The Neural Mind: How Brains Think
HYPERLINK "https://www.amazon.com/George-Lakoff/e/B000APCCII/ref=dp_byline_cont_ebooks_1"George Lakoff Srini Narayanan

Excerpts and notes by Stanley Applebaum

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We don't passively see what comes to our eyes, feel what touches our skin, or hear what is presented to our ears. Our neural circuitry takes what is presented to our sensory organs and creates what we see, feel, and hear, mostly unconsciously and not directly or in any simple or straightforward way. In short, much of perception is created, although we are not consciously aware of the creation.

You can communicate ideas, but ideas don't move through the air. There are no physical entities called "memes" that float like viruses from person to person and country to country. When you "give" someone an idea, you still have it. Ideas are created by our bodies and brains and are constituted by our neural circuitry. Because we have no conscious access to our neural circuitry, most ideas are unconscious, with estimates ranging up to 98 percent of thought being unconscious and only about 2 percent of thought being conscious. Estimates differ, but in our experience this seems a reasonable ballpark estimate.

This book asks how ideas can be constituted by neural circuitry. In other words, how can we get ideas out of neurons, which are physical cells, living biological entities that function via electrochemistry? How can physical entities such as neurons create nonphysical ideas? And what is the role of the brain in communication? That is, how can the brain of one person reproduce the ideas in the brain of another person? These questions pose the central challenge of this book. Addressing such a challenge will require us to examine and integrate converging evidence from many of the cognitive and brain sciences.

Animals communicate without language, at least without what we call language. The "things" that appear in our minds arise from the neuronal networks in our brain. They don't emerge from a "soul".

Pre-language humans had ideas but post-language humans have more.

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The Creation of Perception: Color In the Marx Brothers' movie Duck Soup, Chico Marx, imitating Groucho's outrageousness, says, "Who ya gonna believe, me or your own eyes?" It is usually assumed that what you see is what there is, that seeing is believing. But the science of the neural mind tells us otherwise, that much of what we see, hear, and feel is not out there in the external world but instead is created by the body and brain, even the most elementary properties of physical objects. The neuroscience evidence is clear: in many cases, your lying eyes are what you believe.

Some people want to believe we are "special" but we are animals just as all the other creature on our planet.

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Model = NetModel [{"GPT Transformer Trained on Web Text Data", "Task" "Language Modeling" }]

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Why Early Childhood Education Is Vitally Important By mid to late childhood, about half of the quadrillion connections that we are born with die off, the ones that are least used. That still leaves hundreds of trillions of connections available to form future circuits through use. Many of those early childhood connections have formed fixed circuits that will be there for life. That is why early childhood education is so important. Debates on the)politics of early childhood education usually miss this crucial fact about the die-off of neural connections in mid to late childhood. The politics of early childhood education is rarely informed by neuroscience, though the neuroscience is crucial to the politics. All of the circuitry that characterizes fixed concepts is acquired in this way. But we do not start with a blank slate. We exit the womb with embodied circuitry, which imposes a considerable amount of neural pathway structure on both possible thoughts and possible linguistic forms. We all also start life in the same world with basically the same kinds of bodies, with neural circuitry not just in the brain but also throughout the body and connected to the brain. Human beings share a great deal of common neural structure and common real-world experience (in a gravitational field, moving our bodies, perceiving, eating, and so on). Part of what we share is a mechanism for forming circuitry: neural recruitment via neural natural selection that operates via the strengthening and weakening of synapses.

In early childhood our body kills off almost half of the neuronal connections we inherit at birth and begin creating new neuronal connections on throughout our lifetime. I wonder if the emergence of language caused the elimination of so many neuronal connections in early childhood.

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In short, we don't just understand what we are conscious of. Understanding is always complex. There is circuitry linking and integrating various modalities: for example, vision, motor control, and touch. We regularly use such multiply connected brain regions. These are brought together by integration circuitry that allows them to function as integrated wholes. Our normal understanding of the world is thus unconscious, fragmented, and distributed across various brain regions, while conscious thought is unified and arises via the integration of unconscious fragments across multiply connected brain regions.

When we hear words spoken or read words on a page neurons in various brain regions are stimulated resulting in a recognition of the conceptual content expressed.

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The warehouse theory is false. There is no lexical component in the brain, no single location where all words and their meanings are "stored." Words in the brain have connections to different brain areas depending on how word meaning is embodied.

The ability to use language does not arise until the child has developed many sensory motor skills. These skills are controlled by neurological subnets and those are reused in language processing. Language uses neuronal structures that are built up from neurological subnets in the sensor-motor parts of the brain. When we understand something we often say, "I get that" thus reflecting the use of a subnet for grasping an object. The experience of understanding resembles the feeling of grasping something. The linguists have studied these metamorphic combinations that indicate how sensory-motor subsystems in our brains support our language.

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The basic-level cases are normal and natural, because in the brain action-perception and imagination-perception circuits do overlap naturally. The fact that mental imagery and physical experience use the same neural circuitry suggests that the same circuitry is used in conceptualizing experience and, moreover, that active neural circuitry is central to any account of conceptual thought.

Today linguists believe that conceptual thought arises out of neural networks that include subnets that are also used to move our body parts. The current theory is that the same neurons used in moving the body are also used in creating concepts.

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The pattern is learned, and the parts are well known and embodied, making new sound-symbolic words not only easy to learn but also natural. Rhodes and Lawler point to the combination of the phonaestheme dr- "water": "drink," "drown," "drain," "drizzle," "drought," "dry," "drop," "dregs," "dredge," and so on. Dr+ip: a watery short movement to a sudden stop. Another excellent sound-symbolic word! Given that embodied image schemas can structure visual perception, imagination, and motor control, it is not at all surprising that such image schemas could also structure the mouth. The Point Sound symbolism is embodied, cross-modal, and unconscious and uses embodied schemas that occur in visual perception, imagination, and motor control. Sound symbolism is part of the structure of language. As we shall see throughout this book, those are normal properties of conceptual thought and language.

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We began this book with a fact that is not known to the general public, though it is well known in the brain and cognitive sciences. Most thought is unconscious. The ballpark estimate extends to around 98 percent, according to neuroscientist Michael Gazzaniga (as cited in Rock 2005). The neuroscientist Stanislas Dehaene (2014) in Consciousness in the Brain reviews experimental evidence for the overwhelming role of unconscious thought versus conscious thought. Nobel Prize winner Daniel Kahneman (2013) in Thinking, Fast and Slow documents massive experimental data showing how people make decisions unconsciously on the basis of fast, automatic, effortless, unconscious thinking. Kahneman's book, like this book, seeks to make us conscious of the extent and power of unconscious thought so that we can at least notice it and possibly not be misled by it. And Ezequiel Morsella and colleagues (2016) in "Homing in on Consciousness in the Nervous System: An Action-Based Synthesis" argue that "the primary function of consciousness is well-circumscribed, serving the somatic nervous system" (p. 1).

