The Scope of Human Thought


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Biologically, we resemble other animals, but mentally, we leave them in the dust. The scope of human thought is vast. Why are we so different?

Animals—including us—live, think, and feel in the here and now. Living, thinking, and feeling are biological events, existing only in the present. When we think about the past or the future, or anything distant or outside the situation we inhabit, the thinking and feeling are not distant—they are right here, right now, present, confined to our local, human-scale situation, conducted through here-and-now biological systems.

In this regard, we are like dogs, dolphins, corvids, chimpanzees. A human being may have been alive 10 years ago and may be alive 10 years hence, but our brain activity of 10 years ago or 10 years hence does not exist. The only systems for living, thinking, and feeling that human beings possess are run by their bodies here and now.

This picture was sketched by Sir Charles Sherrington, who described the brain as an "enchanted loom" where "millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern, though never an abiding one" (Sherrington, [1941] 1964, p. 178).

Dissolving, never abiding. Yet our thought ranges over time and space, over long-range causal chains and possibilities, over present and potential absences, over mental stories we populate, in imagination, with thousands, billions, of human agents whose minds we imagine to be like ours—full of beliefs, desires, plans, decisions, and judgments, all with vast scope. The contents of our thoughts do not seem to us to be dissolvingly evanescent.

Scientists have meditated upon the scope of human thought and tried to explain its origins. Antonio Damasio, in *The Feeling of What Happens* (1999),

offers a speculative theory of how neurobiological development could have made "extended consciousness" possible:

> Extended consciousness still hinges on the same core "you," but that "you" is now connected to the lived past and anticipated future that are part of your autobiographical record (page 196).

Endel Tulving (1985a and 1985b) emphasized our ability for mental time-travel, our capacity for episodic memory and autonoetic ("self-knowing") consciousness. In autonoetic consciousness, we can recover the episode in which something occurred. "Autonoetic consciousness . . . allows an individual to become aware of his or her own identity and existence in subjective time that extends from the past through the present to the future" (1985b, page 388). Ulric Neisser drew attention to our remarkable capacities in his classic article, "Five Kinds of Self-Knowledge" (1988). Hundreds of other scientists have participated in the inquiry. Here is one of the most recent:

> A self can feel such a singular fixture, hugging one's here-and-now like a twenty-four-hour undergarment, but actually it's a string, looping back and forwards in time to knit together our past and future moments. . . . A self is a Tardis, a time-machine: it can swallow you up and spit you out somewhere else. — Charles Ferneyhough. 2008. *The Baby in the Mirror: A Child's World from Birth to Three.* London: Granta, page 129.

Expressing astonishment at the vast scope of human thought invites objections.

> Objection 1: What's the big deal? How can it be so astonishing and difficult if everyone, even children, can do it?

This lay objection carries no weight within scientific communities. Cognitive science has shown repeatedly that seemingly simple human behaviors are far more complicated than we might have imagined and that our folk theories purporting to account for them are in many ways wrong from the start. The vast scope of human thought is a recognized major

problem: it lies far beyond the abilities of other species and we have no scientific consensus on what makes it possible.

> Objection 2: Doesn't evolution build us so that our actions here-and-now have long-range consequences? Doesn't instinct provide the connection between here-and-now and the rest of our lives?

It does: instinct makes the squirrel bury nuts and the human being lust after a member of the opposite sex without any need for thought about hunger or cute great-grandchildren. But that's not the issue. The question is, how can a human being *think* about a network of such vast connections, including past and future states of their own minds and the minds of other human beings?

> Objection 3: What about memory? Doesn't memory solve the problem of continuity over time, at least? Doesn't memory bring the past into the present?

Not so fast. Memory is of course only in the present, and a particular memory is only in the present, even though it seems as if the detailed memory comes winging in from long ago, carried to our present minds on winds from yesteryear. Both our memory as a system and any particular memory we experience are present biological events. The universe does not bend back upon itself when we remember, to make two different times intersect in one time. This sense of the intersection of past and present—one of the basic mainstays of life and art, from Homer to Proust, from the witches in *Macbeth* to Dr. Who, is an adaptive delusion.

