

Compression and global insight

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Abstract

Compression is a phenomenon in conceptual integration that allows human beings to simultaneously control long diffuse chains of logical reasoning and to grasp the global meanings of such chains. Compression operates on a small set (under twenty) of relations rooted in fundamental human neurobiology as it applies to shared physical and socio-cultural human experience. So-called Vital Relations, including Cause-Effect, Change, Time, Identity, Intentionality, Representation, and Part-Whole, can apply across mental spaces, and also define essential topology within mental spaces. In blending networks, a vital relation across inputs (outer-space vital relation) can be compressed into a vital relation within the blended space (inner-space vital relation). We show how one of the overarching goals of compression through blending is to achieve 'human scale' in the blended space, where a great many of our conscious manipulations take place.

Keywords: mental spaces; conceptual blending; blended space; integration; compression; causal reasoning.

There is nothing more basic in human life than cause and effect and our understanding of their relationship. It has been a triumph of mathematics, science, and engineering to break up unified events into causal chains. A chain is made up of much more elementary events, such that each one is the effect of the previous one and the cause of the next. This kind of causal analysis gives us, individually and collectively, the feeling that we understand the complex event, since it has now been consciously reduced to a set of basic events and their combinations, and the basic events are taken as self-evident. Furthermore, this type of explanation lends itself especially well to expression in formal approaches because we can code the basic events and the causal relations

symbolically with forms, in such a way that the manipulation of the formal objects correlates with the changes in the complex system they code.

For example, life and death are the biggest mysteries, and the moment of death is dramatic and immediate, but medical science breaks the event into complicated causal chains involving simple cellular and metabolic events based on pumping rates, blood flow, oxygen delivery, neuronal activation, and so on. Similarly, a logical or mathematical truth can seem striking and even mysterious, but logic and mathematics break those mysteries down into a sequence of logical steps, each seemingly simple and obvious, where each step leads to the subsequent step, until the conclusion is reached. This was Aristotle's insight, which also drives modern computers.

Global insight

But this step-by-step kind of understanding is only one side of the coin. The breaking down of an event into a set of smaller events, each understood consciously and separately, can paradoxically give us a feeling of less understanding, because we miss a sense that we have grasped the essential whole. It is a strength of human understanding to be able to do both, and our greatest assurance comes when we feel that we can do both of the same event. For a mathematician, fully understanding a complex mathematical result demands both its intuitive apprehension as a whole and its detailed proof broken down into a series of steps. The former is actually highly valued and commonly viewed as the essence of all creativity. The latter is also valued of course, but often viewed as a way to keep intuition in check and publicly share the results of a discovery.

Evolutionarily, our ancestors were often in situations where they needed to be able to recognize, in a flash, the potential integrated event: the falling tree has to be connected instantly to potential harm and to the right and wrong places for us to be standing when it falls; the roaring tiger needs to be connected, hypothetically and one hopes counterfactually, to its killing us. It is a commonplace in psychology that higher animals are evolutionarily equipped to recognize various facial expressions, postures, gestures, voice tones, and so on as indicative of ensuing behavior. We even say that someone *looks* or *sounds* "violent" or "criminal," assuming that there is a causal link between behavior and appearance, and conflating the two. In short, it is evolutionarily advantageous to be able to unite cause and effect in our understanding. It's good to see potential effects in a cause, and conversely, it's good to see potential causes in an effect—it's probably a tiger that is behind that roar. We recoil from the scene of

death, we like the scene of eating. When we recoil from the rattle of the rattlesnake, it is because we are integrating it with its potential effect. When we are attracted to the luscious fruit, it is because we are integrating it with its potential effect.

In fact, the seemingly basic case of stimulus–response conditioning—Pavlov’s dog, who, having had a ringing bell and a piece of meat presented in quick succession several times comes to salivate for the bell alone—shows how common it is to integrate cause and effect. Evolution set up the part involving salivating for the meat, but not the salivation for the bell, which is purely learned. The dog looks stupid, but is in a way quite smart. It takes sophisticated cognitive operations to become conditioned in this way. Integrating cause and effect is, on its own, no sign of stupidity. The dog would be stupid only if it lost the distinction between cause and effect entirely and ate the bell.

It’s not trivial to bring cause and effect together. On the contrary, they have to be brought together in one mental space, in the right way, while being kept distinct in other mental spaces. Appropriate integration of cause and effect is a matter of having your cake and eating it too.

Pavlov’s dog, who has learned to mentally integrate the food with the ringing bell, and the fleeing antelope, who has a genetic disposition to mentally integrate death and the tiger’s roar, have their analogues in the highest intellectual realms. Consider a comment made by the mathematician Jacques Hadamard: “Any mathematical argument, however complicated, must appear to me as a unique thing. I do not feel that I have understood it as long as I do not succeed in grasping it in one global idea ...”. Such a global understanding is a matter of integrating cause and effect. Each step of a proof is the effect of the previous steps. All of these causes and effects can be followed as a sequence, but to achieve a global understanding requires integrating them all in one mental space (see Robert 1998).

