally evolved double-scope conceptual integration. As Turner and I have argued, double-scope integration is not a weird curiosity of human thought, reserved for eccentric mathematical or literary processes. It is a mainstay of human thought that shows up throughout human activity, be it artistic, religious, technical, or linguistic. We have also argued that the capacity for double-scope integration could well be the crucial distinctive feature of cognitively modern humans, and we have shown how such a singularity could have emerged through standard evolutionary processes.[1]

To show the generality of the principles of structure emergence described for complex numbers, I turn to another stock example of conceptual blending, the Bypass. Its properties are summed up in the appendix, with appropriate references. My goal here is to sharpen the notion of emergent structure and to highlight the similarities of the Bypass with Complex Numbers, as just discussed. The point is that although these examples are completely different at a superficial level (deep mathematics over centuries versus ephemeral advertising), they work according to the same principles of integration. Neither case, complex numbers or the Bypass, is in any way metaphorical. I will show a little later how metaphor fits into this general story.

As explained in the appendix, the conceptual integration for the Bypass performs multiple compressions of vital relations. Crucially for the present discussion, the blended space by itself has very simple structure. It consists of the simple scenario of children performing the functions normally reserved for adult physicians with extensive complex training and seasoned experience. This simple structure is available to us quite independently of the other mental spaces in the Bypass integration network. That is, we can manipulate this structure on its own and draw inferences internal to that structure. Let us examine such inferences quickly and spell out why they are independently available to us.

Suppose we are told about children performing complex surgery. It does not matter that we have never actually witnessed such an event or that we probably have never

[1] Fauconnier and Turner (2003, Chapter 9), Mithen (1996), Klein (1999).

heard reports of such an event.[2] Straightforward blending allows us to immediately imagine the situation and its likely consequences. Here are some of the possible inferences and emotions that could emerge in this simple imaginative blend:

— The children are ignorant and will not know what to do.
— The children are unskilled and cannot perform.
— The children do not realize their limits and so they will go ahead in spite of everything.
— The patient (already anesthetized on the operating table) is not aware of what is going to happen to him.
— Therefore, the operation is going to be a disaster; the patient will die without ever knowing what happened to him.
— This is a terrifying situation which must be prevented at all costs.
— We must act urgently to remove the children and replace them with competent adult surgeons.

So, clearly, this is in itself a simple scenario that we can process almost instantaneously: Its logical and emotional consequences are self-evident. But, even though the scenario is quite simple, it carries a rich set of implications and those are of course the ones that will be exploited in the much more complex Bypass network.

Now, the theoretical point that I wish to emphasize is similar to the one made regarding complex numbers: the structure of the blended space with the children operating is not by itself a novel creative emergent structure. In fact, it is readily accessible to most people and fits widely-shared, more general cultural schemas of the form {*It is dangerous for children to perform expert adult activities.*}. Such a schema covers driving cars, sawing wood, lifting furniture, and so on. The activities and the corresponding danger fall on a scale, and operating on patients is clearly at the top of such a scale. It is this simplicity and accessibility of the blended space that give power to the integration network: The logical, emotional, and social inferences within the blended space are inescapable; their validity is not in question.

Where then is the emergent structure of the network if it is not in the blended space? Clearly, it is in the links and compressions of the network as a whole. What is emergent in the network is the compression of diffuse links into coherent vital relations in the blended space and projection of the blended space back to the inputs. In the case of the Bypass, salient properties of the blended situation with the children operating include

[2] One may also draw on reports of real events. During the cultural revolution in China, it was reported that some inexperienced teen-agers took over hospitals with predictably disastrous consequences.

urgency, absurdity, fear, danger, risk to themselves and to others. All this maps back to the inputs: It is extremely urgent to educate the children, and absurd not do so; we are in danger and have good reason to be afraid of the future, the children are at risk and so are we. Education, perhaps viewed as a dry, abstract set of pedagogical questions with no immediate impact on the rest of us, has been instantly transmuted into a very scary life-or-death situation demanding immediate action. Time is running out and a rescue operation is terribly urgent.

To repeat, the theoretical point of all this, whether for Complex Numbers or the Bypass, is that while the blended space by itself is straightforward, its incorporation into the network as a powerful compression is not.