> Objection 4: Are we really so special? Don't other animals show signs of thinking beyond the here-and-now?

This objection is very serious and important. The studies on this topic are fascinating: Hints that dogs have some human-like social skills (Hare & Tomasello 2005); that rats have some recollection-like memory retrieval (Fortin, Wright, & Eichenbaum 2004); that scrub jays have some episodic-like memory (Clayton & Dickinson 1998); that chimpanzees have some understanding of conspecifics as possessed of goals, intentions, perceptions, and knowledge (Call & Tomasello 2008; Tomasello, Call, & Hare 2003); that Santino, the Swedish zoo chimpanzee, stores rocks as part of a plan to throw them at human visitors later (Osvath 2009); and so on. There is considerable

evidence for the weak form of this objection, and science will presumably inch significantly here and there to extend our conception of what other species can do mentally. But the strong form of this objection does not have a leg to stand on. The highly impressive performances by members of other species have severe limits that human beings everywhere indisputably blow right past, effortlessly, from an early age, without help from a more advanced species.

What makes the vast scope of human thought possible? Elsewhere (Fauconnier & Turner 2002, Turner 2003-2009), it has been argued that nonhuman animals possess impressive rudimentary abilities for conceptual integration, but that human beings have an advanced form, called "double-scope blending." It has been argued (Turner 2008, Turner 2004, e.g.) that double-scope blending makes the vast scope of human thought possible. Double-scope blending gives us the ability to conceive fully of other minds and to grasp extended conceptual networks that would otherwise lie beyond our cognition. These extended conceptual networks have elaborate "vital relations" running across the network—relations of time, space, cause-effect, representation, analogy and disanalogy, change, identity, uniqueness, and so on.

What follows is the tiniest gist of this hypothesis.

## Human Scale

A human being in the local, present moment has, like any mammal, a brain in a certain state of activation, with integrated systems for affect, perception, inference, and construal. Human brains are built to conceive of scenes that are at *human scale*. At human scale

- We operate within limited ranges of space and time.
- We partition our sensory fields into objects and events.
- We interact with objects locally.
- We recognize some of those objects as agents.
- We interact with a few agents in patterned activity: eating, moving, fighting, mating.

That is pretty much what we are built for. In one sense, it is what we are.

For other species, this scale, or a similar one, seems to be pretty much the entire story of existence. No nonhuman animal, for example, seems to be able to understand that other animals hold beliefs, or what those beliefs might be. No nonhuman animal seems to be able to wonder what its life might be like if it had done something different ten years ago. No nonhuman animal seems to be able to wonder what will become of its as yet non-existent offspring.

Human beings, by contrast, have

- a conception of self as possessed of a *characteristic* personal identity *running through time*;
- conceptions of other agents as similarly possessed of *characteristic* personal identities *running through time*;
- conceptions of other agents as possessed over time with the standard system of elements in folk psychology, that is, emotions, goals, and beliefs that drive actions and reactions;
- a conception of self that includes relationships with the psychology of others, and, conversely, conceptions of those others as themselves possessed of conceptions of self that contain relationships with the psychology of oneself, that is, the self doing the original considering of those others;
- a conception of self and one's personal identity as richly inhabiting both the past and the future.

It is a spectacular scientific puzzle that human beings are the sole species that seems to be able to think and feel beyond the limits of the scale for their species. *Human scale* is fundamental for human thinking and feeling, but we go beyond our scale in ways so thoroughly different from members of other species as to place us in a different galaxy of thinking and feeling. We are like Dr. Who, the time lord of science fiction, who can use his Tardis to move across ranges of both time and space that go way beyond human scale. Human beings have a mental Tardis, an internal Tardis. Our mental Tardis is the subject here.