Perception and sensation

The integration of cause and effect is the central feature of perception. The perception of a single entity, like a cup, is an imaginative neurobiological feat still very poorly understood by neurobiologists. That perception, which is available to consciousness, is the *effect* of complicated interaction between the brain and its environment. But we integrate that effect with its causes to create emergent meaning: the existence of a *cause*, namely, a cup that has unity, color, shape, and weight as intrinsic properties independent of the perceiver. As a consequence, the effect is

now in its cause: the color, the shape, and so on are now intrinsically, primitively, and objectively in “the cup”.

In perception, at the level of consciousness, it is usually only the integration of cause and effect that we can apprehend. We cannot fail to perform this integration and we cannot in consciousness see beyond it. Consequently, this integration seems to us to be the most bedrock reality. Evidently, there are only a few ways to make the distinction between cause and effect even perceptible in consciousness. Brain damage, psychoactive drugs, and certain neurobiological syndromes can cause breakdown of these integrations and consequent bizarre perceptions. But for the most part, in the case of perception, when we are functioning normally, consciousness cannot see the rest of the integration network. Accordingly, we are likely to think that the perception of a spot in the visual field is caused simply and directly by the light coming to our eye from it, and we think of a black spot as being one from which no light is reflected. This is quite wrong, as it turns out. The amount of light reflected to our eye from a *black* letter in a newspaper headline outside in the sun is about twice the amount of light coming from the *white* paper in a dimly lit office, but we still see the letter as black and the paper as white under both conditions (see Zeki 1993, Hubel 1995). We think the letter has the invariant property *black*, but that invariance is a neurological effect. *Black* in this case is not a primitive cause; it is a complex neurological effect. We integrate the effect—black—with its causes—the light striking our eye—to create the emergent meaning that black is primitively and intrinsically an invariant property of the letter.

Similarly, a large spot of uniform illumination, such as a purple disk on a white wall, seems uniformly vivid, but ganglion cells are in fact reporting information from only its border, making the vividness of the interior, no matter how apparently real, a downstream cerebral computation. We think the purpleness of the center is directly causing our perception of it as purple, but our perception of it as purple is simply an integration of cause and effect. When two lights flash in succession, provided they are the right distance apart and the flashes are the right distance apart, we see (and cannot help seeing, no matter how we try) a beam of light sweep from one to the other. Our perception of the beam, and our feeling that we are watching the beam in real time, are both effects, and again we integrate effects and causes to create an objective sweeping beam of light. The effects seem to us to be in the cause. In this case, unusually, by covering up one light or the other, we can get evidence that our perception is an integration.

Sensory projection is a universal feature of our perceptual life that also arises from integration. A sensation of pain in an ankle is constructed

in our central nervous system, but we “feel” the pain, of course, as located exclusively in the ankle. We have conceptually integrated part of the cause with the mental effect, to create a “painful ankle”, so that cause and effect are now mentally located together in our mental conception of the ankle. The neurological effects that constitute the “pain” are distributed throughout the central nervous system, but the integrated cause and effect have only the single, undistributed location of “the ankle”. Obviously, we do cause–effect integration for sensation of pain because it is in some adaptive sense quite accurate: it typically is the anatomical ankle that needs attention and care. But in fact, the pain can occur under quite different conditions. It can be triggered by an electrode inserted directly in the brain. The impression will still be that the pain is localized in the ankle, although the real ankle is not involved. Even more spectacularly, as V. S. Ramachandran discusses in *Phantoms in the Brain* (Ramachandran and Blakelee 1998), the real limb may be missing entirely and still be constructed as existing in the blend. An amputee can feel not only pain in the missing ankle, but also that he has the ankle as a result. He may “absent-mindedly” reach down to rub the ankle that is not in fact there. The pressure for the brain to achieve integration of cause and effect is so great that it will use conceptual integration to give as emergent structure not only a localized pain but also a phantom body part for that pain to take place in and an external cause of the pain in that body part. The amputee has no control over this sensation even though it is outrageously opposed to everything he believes. Ramachandran cites the case of the amputee whose brain rewired itself so that pressure on the cheek was linked to the brain area previously associated with the limb. Amazingly, pressing on certain spots on the cheek caused a sensation of pain localized “in the missing limb”. The limb but not the cheek was reconstructed in the cause–effect blended space. Integration of sensory cause and effect, which is in almost all cases extremely useful to us, is in these cases badly misleading, but the integrating brain charges ahead unimpeded. Ramachandran discusses from both a clinical and a cognitive scientific point of view many other cases in which the brain turns a neurological effect into an “objective” cause that is not actually there. Ramachandran’s observations and insight have important consequences for conceptual integration theory which we discuss in *The Way We Think* (Fauconnier and Turner to appear).