We are often told that there exists a mind body split but in fact the brain is part of the body, there is no split. We are the product of millions of years of evolution. Language has only existed for 100,000 years- a mere moment in terms of our body's history.

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In short, most of what we do is directed unconsciously, with consciousness playing a crucial but limited function. This assessment is very much in line with the results of cognitive linguistics. Most conceptual understanding is unconscious, as is most of the structure and use of meaningful language.

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Human neural circuitry has been inherited from animals via evolution and "repurposed" for thought. Human thought and language use the same basic circuitry types that are used in the perceptual-motor systems of both humans and other animals.

Learning = Neural Recruitment + Synaptic Strengthening We are born with between 85 billion and 100 billion neurons in our brains and with between 1,000 and 10,000 connections for each neuron. That translates into hundreds of trillions of connections, with each connection between neurons actually being realized not as a physical connection but rather a chemical connection established in the chemical flow between neurons. Many of those connections in chemical flow are randomly distributed throughout the neural system, throughout the body and the brain. What we conceptualize as a "circuit" comes into being when that random fluid distribution allows for a meaningful action, such as kicking, turning over, and thumb-sucking in the womb. When those occur and are repeated, synaptic strengthening occurs, and circuits form through use. When this happens, we say that a useful random circuit has been recruited to perform a meaningful action, and that repeated use results in synaptic strengthening, which occurs via chemical action. If sufficiently repeated, a fixed circuit will be formed. All neural learning works like this, including the learning of systems of thought and language. This is a natural selection mechanism, sometimes referred to as neural Darwinism.

Lakoff is describing the learning process at the neuron level. There is no role for the " soul" in this version of the human being.

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What is remarkable is that the same neural circuitry used to run our bodies physically can also structure our reasoning processes about all events and actions, not just physical ones but abstract actions and events as well. Moreover, these structures are represented as types of aspect in the grammars of languages throughout the world. This neural computational model of hierarchical motor control appears to characterize motor control for animals as well as human beings. In order to characterize motor concepts, inferences, aspect, purpose and causation, we hypothesize that the neural circuitry for motor control in humans has been exapted, that is, repurposed over the course of evolution from the circuitry used for purposeful movement by animals and actions, not just physical ones but abstract actions and events as well. Moreover, these structures are represented as types of aspect in the grammars of languages throughout the world.

Moreover, results by Martha Farah (1989) and a subsequent study by Graybiel and Smith (2014), show that the same circuitry is used for both acting and imagining acting. We conclude that the same circuit types—X-Nets—are used for both actual physically carried-out motor control and a conceptual understanding of actions and events. That is, imagining moving uses neural circuits involved in actually moving.

In short, if our hypothesis holds up, X-Nets play a major role in thought, especially about ideas of events, events with consequences and purposeful actions. First, X-Nets structure and carry out mental inferences for all action and event concepts, both physical and abstract. Second, X-Nets are used in simulations to carry out the action of reasoning itself! This is important. ***Reasoning is an action, an action that has the same general conceptual structure as other actions.*** **Physical action requires movement. Thinking is a kind of mental movement, understood via the metaphor "thinking as moving"; thinking, like movement, is done sequentially in time.** Examples of the common conceptual metaphor of thinking as moving include "I'm stuck," "You've gone off on a tangent," "I'm not getting anywhere on this problem," and so on. It would not be surprising if the neural circuitry for guiding physical movement were to be used as well for the action of thinking.

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support our views on exaptation: via evolution, neural circuitry for motor control in animals has been repurposed for use in conceptual thought by human beings.

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Saying or hearing a word evokes the corresponding frame, which, in the brain, involves activating the frame circuit that neurally constitutes that frame. Just hearing and understanding a word has the consequence that its neural frame circuit will be activated and therefore strengthened. Negating a frame cannot happen without activating that frame. George Lakoff's (2004) book title Don't Think of an Elephant! makes this point clearly: the title makes you think of an elephant. When Richard Nixon during the Watergate investigation said "I am not a crook," he led people to think of him as a crook by negating and thus activating the crook frame.

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People were functioning in what he called "frames": the collection of roles, defined as in a play by clothes, postures, relationships, language, and actions. Goffman saw frames as lived by people in institutions and cultures. They could be described by conceptual structures, but those conceptual structures were understood as implicit guides for living. Croupiers in a casino and nurses in a hospital were seen by Goffman as living out different frames.
…………………………………………..differences such as "accuse" versus "blame"; and differences in deixis such as "go" versus "come." To account for these semantic relationships, Fillmore postulated "frames"—wholes containing parts called "semantic roles," where the roles were defined by certain properties (e.g., person, animal, object), relations were characterized(by other frames, and "scenarios" included actions and events among the roles in a scenario frame.

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All of these are primary embodied schemas and are part of what you know about transfers, mutual transfers, and exchanges. In understanding "Harry bought a book for ten dollars", all of this is unconsciously, implicitly understood, so quickly and effortlessly that it all goes unnoticed. That is how the commercial event frame is given meaning. It is linked to some of the most basic forms of embodied cognition: forced movement and change of possession. The two transfers are each further structured by an X-Net with a purpose schema, whose roles are means, cost (as resource used), and benefit (as purpose achieved). For the buyer, the benefit is the goods, the cost is the money,
and the means is the buying transaction. For the seller, the benefit is the money, the cost is the goods, and the means is the selling transaction. The general-purpose schema is deeply embodied and is used a great many times every day.

Modern linguistic theory assumes that a neural network is embodied in the brain to facilitate the commercial transfer of property. This network is established during the learning process that the human being experiences in the modern world. When we read FW we find that our expected structures such as described in this excerpt are disrupted and we are forced to compensate and create. Some people rebel and refuse to engage others accept the challenge and proceed ahead.

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And then there are commercial transactions based on metaphors. For example, in economic theory, employment is the sale of one's labor to an employer within a "labor market," the employee is the seller, the employer is the buyer, and the employee's labor is the goods. In a loan, the money loaned is the goods, and the interest is the money paid for the goods. All such conceptual complexities provide challenges for any account of neural circuitry for composite frames. Composite frames are formed by bindings that identify roles across frames, integrations that bring together multiple bindings or perform multiple activations and inhibitions, and cascades that extend across brain regions controlling complex composites of activations, inhibitions, bindings, and integrations, as we will see.