Network Scale

The hypothesis suggested here is that our ability for double-scope blending gives us the capacity to create vast conceptual networks with extended vital relations that are nonetheless anchored in scenes that are at human scale. *Network scale* can be vast even though *human scale* is not, because the network scale is anchored in the human scale. The *human scale* blend contained in the network provides us with a platform, a scaffold, a cognitively congenial basis from which to reach out, manage, manipulate, transform, develop, and handle the network. The human-scale anchor in the network can be achieved by blending conceptual elements of the network into a human-scale scene or by recruiting to the network some mental array that is already at human scale and blending the rest of the network with it. Importantly, once we have blended conceptual arrays to make a new blend that has human-scale properties, that blend is now, for us, at human scale, and can be used as an anchor for future networks. These new human-scale blends become second nature for us, and blending is recursive: packed, human-scale blends become inputs to new networks. What was once beyond human scale is now packed to human scale. What counts as human scale is repeatedly extended over the course of a lifetime. To give one example, the concept of *writing* is the result of repeated double-scope blending (Fauconnier & Turner 2002). Conceptual integration networks for *writing* seem to be at most 8,000 years old. It accordingly must have taken cultures tens of thousands of years to invent the networks necessary for writing, and today's child, with elaborate cultural tutelage and support, must still spend considerable time and effort to build the relevant human-scale blend and its network. But once the network is acquired, it seems natural, inevitable, effortless. It becomes difficult if not impossible to look at appropriate marks and to see only marks, not words. The conceptual integration work required for understanding *writing* takes conceptual elements that are at network scale and creates a human-scale blend for the network, so we can hold onto that conceptual network.

The scope of human thought is network scale, even though we are built for human scale, because double-scope blending provides human-scale anchors for the vast conceptual integration networks.

## Packing the Known Universe to Human Scale

Toward the end of the film version of his slide-show presentation on global warming, Al Gore posts a picture of Earth, the pale blue dot photographed from 4 billion miles out in space. He explains,

> Everything that has ever happened in all of human history has happened on that dot. All the triumphs and tragedies, all the wars and all the famines, all the major advances. That is what is at stake—our ability to live on planet Earth, to have a future as a civilization.

Concluding, Gore states,

> Future generations may well have occasion to ask themselves, "What were our parents thinking? Why didn't they wake up when they had the chance?" We have to hear that question from them now.

Gore prompts for vast conceptual integration networks that are at vast network scale: a distance of four billion miles, and all of human history plus the future. But, through double-scope blending, we can pack this network to human scale.

First, space is packed to human scale. We have a bodily notion of vision, at human scale, taken from our local visual experience, according to which, the farther we back up from an object, the smaller the angle it subtends in our field of vision. This is a human-scale conceptual array. Gore also prompts for the conceptual array of the universe, with the Earth somewhere in it. The incompatibility of these conceptual arrays is evident. Just for starters, human beings cannot walk backward four billion miles from Earth to have a look. But we can project our local visual intuitions to the packed blend, and in the blend, we can see the Earth from four billion miles the way we might see a bird in a tree. In the blend, Earth becomes one small, fragile thing, subject to our action, evoking local responsibility.

Second, time is packed to human scale. Unborn descendents—billions of them—are talking to us, and we hear them. There are reasons we could not hear them: they do not exist; there are far too many of them; they are distributed around the entire Earth; they stretch across many generations; they do not all speak English; they might not be speaking at all, but rather writing or thinking; and so on. But now, in the packed blend that anchors the network, all the individuals of future generations are packed into one human

voice, the voice of our child. The emergent structure in the packed blend is amazing: now, in the blend, each of us can hear voices of our descendents, even if in fact some of us, in reality, have no children at all. And we hear their question now.

This conceptual miracle—anchoring vast network scale in human scale—is child's play for human beings. This child's play is what separates us from all other species. Every human child is born a genius.

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**Responses to comments, 26 August 2009**

All hail the National Humanities Center and Gary Comstock, editor of *On the Human,* for establishing this Digital Forum—which is itself a blend, a frame blend, of the ancient Roman Forum and our quite different contemporary academic network. *On the Human* is a welcome imaginative place for discussing these important questions.

In early days, I described blending theory as embryonic. By now, hundreds of people have participated in its development. The commentators in this Forum have suggested further lines of development. It would be an excellent outcome of the Forum if the research community would take up some of these suggestions.