Conceptual blending and vital relations

The articles in this issue explore the theory of conceptual integration, also known as “blending” (Fauconnier and Turner 1998, Coulson 2000).

In conceptual blending, structure is selectively projected from “input” mental spaces to a “blended” space that also develops its own emergent structure. In the process, a partial mapping is constructed between the input spaces. That mapping is dynamic. A “conceptual integration network” consists of the input spaces, the blended space, a generic space, and their connections. We develop simultaneously a mapping between two inputs and a generic space that contains the structure applying to both of them. Typically, there are vital relations between these inputs, of the sorts that we will now discuss.

Consider an advertisement run by the Education Excellence Partnership, meant to persuade readers to help in the fight to raise standards in American schools (Figure 1). This ad shows three doctors in an operating room, looking at the reader of the ad. The headline of the ad 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.” The only odd thing about this scene is that Joey, Katie, and Todd are about seven years old. The body of the ad reads:

Before you know it, these kids will be doctors, nurses and medical technicians, possibly yours. They’ll need an excellent grasp of laser technology, advanced computing and molecular genetics. Unfortunately, very few American children are being prepared to master such sophisticated subjects. If we want children who can handle tomorrow’s good jobs, more kids need to take more challenging academic courses.

To find out how you can help the effort to raise standards in America’s schools, please call 1-800-96-PROMISE. If we make changes now, we can prevent a lot of pain later on.

The point of the ad is that the children, under today’s curricula, won’t 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. The inference is that the reader should help get standards raised.

Joey, Katie, and Todd in one input mental space are children whose education lies before them. In the other input mental space, they are doctors, whose education lies behind them. There is a cross-space mapping between the inputs. This is an “outer-space” mapping, because it connects two separate mental spaces. In this outer-space mapping, a child with a certain degree of education in one input space connects to an adult with a certain degree of professional competence in the other. Both the child and the adult, with their degrees of education or competence, are projected to the blended space, partially, and fused there. We also project to the blended space the frame of surgery that comes



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The Business Roundtable
U.S. Department of Education
National Governors' Association
American Federation of Teachers
The National Alliance of Business

Ad Council
EDUCATION EXCELLENCE PARTNERSHIP

Figure 1. *Bypass blend* (reprinted by permission of the Education Excellence Partnership).

from the input space with the adults, but we project from the other input space the individuals as children. 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 what to do to turn the children into competent adults. If we do nothing, the ad tells us, these children will be doomed to a system in which they will not learn 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 will be old and need a 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 and cut into the chambers of your heart. Interestingly, the emergent meaning in the blend in this case includes the emotions linked to urgency and anxiety, which are not attached to the inputs.

Input spaces in a conceptual integration network are linked by essential relations that we call vital relations. There is a small number of them, around seventeen, which we discuss in *The Way We Think*. They include change, identity, time, space, cause-effect, and uniqueness. In the bypass example (Figure 1), the children in one input are connected by identity to the adults in the other. But they are also connected by change: the children change into adults. The two spaces are connected by time: a passage of many years separates youth from adulthood. Perhaps most importantly for the ad, the two spaces are connected by

cause-effect: the degree of childhood education is causal for the degree of adult professional competence.

Structures in the separate inputs and vital relations between them are compressed, selectively, within a single blended space. The vital relation of change between the child in one space and the adult in the other is compressed into uniqueness in the blended space: the child and the adult are fused.

The length of time between the two input mental spaces is also compressed: the time it takes for a child to grow up to be a doctor becomes the ten minutes before they begin operating.

The cause-effect vital relation between degree of childhood education in one space and degree of adult professional competence in the other is compressed in the blended space into identity: the degree of education is the degree of competence.

As we see, an outer-space vital relation between inputs can be compressed into an inner-space vital relation in the blend of the same kind, as when a long interval of time is compressed into a short interval. But an outer-space vital relation of one kind can be compressed into an inner-space vital relation of a different kind, as when outer-space change is compressed into inner-space uniqueness, or outer-space cause-effect is compressed into inner-space identity. Such compression is a general feature of blends and a crucial feature of the theory of conceptual integration. It is guided by a number of overarching goals and governing principles, which we discuss in *The Way We Think*.