Can we analyze a passage in FW in terms of frames and roles?

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For Aristotle, it was therefore vital to understand similarity, since he understood similarity between entities as the sharing of essences. Understanding similarity, he believed, allowed you to understand

From the perspective of frame semantics, many people have a commonplace essence frame, with roles pretty much as Aristotle described them: substance, form, process of change, and natural behavior following from the essence. The essence frame is a conceptual frame that has practical utility in many cases, both for natural entities such as trees and in building artifacts to fit a given frame. Aristotle mistook the frame for the world. And it led him to take a commonplace metaphor literally, the metaphor that "understanding is grasping," as in "He grasped the idea" and "That idea went over my head" (couldn't be "grasped"). Aristotle believed that we can have knowledge of the world because the mind can reach out and grasp the essences of the world. This, he believed, would allow us to understand natural causation and thereby get control of nature. The mind, he thought, was simply a mirror of nature. That is, he believed that we think in terms of categories defined by necessary and sufficient conditions in the external world. For Aristotle, it was therefore vital to understand similarity, since he understood similarity between entities as the sharing of essences. Understanding similarity, he believed, allowed you to understand essences and their relation to one another. Words, for Aristotle, were therefore defined in terms of essences in the world: lists of properties defined by necessary and sufficient conditions on the world. Metaphor, for Aristotle, could only reside in words. There could be no metaphorical thought, since be believed that thought was carried out in terms of essences of things in the external world as "grasped" by the mind. Metaphor was for Aristotle a matter of language, not thought. Moreover, he saw metaphor as residing not in the ordinary language of reason but rather in myth, poetry, and political rhetoric. He believed that when metaphor had meaning, it had to be literal meaning. His theory was that metaphorical language worked by similarity, that is, the sharing of properties between essences of things in the world. He saw linguistic metaphor, according to his theory, as a great thing, since one could gain knowledge of the essences of things in the world through similarity, that is, the partial identity of the properties of things in the world.

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Reddy was looking at cases such as "You're not getting through to him" and "That poem is densely packed with meaning". Both examples make use of a single conceptual metaphor for communication in which the language is about the transfer of objects in packages, while the subject matter is communication. Lakoff was looking at cases such as "The marriage is on the rocks" and "We're spinning our wheels in this relationship", where the language is about the difficulty of travel to a destination, while the subject matter is difficulty in long-term love relationships. Moreover, in both the Reddy and Lakoff cases, frame semantics characterizes both the subject matter (communication, love with difficulties) and the literal meaning of the words (transfer of objects in packages, difficult journeys). In both cases, the form of reasoning (the "logic") used in the domain of literal word meaning (object transfer, transfer, difficult journeys) was being applied to the subject-matter domains (communication, love). In short, people are reasoning about subject-matter domains in terms of generalizations over literal word-meaning domains (object transfer, difficulties in reaching a common destination) and using that reasoning via metaphorical thought.

Metaphors that express sensory feelings for rational concepts: communication and love with difficulties. "We are not getting through to him" - "this marriage is on the rocks" . This reflects the embodiment of thinking - sensory-motor subnet in the neural network that "reads" a sentence.

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Both Reddy and Lakoff looked at a wide range of examples and independently concluded that people are thinking metaphorically about important subject matters, that is, reasoning about communication as if it were object transfer and about love difficulties as travel difficulties. And people are not aware that they are thinking metaphorically!…………
…………One of the most important developments in conceptual metaphor theory is what is called a primary metaphor, a conceptual mapping from one primary embodied schema to another primary embodied schema. The primary metaphors are the main linkages across and among the embodied schemas. These primary metaphors are what ground the entire metaphor system.
..

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Michael Reddy had found that the abstract concepts of communication and ideas are understood via a conceptual metaphor that he dubbed the conduit metaphor: • Ideas are objects. • Language is a container for idea objects. • Communication is sending idea objects in language containers. • The means of communication includes a "conduit." The "conduit" can be a telephone hard line, an internet transmission, a literary text, or the space between two people or between a speaker or writer and an audience. The above notation, having the form "A is B" or "Target Element (Object) Is Corresponding Source Element (Idea)," characterizes a conceptual mapping from a source domain frame for sending objects in containers to a target domain frame for communicating ideas via language (Lakoff and Johnson 1980). Reddy (1979) found over 100 classes of linguistic expressions for the conduit metaphor. Examples include, among others, the following: •" You finally got through to him". • "The meaning is right there in the words". • "Put your thoughts into clear language." • "Your words are hollow." • "The ideas are buried in dense paragraphs." • "You haven't given me any idea of what you mean." • "Put those ideas down on paper." • "Those ideas have been floating around for ages." • "When you have a good idea, try to capture it immediately in words." • "Emily Dickinson crams an incredible amount of meaning into her poems." • "The introduction has a great deal of thought content." Reddy's point was that the generalization covering such linguistic metaphors was not in language but rather in the metaphorical concept of communication as putting ideas into words and sending idea objects in language containers.

** FW does not give us a familiar foundation upon which we can erect a familiar frame to understand a sentence We have to use unfamiliar skills for interpretation*

- *Metaphors express sensory feelings for rational concepts: <u>communication</u> and <u>love with difficulties:</u> "We are not getting through to him" - "this marriage is on the rocks". This reflects the embodiment of thinking, sensory-Motor subnets in the neural network*.

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A crucial idea in the science of metaphor is that a domain of thought can be characterized by a conceptual metaphor system. This idea was first worked out by Eve Sweetser and Alan Schwartz,11 who observed that there is a domain of mind (a metaphorical target) that is understood via a general metaphor that is in turn split into four subcases, each associated with a separate source domain. The general metaphor is the following conceptual mapping: • The mind is a body. • Mental functioning is bodily functioning. • Ideas are objects of bodily functioning. The four special cases of conceptual metaphors are as follows:

1. Thinking is moving, ideas are locations, communicating is leading, and understanding is following.
2. Understanding is seeing, ideas are things seen, and communicating is showing.
3. Thinking is object manipulation, ideas are objects, communication is sending, and understanding is grasping.
4. Thinking is eating, ideas are food, communication is feeding, and understanding is digesting.