**Johnson** hits the nail on the head in describing conceptual integration theory as, among other things, an attempt to account for our capacity for abstract thought "without presupposing separate systems allegedly unrelated to our bodily engagement with our environment." **Stjernfelt** agrees with the need for an account of abstraction. **Danesi** reminds us that other thinkers, such as Vico, sought to account for such human mental singularity and, in doing so, offered ideas potentially useful to blending theory. **Booth** shows us compelling poetic blends and makes the case for poetry as an intensification of imaginative life, in which compressed blends take form.

**Freeman** observes that, in conceptual integration theory, there is every reason to view the arts as having a primary place in the descent of cognitively modern human beings. Yes: art is a great flowering of our species-wide ability for double-scope blending and demonstrates the ways in which advanced blending abilities have endowed us with the capacity to evolve culturally, in cultural time rather than evolutionary time. Human mental operations seem not to have evolved significantly during the last fifty, sixty, seventy thousand years or so, but during that time most of what we regard as marking our humanity has been invented, art often leading the way.

**Ferynhough** indicates the need for better understanding of the ontogenetic development of double-scope ability and remarks that he doubts that I want to strike a nativist note in saying "every human child is born a genius." "Born a genius?" asks **Fernyhough**. "Probably so. But I think our best chance of understanding how double-scope blending is possible is to look at how children develop in the first three years or so of life—how those innate endowments are stretched, enhanced, and thoroughly reconfigured by experience out here in the world." The child is born a genius in entering life with the capacity for advanced blending, but not yet its cultural products. The child deploys the capacity; culture stands ready to feed the child, interactively, the particular conceptual integration networks it has developed. Conceptual integration networks build up—it's blends all the way down. Often, as in learning numbers, building advanced blends depends upon building others first, with one blend serving as an input to a later blend. The child needs time to progress through such developmental suites.

**Pavel** remarks, correctly, that it would be unfortunate—as we delve into the way we think—to dismiss everyday understanding of the mind as negligible. "Folk psychology," sometimes called "commonsense psychology," is a term of art in cognitive science. It refers to our understanding of human beings as having beliefs, desires, and goals. Perhaps a different term would be better. While there are cognitive scientists and philosophers, such as Paul Churchland, who do argue that folk psychology is profoundly mistaken, folk psychology is already an amazing conceptual achievement—one restricted to human beings, and highly dependent upon double-scope blending in the conceiving of other minds and even one's own mind. At present, there is no consensus on how to cash folk psychology out into other more sophisticated scientific explanations.

Both **Herman** and **Pleshakova**, in supplementary ways, emphasize the importance of networks as niches. Because human beings are able to do double-scope integration, they are able to create culture—concepts, artefacts, and behaviors that are not species-wide and not simply induced by variable environmental features but rather conceived in cultural time in certain communities and transmitted to others in the community, chiefly descendents, in ways that can be sustained and developed rapidly even though the earlier members of the community die off. Human beings create and transform robust cultural niches at lightning speed. This is a human singularity: for other species, if there is any culture in this sense at all, it is extremely sparse, fragile, and narrowly tied to basic mental scaffolding. When we cannot get a sure footing with each other mentally, it is not because we do not share the same basic mental operations, but because we do not share all the necessary cultural networks. Luckily, since we are all double-scopers, there is hope even late in life of acquiring cross-niche understanding, by blending. **Herman** additionally and importantly emphasizes the way in which human thought about the here-and-now involves elaborate conceptual integration networks.

**Deal** is eloquent in discussing the ways in which blending theory and its analysis of conceptual packing and unpacking offer instruments for analyzing conceptual networks in religion. **Harrell** makes a crucial observation about future research on such cultural networks and niches: if our identities are imaginative, the result of conceptual blending, then blending theory could presumably help "elucidate the types of ideologies, social relationships, political configurations, and global conflicts that result in our everyday lived experience as humans." I am particularly grateful for his observation that in imagining the minds of nonhuman animals, we rely on counterfactuality and disanalogy: conceiving of those minds always involves a conceptual integration network that has as one of its inputs our conception of our own mind, with vital relations of counterfactuality and disanalogy helping to structure the network. **Harrell's** proposal to use blending theory to analyze our understanding of identities of other people, other animals, and machines is attractive.