Students of language will be particularly attentive to some conventional phrases in this ad that are specialized for compression: “Joey, Katie, and Todd *will be performing* your bypass”, “Before you know it” and “tomorrow’s good jobs”. The phrase *will be performing* is a deliberate ambiguity, since it fits the blend in which the operation will take place any minute, and the input space twenty or thirty years from now when the children are grown professionals. It is a phrase for introducing the next event (“This evening, the symphony orchestra will be performing Beethoven’s Third Symphony”, “John here will be parking your car”, “Oh, by the way, Mary will be going with us to lunch”), but it can equally be used of the distant future. This use of language looks clever and quite unusual—few contexts come to mind in which the ambiguity could be deliberately deployed. It highlights a deeper feature of language, where tenses are prompts for constructing viewpoints and foci, often gathering temporally distant phenomena into one mental array, and thereby giving us global insight into what is temporally distributed. Tenses are ways to perform compressions of “syncopation” and “scaling” on temporal elements and continua. An example of scaling is reducing

the time it takes to grow up to ten minutes. An example of syncopation is dropping out all the days between childhood and the adult search for employment, so “today’s children” will take “tomorrow’s good jobs”. *Before you know it* is a cliché for compressing time. We can readily think of any number of contexts for its use. It prompts us to compress time in order to give future events immediate status and to give us global insight. It operates over any scale, and performs syncopations of any size. *Tomorrow* is a term for compressing the distance between the present and the future. *Yesterday* is a term for compressing the distance between the present and the past. They prompt for a conventionalized blending network, and they operate over any scale: “The human being of yesterday was an ape; the human being of tomorrow will be a cybernetic organism”, “Just yesterday, a third of a population could be wiped out by something like the bubonic plague”, “A schoolroom is four walls with tomorrow inside”, and so on. One input space is the familiar quotidian sequence we live by, consisting of three successive days, each of the same length: yesterday, today, and tomorrow. The other input is any interval of time containing the present. *Tomorrow* asks us to select some piece of the future and to syncopate the temporal distance between now and then, and also to scale that piece down into a compressed unit. *Yesterday* asks us to do the same with a piece of the past. In the integration networks for *tomorrow* and *yesterday*, the cross-space mapping maps today, tomorrow, and yesterday to some relevant and conceptually connected periods of the present, the future, and the past. In the blend, those periods are compressed into our basic human scheme of daily experience. The extreme familiarity and frequency of *yesterday* and *tomorrow* as prompts for compression indicates how continually cognition depends on compressing otherwise diffuse elements.

“The Bypass” cause–effect blend is a matter of biological and cultural life and death. Let us pair it with a case where the cause–effect blend is a matter of spiritual life and death. There is no work of literature more serious than Dante’s *Divina Comedia*, which offers comprehensive instruction in the most fundamental issues of human existence. In the first section, the *Inferno*, we are given a tour of hell, its geography, its principles, and its characters, so we may understand the varieties and nature of sin. One of the most famous of Dante’s sinners is Bertran de Born, who, when we meet him, is carrying his own head in his hand like a lantern. Dante, en route through hell, has a conversation with the head. While living, Bertran de Born created strife between the English king and his son, and so Bertran’s place in hell is with the “stirrers-up of strife”.

*Perch'io parti' così giunte persone,
partito porto il meo cerebro, lasso!
dal suo principio ch'è in questo troncone.
Così s'osserva in me lo contrapasso.*

Because I parted people so joined,
I carry my brain, alas, separated
from its root, which is in this trunk.
Thus is to be seen in me the retribution.

One input space has Bertran de Born as he was in life: the cause of the division between the king and his son. The other input space is the schematic frame of someone who divides a physical object into two parts. According to a standard metaphoric connection in which social “division” corresponds metaphorically to physical “division”, Bertran is the counterpart of the divider, king and son are as a unit the counterpart of the single unified physical object, Bertran’s sinful separating of king and son is the counterpart of dividing the single unified physical object, the alienated king and son are the counterparts of the two halves of the divided object, and so on. In the blend, Bertran is blended with the divided physical object, thus fusing the cause (Bertran) from one space with the counterpart effect (divided physical object) from the other. The punishment fits the crime. Bertran’s body is in fact a physical object, so it can fit naturally in the blend into the schema of physical division as a man who is decapitated. The imaginative connections achieved in the network work together to give us in the blend an image that integrates cause and effect. This is in general Dante’s goal: to lead us to see the consequences of a sin in the sin itself. On earth, we may have trouble seeing correctly into the nature of our soul and its relation to God. In the *Inferno*, the proper inferences are presented directly, and Dante’s purpose is to provide a tour of hell so we deploy our new insights in our daily lives.

Living in the blend

Integration networks are pervasive in perceptual and conceptual human life. Biology and culture conspire to make much of this integration activity unconscious. In some cases, like the bypass ad, the existence of the integration is striking: degree of success in grade school is obviously different from degree of competence as a doctor. In other cases, we do not typically recognize that we are doing any integration, but we can come to see it under analysis. In yet other cases, it is very difficult or impossible to recognize consciously the separate input spaces and their integration in the blended space. As long as our perceptual

and sensory systems are working properly, for example, it is almost impossible for consciousness to see outside of the perceptual blend of cause and effect. In these perceptual and sensory cases, our conscious experience comes entirely from the blend—we “live in the blend”, so to speak.