Their point is that Reddy's conduit metaphor for communication is a special case of one of four conceptual metaphors that are in turn special cases of one general metaphor for thinking. The main insight is that conceptual metaphors occur in systems. There are many linguistic examples of each of the above conceptual metaphors, such as the following:

- Moving: reach a conclusion; go off on a tangent; do you follow me; go step-by-step.
- Seeing: see what I mean; point of view; shed light on; clear; brilliant.
- Manipulating: turn it over in your mind; toss ideas around; I gave him that idea.
- Eating: food for thought; raw facts; half-baked ideas; digest; he won't swallow that; it smells fishy.

The excerpts above illustrate the wide application of metaphors that make it possible for neuronal networks that comprise the sensory-motor needs of the body to be used in the conceptual and reasoning activities of the brain. The same sensory- motor subnet of neurons are involved but are connected as a subnet in a different overall conceptual network. Researchers have found that neural networks contain gates that allow signals to be blocked or switched down different pathways so that an overall system is established to support conceptual constructs. In this way sensory-motor subnets can support imaginative concepts.

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Domains seem to be characterized by hierarchically structured frames. A frame is a complex schema, a mental structure that organizes knowledge. Each frame makes use of primitive embodied schemas and may make use of prior conceptual metaphors. The elements of a frame are called “semantic roles.” For example, the semantic roles of the seeing frame are the viewpoint, the viewer, eyes, light, the directing of the eyes, the act of seeing, things seen, the gaze (the line from the eyes to the thing seen), and degree of clarity. There is also knowledge about seeing: *You need enough light to see, light has a source, the gaze must extend from the eyes to the thing seen in order to see, things look different from different viewpoints*, and so on. The concept of a gaze is itself metaphorical, based on the metaphor of seeing is touching. The gaze is like an outstretched limb. The eyes can in many cases stand metonymically for the metaphorical outstretched limbs. Examples include *Their eyes met. My eyes picked out every detail of the pattern. I ran my eyes over the wall. She undressed me with her eyes. From Berkeley I can see all the way to San Francisco. On a clear day, my gaze stretches to Mount Diablo*. A crucial thing we learn from this is that important abstract concepts are understood not merely via one conceptual metaphor but instead via multiple conceptual metaphors that provide different understandings of the concepts. For example, communication is not just sending but it is also leading (when thinking is moving), showing (when understanding is seeing clearly), and feeding (when thinking is eating). Ideas, metaphorically, can be not only manipulable objects but also locations and food. Other metaphors for the mind include the following:

- Thinking is addition: *That just doesn’t add up. Let me sum it up for you. I just put two and two together. That doesn’t count!*
- • *Thought is language: Do I have to spell it out for you? It’s Greek to me. Liberals and conservatives don’t speak the same language. The argument is abbreviated. He’s computer literate*.
- • *The mind is a machine: The wheels are turning now! I’m a little rusty. He had a mental breakdown.*

Lakoff and Johnson (1980, 1999) have shown that important concepts such as events, actions, causation, the mind, the self, morality, and being are each defined via multiple conceptual metaphors, sometimes between a dozen and two dozen. Each metaphor supplies a distinct way to understand the concept, which includes an inference pattern for reasoning.

Yes we possess many spiritual and abstract concepts BUT buried in all of them are metaphors linking the concept to sensory-motor actions. We "see" reality through our bodies. Materialism is at the root of spiritualism.

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The primary metaphor theory explains the existence of the most prized of human conceptual thought: imaginative thought, the mode of thought that lies behind philosophical theories, moral theories, poetry, cultural practices, religion, and even higher mathematics and science. The theory explains why imaginative metaphorical thought is a human universal, why it arises naturally in children just from living in the everyday world, and also explains why imaginative metaphorical thought is mostly unconscious and why it could have gone unnoticed for 2,500 years.

p. 61 **of "What is Chat CPU doing"**

In other words, the reason a neural net can be successful in writing an essay is because writing an essay turns out to be a "computationally shallower" problem than we thought. And in a sense this takes us closer to "having a theory" of how we humans manage to do things like writing essays, or in general deal with language.

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The gating nodes allow metaphors to be turned on and off. There are many thousands of cases of complex metaphors that are combinations of primary metaphors. We hypothesize that there are “cascade circuits” that control which metaphors are turned on in particular cases as well as which binding circuits are turned on to link the individual metaphors into a coherent whole. The cascade circuitry linking the metaphors control the activation of both primary metaphors and complex metaphors, thus allowing the cascade to control complex metaphorical inferences.

This hypothesis describes a mechanism that can build complex explanations out of simpler neural networks by linking many subnets into a larger network. The FW experience illustrates what happens when the links are broken and the readers are left to build the links anew on their own without the help of “learned” circuits.

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The statement “Socrates is a man” places Socrates in the inner container, which in turn places him in the mortal category. The logic of containers thus becomes the classical syllogism, given the primary metaphor that categories are containers. In general, the standard principles of formal logic arise biologically from the logic of embodied primary schemas. Primary metaphors provide the elements of the overall inferential structure to our system of concepts. The neural binding of primary metaphors together to form complex metaphors results in complex inference patterns. The main point here is that

Bourbon resists this and his emphatic refusal to publish the image of the Twitter Machine illustrates this.

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In the experiments Shimojo cites, disjoint percepts are changed to already integrated, well-established patterns before they can be seen, felt, or heard consciously. We don’t necessarily see, feel, or hear certain fragmented material that is presented to our senses. In those experimental cases, principles of best fit (that is, least energy) actively change what impinges on our sensory organs to fit prior well-integrated patterns already in the brain

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A circuit has to indicate exactly how the integrated meanings of “over” and “look” fit together for “overlook” and “look over.”

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Children learn to do a lot of thinking before they learn language. All the embodied neural circuitry for controlling the body and for the basics of human thought is present in the brains of children before they learn language. For a young child to function physically and socially in a child's environment, much of the circuitry for thinking and understanding basic experiences must already be present. In short, . These are learned purposeful actions in response to perceived purposeful actions by the parent. Once learned, the action can be carried out via existing neural circuitry. Children learn early to perform actions with hidden purposes, such as refusing to get dressed for bed by starting to play intently and

• There is in the brain a collection of control nodes and gates that govern the activation or inhibition of the fixed circuits for schemas, frames, metaphors, and bindings.

• Integration circuits create wholes by activating or inhibiting combinations of control nodes and gates. In short, integration circuits turn combinations of other fixed circuits on or off as needed to avoid neural contradictions. The result creates entities such as flying horses (Pegasus); gods such as Zeus, who can turn himself into a swan; a walking, talking skeleton dressed in black who comes to your door, knocks, and leads you off to death; and cartoons with talking ducks and wise-cracking rabbits.