Let me now turn to cases of metaphor. Metaphoric mappings yield some of the most spectacular double-scope integration networks. Inputs that have little to do with each other are partially mapped and then integrated into a blended space. For example, suppose I say {*Your magnificent theory will share the fate of the Titanic when it hits the iceberg of hard empirical data*.}. The integration network for this metaphor will have the familiar story of the Titanic and the iceberg as one input, the theory under scrutiny with empirical facts pertaining to it in a second input. The blended space will include the theory as Titanic and the facts as iceberg. Running the blend is easy by projecting available structure and information from the Titanic input: The Titanic, in spite of being the greatest ocean liner ever built, hits the iceberg and sinks. Projecting back to the science input is straight forward: The facts are incompatible with the beautiful theory, and the theory therefore fails and is abandoned, while the facts remain.

The emergent structure in this network is the failure of the magnificent theory and the consequences of that failure. But nothing is emergent in the blended space itself, because in this particular case it gets its frame unmodified from the Titanic input. The metaphor works, not because the hearer constructs novel emergent structure in the blended space, but rather because he or she does not! As in the Bypass, the blended space is straightforward and accessible, because the Titanic story is known by all.

Mapping of an already known structure to a different domain or situation is the most widely recognized feature of analogy and of metaphor. However, as often pointed out in the blending literature, metaphors frequently do not preserve inferences and frame structure.[3] So consider another stock example used to illustrate aspects of integration theory: {*If Clinton had been the Titanic, the iceberg would have sunk.*}.

This time a network is constructed with the same Titanic input space as before and with a second input mental space of Clinton's travails. In the blended space, the Titanic

[3] Metaphors like {*digging your own grave*} or {*This surgeon is a butcher.*} have been discussed in some detail to make this point. Metaphors are usually cases of double-scope integration with emergent structure in the blended space.

does not sink! It is the iceberg that sinks, contrary to what we know, and contrary to the laws of physics. So the familiar frame of the Titanic story has not been projected; instead, a truly emergent structure has been created in the blended space.

This case is more like the first two we discussed, Complex Numbers and the Bypass, insofar as the structure of the blended space is novel, compared to the input spaces. But what about the observation for the first two that the blended space, although novel, is by itself a familiar structure and hence easy to manipulate? Well, at one level the Clinton example is surely different: Not only is the structure of the Titanic sinking the iceberg unfamiliar; it also describes a physically impossible event!

Yet, at just a slightly less specific level the scene is a simple and familiar one: Two large objects on the water colliding with each other so that one of them sinks. That scene has all the "overarching" desirable properties of blended spaces: human scale, only two objects, simple concrete action, clear-cut outcome.

Once again, then, the structure of the blended space can be viewed as easily accessible. The twist here is that implausibility and impossibility are also salient features of the space and they allow the full emergent structure of the entire network, where it follows that Clinton's political, and perhaps marital, survival is nothing short of miraculous.

To pursue the analogy with mathematical thought, consider the familiar type of reasoning called *reductio ad absurdum*. To prove a theorem T, we assume that **notT** is the case. This type of reasoning consists in building a blended space in which the known axioms and theorems hold and which also includes **notT**. "Proving" a contradiction in that space yields the desired result that T must be true. Such a space is clearly impossible since it contains mathematical falsehoods. And yet, it is mathematically simple: Ordinary laws apply unproblematically.

Impossible worlds are a rich source of fiction, humor, fantasy, and religion. We have no trouble building mental spaces in which people can walk through walls, live forever or resurrect, be granted extra rations of time, alter the world by making wishes, travel in time, and so on. Such worlds, even though they incorporate impossibilities, just like *reductio* in mathematics, work according to everyday logic. Blending of the impossible with the ordinary yields emergent structure. For example the power to traverse walls can be strong or weak like any other power. When it is too weak, the "passe-muraille"[4] may end up stuck inside the wall. The blending that goes on to build these strange worlds deserves to be studied further. When they are part of shared religious beliefs, such worlds are understood not as impossible fictions, but rather as the deepest reality behind our conscious experience.

[4] *Le Passe-muraille* is the title of a story by French writer Marcel Aymé, in which the hero is able to pass through walls. *Passe-muraille* literally means "(he who) passes (through an) outer wall".