In high-level abstract thinking like mathematics, we need both step-by-step separation of cause and effect and global understanding in which they are integrated. In these cases, our conscious apprehension has more leeway to go back and forth, to “live in the full integration network”.

Why would it ever be good to be condemned to live only in the blend? Evolution has restricted consciousness to live in the blend for activities that are crucial to the species—perception, sensation, arousal, immediate reaction to basic environmental threats. In these cases, global and immediate insight is the priority, and there is little evolutionary incentive to check step-by-step how that global insight is achieved. For obvious reasons, we also live in the blend for rudimentary mathematical and physical reasoning: we see globally and instantly that three apples is more than one, and that the limb falling from the tree is going to hit us and we should jump out of the way. In contrast, the development of sciences leads consciousness to live in the entire network: global and creative insights require the blended space, and proof, analysis, and verification and communication of theories require explicit unpacking of cause and effect.

It is often desirable to decrease the extent to which consciousness lives in the full network. The acquisition of expert knowledge is in many ways the achievement of successful integration networks in which living in the blend gives you the desired effects with no conscious attention to the other spaces. Expert performance consists in having acquired the blended pattern in such a way that it is felt consciously as primitive. The child learning letters keeps a forceful distinction between seeing a shape and seeing a letter: the first causes the second. But very soon, the child cannot distinguish the cause from the effect: she can no longer see the shape without seeing the letter.

Ritual projections

The integration of cause and effect is often the central motivation of ritual and—in contrast to the case of perception—in the case of ritual we can perceive consciously the difference between cause and effect even as we see their integration. Eve Sweetser (2000) discusses a ritual in which the newborn baby is carried up the stairs of the parents’ house

as part of a public display. This ritual is meant to promote the child's chances of rising in life. This ritual has its meaning in virtue of a conceptual integration network. In one space, the baby is going to be carried up the stairs. In the other space, which is schematic, someone is going to live a life of some sort. This schematic space of life is already structured by basic metaphors so that living a life is moving along a path in some manner, and good fortune is up and misfortune is down. The stair ritual has been chosen because it has many elements that can map naturally to the schematic motion in the space of life. In the cross-space mapping, the path up the stairs corresponds to the "course" of life, the baby is the person who will live the life, the manner of motion up the stairs corresponds to how the person "goes through" life, and so on. The main parts of the "life course" space are projected into the blend. From the space with the stairs, we project to the blend the actual motion of going up the stairs and the manner of that motion, as well as the identity of the baby.

As the ritual is enacted, the participants and audience are running a conceptual integration network that now has the enactment as one of its most powerful inputs. In the blend, an easy ascent of the stairs determines the child's easy rise in life. The goal is of course to climb the stairs smoothly all the way to the top. Running the conceptual blend is now imbued with deep symbolic meaning, because in the blend whatever happens is the baby's future life. This has interesting effects: while it would be insignificant in actually carrying a baby up the stairs if one stumbled slightly on the third step, this manner of motion takes on enormous significance in the blend, and is quite different from stumbling, say, on the last step.

The ritual studied by Sweetser is fairly representative of rituals in general and suggests that this fundamental and elaborate human activity, unparalleled in the animal world, makes use of the operation of conceptual blending as its basic instrument of imaginative invention. Its power is to integrate in a single, very brief, concrete event the complicated and extended causal patterns of a human life. In the blend, reaching the top of the stairs is the desired effect, a successful life. But reaching the top of the stairs is also the ritual cause of the successful life because the ritual is performed to bring about success in life. The blend presents the effect directly as contained in its cause.

Rituals are performed carefully and accurately, in an atmosphere of seriousness and even solemnity. It is not only the core events of the ritual that count—such as getting the baby up the stairs. Minor aspects of the performance often seem to be all-important. This leads us to some immediate questions. Why are people such sticklers about rituals? Why

do rituals have to be performed just so? If rituals are complex blends, what is the role of the minor aspects of the performance in such blends?

Since the ritual integrates cause and effect, any aspect of the performance can be experienced as simultaneously a cause and its effect in both the blend and the future life. Running the blend therefore assumes deep significance. Scripting it is one thing, running it is quite another, and the performance may carry effects that are not in the script. This is an example of what we have called emergent structure in blends. The example of an unexpected slight stumbling on the stairs that is obviously inconsequential in the input space of climbing the stairs can cause observers of the ritual to catch their collective breath in apprehension. An abnormally quick ascent of the stairs might be experienced as a successful but much too brief life, and therefore a bad performance of the ritual. Since lives are rich and so are manners of performing ritual acts, the possibilities for projection from the ritual to the life are open-ended, and the conservative script of the ritual is meant to shut down the possibilities of unintended projections which could mean harm for the infant. The ritual is meant to give the best possible life, so any departure from the norm can count as a detriment. Having the integration network does not entail believing in its efficacy, but having it is all that is needed to activate emotions in the blend. Independently of any belief in the efficacy of the ritual, one does not want it to go wrong, because for both believer and nonbeliever, its going wrong calls up real emotions that are part of an important social situation.