**Stjernfelt** offers a perceptive reminder that the study of double-scope blending must be carried out simultaneously within the frame of human singularity and within the frame of evolutionary descent, and that these two frames are only superficially at odds. The capacity for double-scope blending seems to be species-wide. Its emergence was a fully evolutionary event. That it provided us with the

mental capacity for extraordinary discontinuity with other species does not make it any less evolutionary. **Stjernfelt** also emphasizes that double-scope blending, to be possible, must rely upon a great range of animal capacities that lie in our line of descent. That is a fundamental point: human singularity—in this case, the capacity for double-scope blending—is a small extra step following two billion years of evolutionary descent. But what a difference that small step makes: it gives us the ability to develop robust and inventive conceptual worlds in cultural time, and this is the source of our discontinuity with other species.

**Cienki** points out a rich area for the study of blending, one that has developed impressively in the last several years—co-speech gesture: "One thing I find fascinating is how not only cultural artefacts (writing, clocks, and other examples discussed in Fauconnier and Turner 2002) reflect conceptual integrations which we employ when we use them, but we ourselves are visibly performing blends any time we use spoken or signed languages." His survey of the current work on gesture, sign, and blending is an invaluable small introduction. I recommend co-speech gesture as a laboratory to any interested student in cognitive science seeking an area of specialization. It provides many potential dissertation topics—free to a good home.

The commentators raised several topics often discussed in blending theory, and it is good to see them again in the Forum. I comment on a few of them here.

*Other animals, "specialness," hubris, teleology* (**Rohrer**, **Herman**, and others). When I teach and lecture, I often include riffs about the amazing abilities of other animals. I am frequently cast in the role at conferences and on panels of reminding participants of how weak we are in various ways, mentally, compared to other species and how we simply lack some of their abilities. I explain how, even for mental abilities at which we are superb, we lie on a gradient with other animals, not in a separate galaxy. My sole use of the word "special" in the target article was in my caricature of the cliché objection, "Are we really so special?" "Different" is a better word. The word used in the National Humanities Center initiative underlying *On the Human* is "singularity," and that's the best word, I think, except that it is a technical term. Different people may like different vocabulary, but the facts are not controversial. We have extremely robust culture; cultural evolution is much faster than biological evolution; we are immensely creative in the sense that we invent new concepts and activities that are not species-wide; we conceive over vast scope. These are facts. Blending theory has been explicit from the beginning in reminding

audiences that discussion about higher-order human singularities seems to elicit teleological misconceptions about our evolutionary status, and even triumphal misconceptions, dressed up in purple prose, but that these misconceptions must be stopped on the beaches. The capacity for double-scope blending is an evolutionary development. It seems to have been adaptive. Blending theory rejects any triumphal or teleological framing. Indeed, there are many who think that the evolutionary experiment that produced cognitively modern human beings—probably not even a hundred thousand years ago, a blink of the eye in evolutionary time—is doomed to crash and burn, not only for us, but with considerable collateral damage for other species. The question here is not triumph or teleology but rather our singularities, and it is important to remember that researching human singularities presents special technical challenges, some of which have to do with the place of other animals in comparative research. We are often willing to take drugs because they have been tested on animals. Our reasoning depends upon our belief that, for the relevant systems, the test animals have biology analogous to ours. No doubt, throughout the scientific study of human beings, it is good to look for robust "animal models." But it is crucial to remember that for higher-order human cognition—art, religion, grammar, mathematical insight, creativity, scientific inquiry, etc.—*there are no robust animal models*. Beavers, border collies, and barn owls do amazing things, things important to understand, but they do not present us with models for human singularities. All animals exist in networked ecologies in which their actions have long-range consequences, simply in virtue of their having metabolism, reproduction, and local habitation. The beaver's dam-building is only a particularly visible and memorable instance of such ecological consequentiality. But there isn't any evidence, for example, that beavers think about and design those extensive and cross-generational networks of consequentiality, or are aware of them mentally as networks, and it's indisputable that they do not conceive, contemplate, plan, and install inventively different networks in cultural time. We do not have all the abilities that other animals have, and the networks that nonhuman animals inhabit are not fully or even in some cases largely available to our human abilities, but those animals do not have human higher-order cognition. Cats are a great animal model for studying human vision, but they don't paint, and they don't *think* at network scale. We do indeed blow entirely past other animals on *the scope of thought*.