The structure of an integration circuit contains nodes and connections that activate or inhibit those control nodes and gates. Learning which of your existing circuits have to be activated or inhibited in a given case is carried out via the recruitment of an integration circuit that does the job. When the integration node is activated, the integration circuit forms an integrated whole. When it is not activated, the fragmented unconscious circuits are free to form other combinations.

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Learning is a process of repeated activation of neurons via circuits. Those repetitions cause the connected synapses to strengthen through the STDP (Hebbian) process.

Spike-timing-dependent plasticity

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Now we have the fundamental meaningful parts. In short, the structure of categories arises from the basic mechanisms of thought.

- Hierarchical network of simple mechanisms. All of conceptual thought arises from a small number of basic conceptual mechanisms that combine to create more complex conceptual mechanisms: primary embodied schemas, frames that use primary embodied concepts, metonymies that use frames, conceptual metaphors that map schemas to schemas and frames to frames, bindings that identify two semantic roles across schemas or frames as being identical, and conceptual inhibiting binding circuits and integration circuits to form complex ideas.

• X-Nets. X-Nets are networks that "execute," that is, perform actions. Motor control is a well-understood example. There are neural networks that control how we move our bodies.

* "X-Net" is a computer science term used in the present book for computational models of neural control systems.
* • Motor control and thought. Motor control and thought involve aspect, causation, and purpose. Hierarchical motor control applies to the physical body. The fact that at the highest level the neural computational structure of motor control characterizes the concept of aspect (the structure of events and actions in general) in all natural languages brings embodiment front and center into conceptual thought. Motor control constitutes a claim that we understand

all events and actions in terms of what our bodies can do using our neural systems. The hierarchical motor control system also characterizes the general structure of cause and effect and of purpose as they apply in the body.

* • Exaptation (“repurposing”). The human motor control system evolved from the motor control systems of animals. The use of this system in basic concepts of conceptual thought and in logic schemas is an example of the repurposing of motor circuitry over the course of evolution for use in thought in human beings.
* • Primary embodied concepts. Primary embodied schemas provide structure to what we see and how we move. They provide the embodied content for primary embodied concepts. Primary embodied schemas have a structure in terms of wholes with related parts called “roles.” They are gestalt structures in that activating one or more parts activates the whole, and activating the whole activates all the parts. Embodied schemas come with logic schemas that carry out inferences.
* • Frames. Frames are very general conceptual structures that allow us to conceptualize types of experience in terms of compositions of embodied schemas. Frames come in hierarchies: there are lower-level subframes that are instances of higher-level frames. At the highest level, frames are embodied by primary schemas that can form composites. Most frames are cultural in nature, characterizing institutions, cultural practices, and so on. Frames have logics, that is, frame-specific inference patterns that derive from the logics of the primary schemas that are combined to form a frame. Roles in frames can be filled by individuals or types or by individuals that fit types. Frames can combine to form more complex frames via bindings, in which roles in one frame are neurally bound to roles in other frames.
* • Frame circuits. Every frame is characterized neurally by a frame circuit. Negating a frame activates that frame. For example, the sentence “Don’t think of an elephant” leads you to think of an elephant. Every time a frame circuit is activated, it is strengthened, and all the frame circuits above it in its hierarchy are also activated and strengthened. Thus, negating a frame activates the frame in people’s brains. Donald Trump is the classic example of someone who exploited this fact. It doesn’t matter to him if he is praised or attacked. In either case, he becomes more prominent in people’s brains. The only way to avoid making him more prominent is not to mention him, to ignore him.
* • Words defined in terms of frames. The great linguist Charles Fillmore (1976) discovered that all words and morphemes are defined in terms of frames and embodied schemas. The use of a word strengthens its frame circuit and all the frame circuits in its hierarchy.

* • Conceptual metaphors as asymmetric frame-to-frame neural mappings. Neural mappings are circuits extending from one brain region (a “source”) to another (a “target”). These mappings are structured so that frame roles in the source brain region map to corresponding frame roles in the target brain region. As a consequence, the inference patterns of the source frames are imposed on the target frames. Metaphors can be neurally bound together to form more complex metaphors.
* • Primary metaphors. From primary embodied metaphors, we learn that just functioning in the everyday world on this planet has profound effects on systems of human thought. Because it is common for pairs of embodied experiences to occur together (such as parental affection and parental warmth), a wide range of primary embodied metaphors are acquired just by normal neural learning processes such as STDP (Spike-timing-dependent plasticity).
* • Primary metaphors as circuits linking embodied circuits. There are hundreds of primary metaphors in the form of circuits crisscrossing the brain from one embodied circuit to another, imposing modes of inference from one brain region onto another brain region
* • Emotion metaphors. From emotion metaphors, we learn that a wide variety of physiological correlates of emotions can give rise to a correspondingly wide variety of embodied metaphors.
* • Sweet talk. The sweet talk experiment shows that even the embodied neural circuitry for taste—the gustatory region—can play an active role in metaphorical thought. As Adele Goldberg showed, “She talked to him sweetly” activates the gustatory cortex even though the sweetness is metaphorical, not literal (Citron and Goldberg 2014).
* • Idioms, images, and knowledge. From idioms based on images, we learn that we have in our memories thousands of cultural images and knowledge about the images and that general conceptual metaphors can apply to that image-based knowledge to provide the meaning of those idioms that have accompanying images. The words in those idioms often name what is in the image, although what is in the image may not be in the meaning of the idiom. A classic example is “spinning your wheels,” which can mean that one is using effort toward achieving a purpose without making any progress in achieving that purpose even though one is not literally talking about wheels. This is based on the conceptual metaphor that action is motion and that achieving a purpose is reaching a physical goal. Cultural images such as spinning one’s wheels can thus play a crucial role in linking language to embodied meaning via conceptual metaphors. The point is that there is no clear separation

between cultural images and linguistic meaning. The meanings of words can make use of cultural images, such as the mental image of a car spinning its wheels.

* • Conceptual integration. Most unconscious thought is fragmented. Conceptual integration forms an integrated whole from unconscious fragmented parts. Conscious thought tends to be integrated, although there is also integrated unconscious thought. In many cases, unconscious thought arises from diverse unintegrated circuits across brain regions. Conceptual integration, operating unconsciously, changes unintegrated unconscious thought to make it integrated and a candidate for consciousness.
* • Categories. Categories are complex and meaningful, since they make use of the full range of conceptual neural mechanisms listed above.