Although many of the participants may lack belief in the efficacy of the ritual, there is a shared interest in achieving optimal correspondence between the performance of the ritual and the reality it is meant to capture. The performance can label the participants, and the labels can have social effect over time, making the performance at length self-fulfilling. The blend, for social reasons, can create its own efficacy. For instance, someone who has undergone the ritual of being made a knight, including praying on his knees in full armor all night and then rising to leap onto his horse, might be expected to behave dutifully, piously, and courageously, and this expectation can induce on his part actual duty, piety, and courage. The members of the community will also be biased to judge his perhaps ambiguous actions as dutiful, pious, and courageous. The label is a global insight integrating vast ranges of cause and effect. The knight's good qualities cause him to become a knight, but his being a knight causes him to have those qualities. And so on. A remarkable case of this is voodoo death, where the belief in the efficacy of the network is basic for the community and

for the victim, so that the effects of these beliefs is that the social body and the physiological body conspire to make the death happen. This is an extreme case of living in the blend. In the blend, the victim is dead, and so the body is doing what it can to match that blend.

Some rituals are trials—elements of the blend are left undetermined by the script and are to be determined during the performance of the ritual. Trial by fire is a ritual where guilt or innocence is left unscripted and to be determined by the events that arise in performing the ritual. But the ritual of the baby and the stairs is not meant to be a trial. The script for the blend includes the desired outcome, and the only question is whether the performance will match the script. The script is intentionally made easy to perform exactly so the performance will match the script closely.

Clearly, then, a ritual blend needs additional specifications in order to count as a trial, a prediction of the future, a virtual enactment of what we want to happen or not to happen, a glimpse of another world, a technique of discovering history, and so on. Baptizing a baby by immersion is meant to make it eligible for spiritual salvation, not to protect it against drowning or to make it good at having deep thoughts.

But even though a ritual is constrained by social purposes, new meaning can arise as it is performed, as we saw in the case of the stumbling on the stairs. This is a remarkable property of human cognition: performances that are grounded in specified scripts can always take on new emergent meaning because conceptual integration is active during the performance. The performance of the ritual, for example, is embedded in the full richness of human life, and on-line blending can recruit from that richness.

Compressing vital relations

In everyday conceptual life, we integrate clashes and compress vital relations such as identity, time, space, cause–effect, change, and part–whole. Life is various and diffuse, running over large expanses of time and space. To have a human life, a human mind, and a system of constructing intelligible meanings is fundamentally a matter of continually compressing over such vital relations.

When we look at the Persian rug in the store and imagine how it would look in our house, we are compressing over two different physical spaces. We leave out conceptually all the actual physical space that separates the real rug from our real house. When we imagine what answer we would give now to a criticism directed at us several years ago, we are compressing over times. In some cases, there is a larger

history that includes the two spaces over which we are compressing. In the case of shopping for the rug, the history includes our desiring a rug, looking at the spot where it might go, making notes, going to the store, looking at several rugs, and so on. We choose two mental spaces in that history for compression. In the case of imagining our present answer to an old criticism, there is a history in which we have been thinking about an idea and dealing with criticisms. We choose two temporally separated mental spaces in that history and compress over them.

Blending is a compression tool par excellence. Selective projection from different related spaces and integration in the blend provides an exceptionally strong process of compression. We have seen blending perform temporal compression in the “The Bypass” (Figure 1), where the entire span of time separating the schoolchildren from the surgical act of incision is scaled down to a few minutes. In “The Baby’s Ascent”, the entire lifetime of the baby is scaled down into the time it takes to climb the stairs. In “The Bypass”, the long causal chain between the early education of the children and the competence of the adult doctors is compressed down to the briefest span.

We want to focus on two phenomena that occur in compression through blending. The first is syncopation. To syncopate is to leave out significant chunks in a vital relation. Leaving out all the spatial distance between the rug in the rug shop and our front room floor is syncopation over physical space. Leaving out all the time between the criticism and our imagined response years later is syncopation over time. In general, we see, syncopation can apply to relationships between input spaces or to relationships between elements within a single input space.

The second phenomenon that occurs in compression through blending is scaling. In “The Baby’s Ascent”, a lifetime is scaled down to the few seconds it takes to climb the stairs so the lifetime can be blended with the actual ascent of the stairs in the performance of the ritual. In “The Bypass”, the time it takes to go from childhood to professional adult, all the long changes involved, and the long causal chain from childhood experience to adult capacity, are scaled down to the short interval between when “you” are introduced to Katie and she applies the knife. The interval to be scaled can be *inner-space*, as in “The Baby’s Ascent”, when the lifetime within *one space* is scaled down to the time it takes to climb stairs. Alternatively, the interval to be scaled can be *outer-space*, as in “The Bypass”, where the temporal interval between *two spaces*—the schoolchildren and the adult doctors—is scaled down to fit into the blend. Scaling, in contrast to syncopation, preserves the topology of what is compressed. For example, temporal scaling preserves ordering of events and spatial scaling preserves adjacency relations.