*Neurobiological substrate* (**Brandt**, **Benzon**, **Rohrer**). One string of responses to commentaries asks about the neurobiological substrate of blending. I have previously published some stretch speculations about that substrate:

(1) Antonio Damasio, in *Descartes' Error*, puts forward the notion of "broker neurons," which might connect up what we think of as disparate neuronal groups subtending clashing conceptual arrays.

(2) What is now referred to as the "mirror-neuron craze" has naturally led to notions that mirror neurons (and maybe canonical neurons) subtend blends of self and other.

(3) Conceptual integration could be a hypertrophy of perceptual integration: the neural mechanisms of perceptual integration might have been recruited and expanded by biological evolution, resulting in a computational ability that made double-scope blending possible. Perceptual integration, called the "binding problem," is perhaps the major open scientific question in neuroscience.

(4) Synaesthesia, or more generally cross-wiring, could provide neurobiology useful for blending. V. S. Ramachandran, Edward Hubbard, and others have worked on the neurobiology of synaesthesia and considered its contribution to conceptual integrations involving metaphoric links. Stephen Mithen, in *The Prehistory of the Mind*, has also considered cross-wiring. Synaesthesia is a kind of neural binding in restricted domains. Perhaps it could have evolved into an ability that is not restricted to particular conceptual domains.

(5) There are other restricted-domain abilities that look as if they involve integration, such as chase play, a kind of simulation of aggression, which evidently is common throughout the mammalian world for species involved in predation. During chase play, parent and offspring simultaneously activate motor patterns, attention patterns, and motivational structures that belong to two clashing domains, such as parent-offspring and predator-prey. Maybe the neural circuitry subtending binding, synaesthesia, or special-purpose blending of the sort we find in chase play got the ball rolling in the run-up to full cognitive modernity.

Behind the comments about the neurobiological substrate seems to lie an assumption that I do not share, namely that our technology for brain imaging is even remotely close to allowing us to detect double-scope blending as such. I love brain imaging: I am spending this year as part of a three-co-PI team designing and running a set of behavioral experiments, and the entire team has worked hard to force the

experiments to conform to the practical limitations on ERP and the extremely severe limitations on fMRI (functional Magnetic Resonance Imaging). We will be running some of those fMRI experiments through the Center for Neuroeconomic Studies. Naturally, we will do what we can, and hope springs eternal. But it's best in cognitive science not to be carried away with enthusiasm about the latest methods. Non-invasive brain imaging on neurotypicals is only a couple of decades old, and extremely crude. What would we need in the way of brain imaging to be able to detect blending as opposed to other neuronal activity? Consider that blending appears to operate throughout all conceptual domains, and constantly. I take it that very few of the brain's blending attempts ever advance past the initial stage, very few of those actually conform to the constitutive or optimality principles, very few of those have effect on thought, very few of those have access to action, and only the tiniest fraction are ever accessible to consciousness. The very seductive fMRI images we see in grant proposals are seductive partly because most readers are unaware of how they are produced. They are crude measures of the paramagnetism of relatively deoxygenated hemoglobin. fMRI is a BOLD response. BOLD stands for "Blood-oxygen-level dependent." Two of the scientists who helped develop MRI were awarded the Nobel Prize, and it's fantastic for detecting what part of the shoulder the weekend warrior blew out lunging for the tennis ball. But when applied to the brain, it's still a measure of blood flow, not neuronal activity. It has low signal-to-noise ratios. The results presented in those colored images derive from many repetitions and then statistical averaging and smoothing, often involving wholesale subtraction. There are claims that fMRI correlates better with input than output. At present, fMRI has many exceptionally severe limitations and uncertainties. If we ask, "*where* does conceptual integration happen in the parts of the neocortex in which fMRI can detect activity?", the off-the-cuff guess would be "everywhere." And if we ask, "*when* does conceptual integration happen in the parts of neocortex in which fMRI can detect activity?", the off-the-cuff guess would be "all the time." It is difficult to see, then, how current fMRI techniques could offer any insight into conceptual blending. **Rohrer** is on the right track, I expect, in calling for advances in cognitive neurophysiology rather than cognitive neuroanatomy. The neurophysiological processes will be very important; it's not yet clear to what extent techniques of anatomical localization, even better ones, could help. To be sure, I was delighted when fMRI was developed; it is a useful addition to the arsenal of indirect approaches to mental activity; and we all hope that