Grammatical constructions also turn out to be integration networks, in which a simple syntactic/semantic structure is integrated with a more elaborate semantic structure (Fauconnier & Turner 1996, Mandelblit 1997). As in the cases above, we find that the emergent syntactic structure in the blended space is maximally simple, but that the overall emergent syntactic and semantic complexity of the full network (or array of networks) is sharply increased. So for example, the caused-motion construction in English recruits the simple structure NP V NP PP, with the associated semantics of an agent (first NP) moving a patient (second NP) to a location (PP), as in basic sentences like {*Jack threw the ball into the yard.*}. Caused motion blends end up with exactly the same superficial syntactic form, as in {*Phil sneezed the napkin off the table.*}, {*The sergeant ordered the tanks into the compound.*}, or {*Junior sped the car around the Christmas tree.*}. However to unpack such blends, we need to decompress the blended construction and construct the full network. In the first example, Phil does not act directly on the napkin. He just sneezes and this causes a new event, the napkin moving off the table. In the second example, the sergeant gives orders to soldiers. A consequence of that event is the motion of the tanks into the compound. Finally, in the third example, the little boy is not speeding at all. He just sits and triggers a remote control, so that a second event occurs, the car speeding around the tree. All these cases are different from each other and more complex than the basic form {*Jack threw the ball into the yard.*}. Complex emergent structure has been produced in the full network. But in the blended space, actions like sneezing, ordering, speeding are simple indecomposable actions like *throw* or *carry.*

It is optimal for a grammatical construction to use existing basic syntactic structure. As in the mathematical and metaphorical examples discussed above, there will be emergent structure in the overall network, but simple, already available structure in the blended space. However this optimal solution is not always possible, and real emergent structure may appear in the blended space under pressure from the rest of the network. This is the case for Causative constructions in Hebrew (Mandelblit), where special morphological blends are used to trigger decompression. It is also the case for clause-union causatives, as shown for French (Fauconnier & Turner 1996). In the latter case, the apparent complexity of the causative construction is in fact the consequence of three different blends operating on basic constructions.

In conclusion, there is still much to discover about emergent structure in conceptual integration networks. The point of the present paper has been to show that the undeniable complexity of emergent structure, central to human thought and action, does not reside primarily in blended spaces. It is optimal for blended spaces to be simple and to recruit existing accessible structure. The power of integration comes from linking such simple structures to the array of mental spaces in the entire network.

Appendix

Two examples analyzed in *The Way We Think.*

The Bypass

JOEY, KATIE, AND TODD WILL BE PERFORMING YOUR BYPASS

The advertisement above is meant to persuade readers to help in the fight to raise standards in American schools. It shows three doctors in an operating room, who seem to be looking in the direction of whoever happens to be reading the ad. The headline is a voice introducing the doctors to the reader, who is also the patient. It says, "Joey, Katie, and Todd will be performing your bypass operation." The only odd thing about this scene is that Joey, Katie, and Todd are about seven years old. The body of the ad explains that doing anything sophisticated, like practicing medicine, requires sophisticated learning, but that America's kids are getting dumbed-down curricula. They will not understand chemistry, laser refraction, or immunology, so they will not be good doctors, and the public, personified by the reader, will be at risk. Specifically, Joey, Katie, and Todd will operate on you, and you will probably die. Therefore, you should help get standards raised.

Joey, Katie, and Todd in one space are children yet to be educated. In the other input space, they are doctors whose formal education lies behind them. The cross-space mapping connects the child to the adult. Both are projected to the blend, partially, and fused there. We also project to the blend the frame of surgery that comes from the space with the adults. The surgeons in the blend are seven year olds, which is naturally terrifying. We want our surgeons to be more competent than seven-year-olds, which leads us directly to the question of how to turn the children into competent adults. If we do nothing, the ad tells us, these children will grow up in a system that will not teach them what they need to learn to be doctors. But we have a choice: we can leap in now and provide the education that will make this integration network no longer terrifying, since it is the input with the *adult doctors* that finally counts. It is a question of how much distance, measured in terms of education, there will be between the blend and the space with the adult doctors. In the blend, the appearance of the doctors matches their competence: They have young bodies and they are incompetent. In the input with the adult doctors, they have adult bodies, and the question is, what kind of competence will they have? Doing nothing leaves the adult doctors with low competence. Improving education in our schools will give us a situation in which the adult doctors have high competence. As the ad says, "If we make changes now, we can avoid a lot of pain later on."