The sequence of basic thought mechanisms presented in this chapter shows how these mechanisms build on one another to produce increasing complexity of thought: from embodied primitives (X-Nets, primary image schemas, and force schemas) to complex combinations of those to frames, metonymies that are based on frames, primary conceptual metaphors (mapping schemas to schemas), complex conceptual metaphors (mapping frames to frames), idioms using cultural images and knowledge to mediate between language and embodied meaning, and conceptual integrations that use all of the above mechanisms as well as to whole systems of thought such as philosophies and branches of mathematics and to imaginative literature, mythology, religion, and politics, human enterprises that let out all the stops and use a wide range of conceptual integrations of more basic ideas to create highly complex thought processes.

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One source of difficulty is that the neural models of how thought might arise are strikingly different from our everyday understanding of thought. When we consider all the neural details required for human thought, it is an amazing feat of human biology that any human being can think at all……………………Recall that the brain contains about 86 billion neurons and between 1,000 and 10,000 connections per neuron. That’s hundreds of trillions of neural firings. A neural firing occurs in about five thousandths of a second (5 milliseconds). That's 200 times a second.

P. 82 **<u>of "What is Chat CPU doing"</u>**

But in the end, the remarkable thing is that all these operations—individually as simple as they are—can somehow together manage to do such a good "human-like" job of generating text. It has to be emphasized again that (at least so far as we know) there's no "ultimate theoretical reason" why anything like this should work. And in fact, as we'll discuss, I think we have to view this as a—potentially surprising—scientific discovery: that somehow in a neural net like ChatGPT's it's possible to capture the essence of what human brains manage to do in generating language.

The foregoing is a linguist's view of brain activity. I imagine these schemas, frames, metaphors, etc. as similar to electrical circuits which I built as a young engineer but more complex and not entirely electrical but electro-chemical. Energy carried not in metal wires but in tiny tubes as sodium ions. An important observation: repeated (STDP) use "strengthens" the subnet. Many circuits we create break down because they are not "learned" - repeatedly reused.

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Summary The sequence of electrical and biochemical events responsible for the transmission of information within a cell (neuron) and between cells through synapses is critical to understanding how the brain/mind works. The bridging models we will be presenting in this chapter are even further simplified than the basic account here. We model the action potential as a single spike generated at a certain time instant and at a specific rate (number of spikes per second). We do not computationally model the dynamics of neurotransmitter release or the biochemical reactions both at the synapse; in addition, cross-membrane ion transport within the cell is not computationally modeled. We conjecture that these simplifications preserve the critical aspects of neural firing that are relevant to the system-level questions regarding thought and language. But the selection of the appropriate is that this book will provide a starting point for more detailed investigations with more faithful and granular models of information propagation and learning.

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The approach taken is to construct computational simulations of the cognitive functions needed for thought and language using simplified models of neural circuits. We believe that the fSNC model we are using makes valid, relevant, useful, and sufficient scientific contributions to the three sciences it links: neuroscience, cognitive linguistics, and experimental embodied cognition.

We do not have the technology today that would allow us to trace the "wiring" between the neurons in the brain. We cannot provide a schematic diagram of the neural circuits. Instead Lakoff and other researchers have built computer models that mimic the human brain's actual wiring. It's as far as they can go with today's technology.

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Ideas, we argue, arise ultimately from neural exaptations—that is, from the repurposing of neural circuitry originally used by animals in the course of evolution or the repurposing of neural circuitry that evolved in humans for needs other than ideas; circuitry for perception, action, emotion, attention, and so on.

The form of language in both grammar and lexicon, we argue, also arises via such repurposing while maintaining connections to still other parts of the sensorimotor and emotional system, those for sound, prosody, rhythm, gesture, and shapes (for letters in writing). Such repurposing results in specialized language circuitry in the brain using the same basic types useful for other social, motor, perceptual and cognitive behavior. Those kinds of repurposing are part of the embodied circuitry in the brain. The big question is, of course, how this happens. Given our embodied circuitry, how have our brains formed, first, the complexities of ideas (including abstract ideas, reasoning, simulation, and imagination) and, second, all the complexities of linguistic form (e.g., words, morphemes, and grammatical constructions) as well as the complex relationships between ideas and the linguistic forms that express those ideas? Given the embodiment structures of the kind discussed in chapter 1, we have identified a number of circuit types that seem to us to be important in characterizing such complexities. We are hypothesizing that those circuit types can be accurately modeled by functional structured connectionist models that capture the necessary generalizations. The types of circuits that we are proposing are all **learnable by normal neural learning mechanisms, electrochemical processes that modulate and change synaptic strengths of neural connections, that is, purely neural mechanisms that are not specific to any subject matter.** In addition, many of the circuits we propose are "functional" in that they have counterparts in mammalian sensorimotor systems as identified through single-cell recordings. Our account, by necessity, uses the structured connectionist framework introduced earlier as a minimal computational abstraction from the details of these studies and recordings. **Our specific hypothesis is that there are integration circuits that have formed complex compositions of the basic circuit types discussed below and that they have a resulted in structures useful for language and thought.** This section is devoted to an understanding of those basic circuit types. How these circuits are integrated to form more complex circuits will be discussed in later sections……………………..in brains, much of neural activity comes from highly specific circuits and structures that are both

- a product of genetic coding, and
- tuned by an activation-dependent process of strengthening and weakening.

"Structured" neural computational models of the sort used in our approach are meant to model this dual fact of **preexisting structure due to genomics plus activity-dependent tuning due to experience.**

A person learning a language works to "understand" the verbal message. When the sound message is successfully decoded a neural network exists. By repeating that recognition of the verbal message and reusing that network the person " learns" that part of the language. Repeating the stimulation of the network lowers the trigger *threshold and thereby "strengthens" the circuit. The learning process worked.*

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Our specific hypothesis is that there are integration circuits that have formed complex compositions of the basic circuits types discussed below and that they have resulted in structures useful for language and thought.

P. 111 **<u>of "What is Chat CPU doing"</u>**

The specific engineering of ChatGPT has made it quite compelling. But ultimately (at least until it can use outside tools) ChatGPT is "merely" pulling out some "coherent thread of text" from the "statistics of conventional wisdom" that it's accumulated. But it's amazing how human-like the results are. And as I've discussed, this suggests something that's at least scientifically very important: that human language (and the patterns of thinking behind it) are somehow simpler and more "law like" in their structure than we thought. ChatGPT has implicitly discovered it. But we can potentially explicitly expose it, with semantic grammar, computational language, etc.