new and better methods will be invented all the time. In particular, ecologically valid fMRI would be brilliant—measurements taken when people are vibrant in ecologically valid activity, rather than still, silent, alone, supine in a claustrophobic tube, following a white-room experimental protocol, often restrained by soft pads and biting a bar to eliminate motion—but it isn't easy to be optimistic that new kinds of brain imaging will give us insight into the neuronal substrate of blending any time in the next few decades.

*Plus ça change, plus c'est la même chose*: When I was studying neurobiology as an undergraduate, back in the early 1970s, the attitude seemed to be that if we learned enough about the plumbing, somehow a theory of thought would precipitate. So we studied ion pumps, myelination, thresholds, and axonal spikes, not to mention neuroanatomy, but never anything like invention, consciousness, the conception of personal identity, the understanding of other minds, or even language. Of course, theory of thought did not easily precipitate from this nuts-and-bolts research, and the vanguard of cognitive neuroscience turned to theorists of mind to learn what neuroscientists should be looking for in all those nuts and bolts. So far, the contributions have been mostly asymmetric, from theory of mental activity (like language) to neuroscience. What would be most welcome would be an avenue along which neuroscience could contribute to the development of blending theory and to specifying the neurobiological evolution that made it possible. Rohrer writes, "So it might be true that human beings have evolved to be unique in the capacity for double-scope conceptual integration, but if so I want to know how and why primate, dolphin, and other mammalian brains and social structures are not capable of supporting and fostering such integrations, and I want to have a clear story from comparative neurophysiology about how the tree of life yields first something like image schemas, then something like single-scope blends, then full scale double-scope blends." That would be great, if it exists. But this call reminds me of a passage from *Henry IV, Part One*:

**Glendower:** I can call spirits from the vasty deep.

**Hotspur:** Why, so can I, or so can any man;
But will they come when you do call for them?

Not having the necessary neuroscience, the effective monitoring techniques, or a time machine, it's not clear yet how we could call such vasty spirits from the

evolutionary depths, or even, if we could, what that knowledge would tell us about the *operation* of conceptual blending.

*Explanation and prediction* (**Cánovas**, **Rohrer**, **Brandt, Tobin**). The literature in philosophy of science on the nature of explanation and prediction is vast. It is impossible here to say more than a few words. (But see Fauconnier, Gilles, "Methods and Generalizations, in T. Janssen and G. Redeker, editors, *Cognitive Linguistics: Foundations, Scope and Methodology*. The Hague: Mouton De Gruyter, 1999, pages 95-127.) The central method of scientific explanation is generalization over data: theory—in the form of efficient generalizations—is put forward and is then tested for its broad application to data that were not part of the set used to conceive of the theory. Newton's laws of motion, for example, fit this characterization of theory, explanation, and prediction. Conceptual integration theory also fits this characterization. For example, in "Rethinking Metaphor," Fauconnier and I make assertions derived from blending theory, that for the relevant (very large) communities, there is an extensive conceptual integration network for understanding time, and that it contains certain smaller conceptual integration networks organized by certain vital relations, projections, and compressions following the lines of the principles of blending that our theory lays out. We assert that our set of generalizations applies very broadly, efficiently, and usefully to the data. We assert that this theory captures great ranges of conceptions, expressions, and actions by human beings, and that it is a basis for understanding each other, and that human beings will continue to use it in the future very widely for conceptions, expressions, actions, and understandings. We also show that for large categories of these conceptions and expressions, rival theories that do not include blending (e.g., basic metaphor theory for TIME IS SPACE) *fail to capture the kinds of data that we have captured*. Our theory offers scientific generalizations that are broader and more integrated and that make better predictions over the data. Our theory is better, where better and worse are to be judged according to the standard expectations of application to data. I offered an analogous demonstration in the chapter on "Analogy" in *Cognitive Dimensions of Social Science,* in which I asserted that for analogy theories that do not include blending, even the examples adduced as the best support for the theories will fail to capture central inferences, and I showed, I believe, that this is true, by taking seriatim any major chestnut examples I could find that analogy theorists had used to support their theories, and showing their inadequacies.