Compression and decompression of identity

Identity is not only a vital relation, but perhaps the primary vital relation without which the others are meaningless. Human mental life is unthinkable without continual compression and decompression of identity. A linguistic system, to be useful at all, has to have a wide and powerful array of resources for prompting such compressions and decompressions of identity. Identity seems like a primitive given but is an achievement of the imagination. To get a feel for the role of imagination and the importance of blending and compression in building up identity, consider the following story, which appeared on the front page of the science section of the *New York Times* for Tuesday, 24 December 1996. The story, titled “Ghosts of Predators Past” was illustrated by a large photograph of a small American pronghorn chased by pen-and-ink prehistoric cheetahs and long-legged dogs. The American pronghorn is excessively faster than any of its modern predators. Why would evolution select for this costly excessive speed when it brings no additional reproductive benefit? The scientists propose that

the pronghorn runs as fast as it does because it is being chased by ghosts—the ghosts of predators past.... As researchers begin to look, such ghosts appear to be ever more in evidence, with studies of other species showing that even when predators have been gone for hundreds of thousands of years, their prey may not have forgotten them.

The conceptual integration network for this passage is exceptionally complex. We will focus on some of the compression and decompression of identity.

The American pronghorn, in the prehistorical story, barely outruns nasty predators like cheetahs and long-legged dogs. In the modern story, it easily outruns all its modern predators. In the blend, the pronghorn is being chased by nasty ancient predators, marked as “ghosts” to signal that they have no reference in the modern world. We are not confused by this felicitous blend: we do not expect to see ghosts chasing a real pronghorn; we do not think the pronghorn today remembers the prehistoric predators. Instead, we know how to connect the blend to the story of the pronghorn today. Great speed was adaptive for the ancestors of the pronghorn today: they faced nasty predators, and although those predators are now extinct, the instinctive capacity for speed survives.

In the blended space of this integration network, there is a single individual pronghorn and that pronghorn remembers the nasty predators it used to be chased by. It was conditioned by those chases, and so now, when any predator tries to chase it, it runs with its old speed.

But wait a minute. Who is this pronghorn? Clearly not any individual animal, but also clearly not just a typical representative of the pronghorns in the world today. It is also not a representative of the modern American pronghorn species, because no member of that species has seen any of these nasty predators, and so could not “remember” them. What we see in the blend, and what gives us the global insight into the evolutionary truth, is a massive compression of identity over species, individuals, and time.

Clearly, to achieve this blend, we must have as inputs a space in which there is a modern pronghorn that runs fast but not from nasty predators and a space in which there is a prehistoric pronghorn that runs fast from nasty predators. Notice that the one pronghorn in the blend corresponds to two quite different pronghorns in the inputs. But where do these input spaces come from? Where do we get “the prehistoric pronghorn” being chased by a cheetah and “the modern pronghorn” with no cheetahs around? Neither “the prehistoric pronghorn” nor “the modern pronghorn” is an actual individual pronghorn. Each one is itself an identity compression over an epoch in the history of the species—in one case, the prehistoric epoch during which both pronghorns and nasty predators existed, in the other case, the modern epoch in which there are pronghorns but no nasty predators. Each one is a pronghorn chosen from an idealized set of “prototypical pronghorns”, which is itself a set that is imaginatively constructed by attributing to each “prototypical pronghorn” the traits that are characteristic of the group of actual pronghorns during the relevant epoch.

Actually, there is even more compression and decompression of identity needed to get to the prototype, but let us consider only the complex of compressions we have seen so far. At the outer limit, we have a decompression into all the individual pronghorns that existed or exist during either of these two epochs. First, they are compressed into two separate groups, each with an identity of sorts. Each group is compressed over time and space (and evolutionary cause and effect, for that matter, since each group consists of all the pronghorns during the epoch as either ancestors or descendents). Each of these groups is compressed by homogenizing their natures, experience, and behaviors into a frame of prototypicality. So now they are all the same in each group. Then each group is compressed by the nifty device of picking one (any one, since they are all the same). This compression turns a group identity into a particular identity. Now, at last, after several compressions, we have what we need to do the actual noticeable blend, of the prototypical prehistoric pronghorn and the prototypical modern pronghorn, to get a single pronghorn in the blend with today’s

flight behavior (the same as the prehistoric flight behavior) and memory of what it used to be chased by, back when cheetahs were around. This memory is an emergent structure in the blend, since the prototypical modern pronghorn cannot remember in a straightforward sense animals it has never seen, and no actual modern pronghorns can possibly have such a straightforward memory either.