The ad is powerful because it uses blending brilliantly to bring together the children as they are now with the frames they will inhabit much later on. The reader is also projected into the blend as the patient. This makes a distant situation urgent by bringing it into the immediate present. In the inputs, the lethal consequences of the children's poor education emerge only much later, when you are old and need a coronary artery bypass. In the blend, you need a bypass now and the operation is just about to be performed. You might be apathetic about what will happen to you in twenty years, and you might be apathetic about the education of children who are not yours, but it is hard to be apathetic about the incompetence of the doctors who are about to open up your chest. Interestingly, the emergent meaning in the blend in this case includes fear and anxiety, which are not necessarily attached to the inputs.

The finer-grained structure of these links is extremely interesting. It includes links from cause to effect, links through time and through space, links through change, and links through identity. The input with the children in school and the quality of their education is causal for the input with doctors of a certain level of competence. This is a Cause-Effect link between the inputs. There is an interval of at least a couple of decades between the children and the doctors. This is a Time link between the inputs. There is a displacement between the physical space of the

elementary school room in one input and the physical space of the operating room in the other. This is a Space link, where in this instance we mean physical space. There is a counterpart link between the children at one stage of life and the doctors later. This is an Identity link. There is a transformation of the children into the doctors. This is a Change link.

Blending plays marvelous and imaginative tricks with these links. Look once more at the blended space in The Bypass. Every one of these "outer-space" links between the inputs to the conceptual integration network has a compressed counterpart in the blended space! There is still cause-effect in the blended space, but now the children must learn all at one shot. There is still a time interval between now and the surgery, but it has been compressed from over twenty years into the few minutes between the time on the clock and the time of the surgery. In the blended space, the schoolroom is the operating room. This is space compression. The children are the doctors. The "outer-space" link of personal Identity running over thirty years between people whose appearance, experience, and belief are very different is compressed "uniqueness" in the blended space. The "outer space" protracted change of the youngsters into employed adults is also compressed in the blended space into uniqueness.

The Bypass example shows how links between the input mental spaces— "outer space" links—can be compressed into relations inside the blend— "inner space" relations. Cause-Effect and Time are scaled down to tighter Cause-Effect and briefer Time. Incompatible physical spaces are compressed into the same physical space. Identity and Change are compressed into Uniqueness.

Clinton and the Titanic

{*If Clinton were the Titanic, the iceberg would sink.*} is a striking counterfactual that circulated inside Washington, D.C., during February, 1998, when the movie *Titanic* was popular and President Clinton, already famous for sexual scandals, had just been accused of another escapade, this time with a young intern in the Oval Office. Yet he seemed to be surviving the rumor without damage.

The counterfactual blend has two input mental spaces—one with the Titanic and the other with President Clinton. There is a partial cross-space mapping between these inputs: Clinton is the counterpart of the Titanic and the scandal is the counterpart of the iceberg. There is a blended space in which Clinton is the Titanic and the scandal is the iceberg. This blend is double-scope. It takes much of its organizing frame structure from the Titanic input space—it has a voyage by a ship toward a destination and it has the ship's running into something enormous in the water—but it takes crucial causal structure and event shape structure from of the Clinton scenario: Clinton is not ruined but instead survives. In the Clinton input, the events were largely speculative. It was not clear how many people were involved in arranging these events or what their motivations were. But the Titanic space supplies to the blend a tight compression at human scale: A ship runs into an iceberg, and the clear and dramatic consequence of that single cause follows quickly. The blend is counterfactual to the space of the historical Titanic, which sank. The historical Titanic is ranked as the supreme vessel on a scale of unsinkability, and therefore the iceberg as the supreme obstacle on a scale of immovability. The blend uses the compression from that space and retains the scales. But it reverses the causality of the sinking so that the Clinton-Titanic is now even more unsinkable than the real one. The blend is deliberately hyperbolic: Icebergs can be submerged but cannot sink. In the blend, Clinton is stronger than

even the laws of physics.

There is a generic space whose structure is taken as applying to both inputs: one entity involved in an activity motivated by some purpose encounters another entity that poses a threat to that activity. In the generic space, the outcome of that encounter is not specified.

The cross-space mapping is metaphoric and recruits basic metaphors like PURPOSIVE BEHAVIOR IS JOURNEYING, FAILING IS BEING STOPPED, FAILURE IS DOWN, and ADVERSARIAL OPPOSITION IS PHYSICAL COLLISION.

References

Coulson, Seana. 2001. *Semantic Leaps: Frame-shifting and Conceptual Blending in Meaning Construction.* Cambridge: Cambridge University Press.

Fauconnier, Gilles. 1997. *Mappings in Thought and Language.* Cambridge: Cambridge University Press.