P. 5 of **<u>Why Machines Learn</u>**

As I did the research for this book, I observed a pattern to my learning that reminded me of the way modern artificial neural networks learn: With each pass the algorithm makes through data, it learns more about the patterns that exist in that data. One pass may not be enough; nor ten; nor a hundred. Sometimes, neural networks learn over tens of thousands of iterations through the data. This is indeed the way I worked the subject in order to write about it. Each pass through some corner of this vast base of knowledge caused some neurons in my brain to make connections, literally and metaphorically. Things that didn't

make sense the first or second time around eventually did upon later passes………………...
Once an idea is exposed, our brains might see patterns and make connections when encountering that idea elsewhere, making more sense of it than would have been possible at first blush. I hope your neurons enjoy this process as much as mine did.

P.7 of **Why Machines Learn**

Newly hatched ducklings must have the ability to make out or tell apart the properties of things they see moving around them. It turns out that ducklings can imprint not just on the first living creature they see moving, but on inanimate things as well. Mallard ducklings, for example, can imprint on a pair of moving objects that are similar in shape or color. Specifically, they imprint on the relational concept embodied by the objects. So, if upon birth the ducklings see two moving red objects, they will later follow two objects of the same color (even if those latter objects are blue, not red), but not two objects of different colors. In this case, the ducklings imprint on the idea of similarity. They also show the ability to discern dissimilarity. If the first moving objects the ducklings see are, for example, a cube and a rectangular prism, they will recognize that the objects have different shapes and will later follow two objects that are different in shape (a pyramid and a cone, for example), but they will ignore two objects that have the same shape. Ponder this for a moment. Newborn ducklings, with the briefest of exposure to sensory stimuli, detect patterns in what they see, form abstract notions of similarity/dissimilarity, and then will recognize those abstractions in stimuli they see later and act upon them. Artificial intelligence researchers would offer an arm and a leg to know just how the ducklings pull this off.

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Reward-Modulated Recruitment: A Hypothesis:

We are born with about 86 billion neurons in our brains and between 1,000 and 10,000 connections each. That’s on the order of magnitude of hundreds of trillions of connections. In childhood, the most-used connections are strengthened by use, resulting in the formation of fixed circuits that are formed when they are activated repeatedly because they serve important functions. Half of those connections, the least-used half, die off, leaving behind a brain highly structured by fixed, highly functional connections that are regularly used, together with a huge number (estimated to be in the hundreds of trillions) of connections that are neither fixed nor function regularly.

The human baby is born with existing circuits useful for the animal existence that is its millions of years inheritance. As modern childhood advances and some of these animal behaviors are not exercised these circuits are weakened through disuse. Eventually half of the circuits humans are born with die by the age of five. New circuits replace them while language is "learned". Neural subsystems have been "exapted" (repurposed from animal behavior) to support language.

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And we hypothesize that existing fixed circuits are formed via what might be called neural Darwinism, a kind of natural selection: the "available" simple networks become fixed when they happen to be used and rewarded—that is, strengthened via use—over and over in everyday experience, strengthened enough for their synapses to become permanent.

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In digesting the amazing results on behavior from neuroscience and the biology of motor control, we arrive at a central hypothesis regarding the neural underpinnings of thought and language. Our results on embodiment suggest that the neural circuits for behavior have been repurposed from animals during human evolution to provide the cognitive operations human beings use in thought and language. At the end of the next section, we will discuss this hypothesis and thus be ready to move on to our computational models of circuits for behavior coordination that are composed of these basic circuits and that serve as the building blocks for quite complex cognitive structures and operations that occur naturally and often.

P. 202

Stimulation in different regions of the cortical map evoked different movements that closely resembled common categories of actions from the monkey's normal repertoire. For example, when sites within one region of the map were stimulated, a hand-to-mouth movement was evoked. The movement included a closure of the hand into an apparent grip, a turning of the wrist and forearm to direct the hand toward the mouth, a rotation of the elbow and shoulder bringing the hand through space to the mouth, an opening of the mouth, and a turning of the head to align the front of the mouth to the hand. This complex coordinated movement occurred reliably on each stimulation trial and could be replicated even when the monkey was anesthetized. This clearly leads to the notion that the common behaviors learned by the monkey and useful for everyday interaction were "packaged" into performable schemas and could be activated as a whole, integrated functional package.

The theory described in this book may seem weird or implausible but we must respect the integrity of the researchers who have been working this out for several decades. It is a view of FW that satisfies my need to understand the process of language.

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After an action has been packaged and its control circuitry is "moved" from the prefrontal regions to routines in posterior cortical and striatal regions, there is still a cortical control circuit connecting these regions to the ventromedial prefrontal cortex (in the IL system in the rat experiment) that can gate the switching on or off of the package. This IL-specific control node is then available for other cortical modulation for triggering or controlling the complex action and coordinating the learned package with other actions to create more complex packagings.

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Every construction is a chunked mapping between form and meaning. Constructional packages occur at all levels of language, from morphemes to grammatical constructions to narratives. The connection between mechanisms for sensorimotor packaging and cognitive packaging thus applies to all the conceptual and linguistic integrated structures that we describe in this book: constructions, image schemas, frames, metonymies, metaphors, integration, scenarios, and narratives. Summary Behavior control requires coordination of multiple circuits that are bound together into cascades of controlled activation and binding to accomplish complex motor behaviors. Our hypothesis is that these binding, mapping, and coordination circuits have been exapted (repurposed from animal behavior during evolution) for language and thought for human beings. **Meaning for neural circuitry is created by the brain performing actions, both internally triggered actions (as in imaginative simulation) and externally directed actions to achieve goals in the context of current and predicted future situations**.

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More recently, there has been an attempt to solve the dynamic variable binding problem with a mathematically rigorous framework called assembly calculus (Papadimitriou et al. 2020). Assembly calculus models operate on assemblies of neurons, such as project, associate, and merge, which Papadimitriou et al. state "appear to be implicated in cognitive phenomena, and can be shown, analytically as well as through simulations, to be plausibly realizable at the level of neurons and synapses." The architecture and underlying operations have been used to model real-time emergence of syntactic structure in language processing. The approach and the results are a nice generalization of previous approaches. They implement the desirable property of the short-term plasticity and updating mechanism in Hebbian learning and is very compatible with the circuits presented in this book. Whether this is the right approach is to be empirically validated.