This is how science works. Of course, blending is not algorithmic or deterministic. Given that theory must preserve phenomena, a theory that proposes to make algorithmic or deterministic predictions of blending should be shunned. In the time since Fauconnier and I published *The Way We Think,* many of the types of conceptual integration networks we put forward—and indeed many of the specific blends—have shown up repeatedly in data that did not even exist at the time. Scientific theory of this sort generalizes but is not reductive in the sense of eliminating one level of phenomena by redescribing it in another—Newton's laws of motion, for example, do not attempt to reduce motion to some underlying substrate that is not motion. In cognitive science, there are explicit attempts at reduction, such as eliminative materialism. The debate over the wisdom or meaning of such reduction is extensive. Just for starters, although we are all keenly interested in the neurobiological substrate of cognition, it is not clear that finding such substrates constitutes either reduction or explanation. We know, for example, a great deal about the electrochemistry of neurons, but that does not mean that we understand the role of the neuron in thought. It would a splendid advance in scientific knowledge to discover neurophysiology widely underlying blending—indeed, perhaps science has already discovered much of it, but doesn't understand how that neurophysiology makes blending possible—but it is not clear that this wonderful new knowledge would at present give us insight into the nuanced operations of blending. Maybe, maybe not.

*The Human Condition* (**Pavel**, **Freeman**). Blending theory is not triumphal. It's easy when reviewing art, poetry, complex numbers, and institutions for decision-making, law, and politics to wax rhapsodic. But human beings seem to suffer greatly from the mental arrays they can construct. They also feel responsibilities, frustrations, and ambitions that are possible only because of the scope of human thought. "Who has twisted us like this?" asks Rilke. "Wer hat uns also umgedreht?"

> . . . the shrewd animals
> notice that we're not very much at home
> in the world we've expounded.
> und die findigen Tiere merken es schon,
> daß wir nich sehr verläßlich zu Haus sind
> in der gedeuteten Welt.

No person, thing, idiosyncratic culture, or local event has twisted us like this, but rather our common phylogenetic development for a mental capacity that brings unprecedented power but no guarantee of pleasure—double-scope blending. Even as it brings the capacity for a sense of responsibility and purpose, guilt and redemption, meaning and value, it also brings a capacity for deliberating over what to do, what to be, how to behave. **Pavel** emphasizes that we want human life to be not only feasible, but also worth living. ". . . our bio-psychological endowment generates a specifically human ability to live not just according to needs but also to norms and ideals. This ability allows us to decide what kind of leadership we want, discriminate between the various ideals we can pursue, and adhere to the norms that govern our actions. I am convinced that Turner's notion of double-scope blending deserves to be expanded and adapted to a more vivid sense of human nature. It would help explain how we, human beings, are capable to make the difference between right and wrong, justice and oppression, worthy and unworthy goals." **Freeman** equally emphasizes the way in which double-scope blending makes possible systems like the arts, which are "crucial and necessary for all human beings to fully realize the possible scope of human cognition within our own individual consciousnesses." The human condition is not simple: evolution did not so much make us human as provide us with the mental abilities we need to make ourselves human, an on-going and dynamic process, with hope and uncertainty stretching over the vast scope of human thought.