Fauconnier, Gilles, and Mark Turner. 1996. Blending as a central process of grammar. *Conceptual Structure, Discourse, and Language*, ed. by Adele E. Goldberg. Stanford: CSLI.

Fauconnier, Gilles, and Mark Turner. 1998. Conceptual integration networks. *Cognitive Science* 22.2:133-187.

Fauconnier, Gilles, and Mark Turner. 2003. *The Way We Think: Conceptual Blending and the Mind's Hidden Complexities* (paperback edition). New York: Basic Books.

Gentner, Dedre. 1983. Structure-mapping: a theoretical framework for analogy. *Cognitive Science* 7.2:155-170.

Gibbs, Ray W., Jr. 1994. *The Poetics of Mind: Figurative Thought, Language, and Understanding.* Cambridge: Cambridge University Press.

Goodman, Nelson. 1955. *Fact, Fiction, and Forecast*. Indianapolis: Bobbs-Merrill.

Hofstadter, Douglas. 1995. *Fluid Concepts and Creative Analogies.* New York: Basic Books.

Holyoak, Keith James, and Paul Thagard. 1995. *Mental Leaps: Analogy in Creative Thought*. Cambridge: MIT Press.

Hutchins, Edwin. 2005. Material anchors for conceptual blends. *Journal of Pragmatics* 37.10:1555-1577.

Klein, Richard G. 1999. *The Human Career: Human Biological and Cultural Origins* (2nd edition). Chicago: University of Chicago Press.

Kline, Morris. 1980. *Mathematics, the Loss of Certainty.* New York: Oxford University Press.

Koestler, Arthur. 1964. *The Act of Creation*. New York: Macmillan.

Lakoff, George, and Mark Johnson. 1980. *Metaphors We Live By.* Chicago: University

of Chicago Press.
Lakoff, George, and Mark Turner. 1989. *More Than Cool Reason: A Field Guide to Poetic Metaphor.* Chicago: University of Chicago Press.
Lakoff, George, and Rafael Núñez. 2000. *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being.* New York: Basic Books.
Liddell, Scott. 1998. Grounded blends, gestures, and conceptual shifts. *Cognitive Linguistics* 9.3:283-314.
Mandelblit, Nili. 1997. *Grammatical Blending: Creative and Schematic Aspects in Sentence Processing and Translation*. La Jolla: University of California, San Diego dissertation.
Mithen, Steven. 1996. *The Prehistory of the Mind: A Search for the Origins of Art, Science and Religion*. London: Thames & Hudson.
Núñez, Rafael. 2005. Creating mathematical infinities: metaphor, blending, and the beauty of transfinite cardinals. *Journal of Pragmatics* 37.10:1717-1741.
Ramachandran, V. S., and Sandra Blakeslee. 1998. *Phantoms in the Brain.* New York: Morrow.
Sorensen, Jesper. 1999. *Essence, Schema, and Ritual Action*. Aarhus: University of Aarhus dissertation.
Sweetser, Eve. 1999. Compositionality and blending: semantic composition in a cognitively realistic framework. *Cognitive Linguistics: Foundations, Scope and Methodology*, ed. by Theo Janssen and Gisela Redeker, 129-162. Berlin: Mouton de Gruyter.
Turner, Mark. 1996. *The Literary Mind*. New York: Oxford University Press.

[Received 26 March 2005; revised 2 September 2005; accepted 15 September 2005]

Department of Cognitive Science
University of California, San Diego
9500 Gilman Drive
La Jolla, CA 92093-0515
USA
gfauconnier@ucsd.edu

濃縮現象與呈現結構

Gilles Fauconnier
加州大學聖地牙哥分校

概念整合網絡由於濃縮現象而產生各種抽象的結構形式，如假設句、隱喻及語法句式。概念網絡中不斷的有新穎而動態的結構呈現。本文目的在探討這個呈現的概念。首先我們利用數學、廣告、日常的隱喻語言及語法等現象說明融合的心理空間所表現的單純與熟悉跟概念網絡中呈現結構所表現的複雜性很不同。

呈現結構主要不是表現在融合的心理空間，而是在整個概念整合網絡。這就是何以創新的數學概念（如複數）其組織卻單純，或複雜的概念，如因果句，卻用簡單的語法來表示的道理。

關鍵詞：概念整合，呈現結構，濃縮現象，心理空間，融合現象，語法