The input spaces are connected by vital relations of time and causality. The reason the modern pronghorn runs so quickly is that it has inherited genetically that capacity down through the generations that connect it back to the prehistoric pronghorn. This cross-spatial relation of evolutionary inheritance *between* the input spaces is compressed into structure *inside* the blended space, namely, the memory of the pronghorn. This is a general strategy available in building integration networks: *a vital relation between spaces is compressed into structure inside the blend*. In fact, this very example of the pronghorn involves a second use of this general strategy. It is easy to think of “the prehistoric pronghorn” as having been conditioned by the nasty predators to run fast, as if “the prehistoric pronghorn” *learned* that it had better run fast. But of course no learning was involved. The reason the prehistoric pronghorn runs so fast is that the pronghorns in the line of descent above it were the ones who were fast enough to escape the predators. Their slow cousins got eaten. This is a story of *adaptation* which connects many different generations of pronghorns, and this connection is a cross-space vital relation of *change*. Change through *adaptation* across spaces is compressed into change through *learning* for the “prehistoric pronghorn”.

When we get to the last compression that we need to perform, we have one input with the prehistoric pronghorn and another input with the modern pronghorn, related by inheritance. In the final blended space, identity is compressed: there is a single pronghorn. Time is compressed: the sweep of evolutionary history across the input spaces is a single lifetime for a single pronghorn within the blended space. What we see here is a standard strategy of compression of identity: two non-identical elements that belong to different times on a time interval become temporal stages of one identical element in the blend. Naturally, the earlier element corresponds to an earlier stage, and the later element corresponds to a later stage. So, in the identity compression of the prehistoric pronghorn and the modern pronghorn, the prehistoric pronghorn is “the pronghorn” when younger, and the modern pronghorn is “the pronghorn” when older, who remembers its youth. Why can this mature pronghorn run so fast when there is no reason for it? Because it learned how when it was young and lived in a bad neighborhood.

In other words, running fast, which is a property of the prehistoric pronghorn, is projected to the blend as a capacity of “the pronghorn”, learned when young. The persistence of this capacity in the species is projected to the persistence through life of something one has learned young. Just as we do not forget the hard taskmasters of our schooldays, the mature pronghorn has not forgotten the cheetahs that taught it to run fast in its youth.

The identity compressions that give us the “Mindful Pronghorn” can be teased apart under analysis. They seem useful and fairly natural, even if they also seem a little supernatural. Some identity compressions seem even more natural. We compress over a person’s lifetime to give a single “personal identity”, and a label that we call a proper name. We see the compression, but it seems somehow true to the essence of human life. An even less noticeable compression is the kind of compression that gives us the perception of a single “blue cup”. In this case, we need a neurobiologist to explain even that there is identity compression—binding—going on. But in the other direction from “The Mindful Pronghorn” there are identity compressions that seem more supernatural. Metempsychosis is a case in point. You might be stunned at the compression involved in the discovery that you, Cleopatra, Saint Barbara, Queen Elizabeth the First, your great-great-great grandmother (the diva), and Sarah Bernhardt are the same person, but this explains why you dream in Egyptian, were once hit by lightning without harm, like to ride horses, think you can sing the Queen of the Night’s aria flawlessly, and have a penchant (your friends say) for being histrionic. This identity compression is not primed for by our culture or by our language, which gives us proper names for individual people, patronymics for family groups, common nouns like *pronghorn* and *cup* for referring to the corresponding compressions, but no expression or construction for picking out the identity that runs from Cleopatra to you. Because it is not primed, it stands out, in ways that the more conventional compressions of personal identity over time or of groups-to-prototype do not. But that does not mean that it is alien to our culture. We routinely use the conventional construction *You must have been So-and-so in a former life* to highlight that “you” are doing something that calls for *some* explanation, and that explanation would be supplied by your having been So-and-so, just as the pronghorn’s speed calls for *some* explanation, which would be supplied by the pronghorn’s memory of the nasty predators. This kind of identity compression across history is a deep principle of life in any culture that supports it, for example, in a culture with a belief system that includes reincarnation.

These compressions of identity over history are meant to give us global insight into that diffuse and various history, into the history of a species in the case of the pronghorn, into the history of an organism in the case of biological identity, into the history of a human being in the case of personal identity, and into the history of a people, its environment, and its culture in the case of William Butler Yeats's description of the metempsychosis of Fergus the Red Branch King as he becomes a Druid:

I see my life go drifting like a river
From change to change; I have been many things—
A green drop in the surge, a gleam of light
Upon a sword, a fir-tree on a hill,
An old slave grinding at a heavy quern,
A king sitting upon a chair of gold—
And all these things were wonderful and great;
But now I have grown nothing, knowing all.
Ah! Druid, Druid, how great webs of sorrow
Lay hidden in the small slate-coloured thing!

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Note

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