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Building Complexity:

One of the most profound properties of such integrative circuits is their ability, when used recursively, to build structured complexity by forming successive layers of embedded circuits. For example, we saw in chapter 2 that image schemas can be bound to other image schemas to form complex image schemas, such as “into”. A motion schema can be bound to the into schema to form a motion such as “He ran into the room”. A force schema can be bound to the integrated motion into schema to provide a complex forced motion + into schema as in “**They pushed him into the room”.** The conceptual metaphor that starting an activity is entering a bounded region can apply to the forced motion + into schema to yield metaphorical cases such as “**They pushed him into running for president”.** Then, the about-to role in an X-Net can be further added to yield “**They are about to push him into running for president”**. Successive applications of basic circuits and integration circuits can build up such complex ideas and combine them into fixed cascade circuits that are integrated unconsciously, automatically, effortlessly, and almost instantly prior to consciousness.

Embodiment and Meaningfulness

When the conceptual content of a sentence is embodied, it becomes meaningful. In a sentence such as “**They are about to push him into running for president”**, the embodiment consists of X-Nets, a force schema, a motion schema, and a container schema as well as the conceptual metaphors whose sources are embodied (indicated in italics): action is motion, an activity is an action sequence, activities are containers for their

X-Nets used for monitoring and control of complex sensori-motor actions	Carry out the monitoring, control, and sequencing of complex thoughts
Gestalt circuits, in which the activation of the whole circuit has a greater effect than the activation of its individual subcircuits	In gestalt schemas and frames, the meaning of the whole is greater than the meanings of its individual parts
Binding Circuit, which makes the bound circuits neurally indistinguishable, thereby linking the circuits and creating an integrated circuit	Creates identity between conceptual elements in different thoughts, thereby linking the thoughts and creating an integrated thought
Activation circuitry, connecting activated neural ensembles and neural circuits	Activates connected ideas
Inhibition circuitry, which turns off neural circuits	Keeps existing ideas from being used at this point in thought
Disinhibition circuitry, which turns off inhibition circuitry, thus allowing activation to occur	Allows unused existing ideas to be used and selectively activates ideas in a cascade
Neural Integration Circuit, a hierarchical circuit that combines multiple cascades through gating and modulation	A conceptual integration network framing that makes otherwise inconsistent ideas into consistent wholes

actions, and causes are forces. Here's how the words in the sentence above work via an integration of all these elements:

• *About to*: The stage just before the start of the X-Net sequence.

• *Push*: A direct cause understood (via the conceptual metaphor "causes are forces") in terms of a pushing force.

• *Running for president*: An activity conceptualized metaphorically as a container. The entry into the container is the declaration of running for president; being inside the container implies running for president.

• *Into*: A neural binding of the meaning of to (motion) and in (containment) to characterize motion beginning outside of and ending inside of a container. Metaphorically, the container is the activity of running for president.

The sentence gets its meaning via the activation, bindings, and integration of all of these embodied circuits, which occur in different and sometimes distant brain regions. Integration circuits not only allow for the building of integrated content but also can combine to form cascades that reach across the brain and integrate the various embodied contents that the meaning of the whole depends on

This description of the building of a conceptual image out of sensory-motor subunits may appear implausible at first glance but I believe it explains our "thinking machine" better than the dictionary compartment model.

P. 214

"The hamburger wants his check". In the restaurant frame, there is a customer, who is the eater, and the product consumed, which is a dish, in this special case a hamburger. There is also a pairing of particular dishes ordered with the customers ordering them. This conceptual pairing occurs within the restaurant frame, allowing the particular dish (the hamburger) to stand metonymically for the customer who ordered it and will therefore get a check, an invoice for payment. All of this is part of the restaurant frame and the metonymic mapping within that frame, and thus “The hamburger wants his check” can be processed unconsciously in a few hundred milliseconds.

This example shows how a metaphor can speed up the process of understanding language. The metaphor is a ready made package that quickly leads to comprehension. Probably the speed can sometimes lead to error. One needs to “think” carefully.

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Active cascades, made of circuits that structure the cascade and direct the activation flow, result in simulations. As others have pointed out, what is called a “memory” is not a “stored” past event that is retrieved from a static store of memories. A “memory” is a partial simulation activated by a neuronal group, which is then “filled in” by existing fixed circuitry that happens to be activated at that time. Which circuits are active can be internally and externally triggered (based on attention, tasks, moods), modulated (based on rewards or intrinsic alertness or arousal), and manipulated (by providing strong contextual cues). Thus, as Elisabeth Loftus (2003) has famously shown, what is experienced as a “memory” may be only partially remembered, with the rest filled in by current understandings, which may have changed significantly since the “remembered” event. Thus, what we understand as the “remembered past” is at best partially remembered, with details filled in by current, unremembered understandings and so on. In cognitive linguistics, such simulations are called mental spaces.

My memory of seeing FDR during the Presidential campaign of 1940 is an example of the "remembered" event. How much of that is "filled in" and how much actual?

P. 235

The language we use and perceive is available to conscious awareness. But what is used to understand that language is overwhelmingly unconscious, and it has to be. **Unconscious understanding uses the massively "parallel" and branching structures of our neural systems, structures that link up language to all the embodied brain circuitry in the many diverse and dispersed regions of the brain used in understanding. Conscious thought is sequential; unconscious thought is parallel and branched.** The flow of conscious awareness may shift with attention, changing direction as it flows. But we are not consciously aware simultaneously of dozens or hundreds of things at every instant. Rather, the unconsciously thinking neural system can be and often is cascading in many branching directions at once. Unconscious neural thought cannot be linearized, so we cannot be consciously aware of most of what we are unconsciously thinking via our neural system.

Although the brain circuits used in simulation are dispersed throughout many physically separated brain regions, simulation is "integrated"; that is, even our unconscious thoughts fit together optimally in coherent "packages" that define "common sense.".

Once you learn an integrated package, it is used automatically, easily, and quickly. But learning such a package is a more complex process. We have fixed coordinated circuitry for tying our shoes. We didn't have it the first time we tried.

The parallel nature of the wired computer architecture of the human brain is not consciously perceived. We are not aware of this unconscious process only its final result when the neurological system produces an output stimulus which we experience as "understanding".

When reading FW we are continuously impeded in reaching that point and are forced to explore alternative branches in our 80 plus billion neuron system.

"Lots of fun at Finnegans Wake".

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The Role of Simulation in Our Mental Life

Pfeiffer and Foster (2013) found a high correlation between which simulated sequences were highly active and the immediate future behavior of the rat. The researchers proposed that the rat is using mental simulation for navigational planning. We conjecture that this basic scheme of forward simulation for planning has been repurposed by human beings to provide imaginative simulation for understanding, as when you hear the beginning of an argument and you can simulate the rest. The repurposed integrated circuit recruits the entire DN* to coordinate this simulation. Indeed, recent evidence suggests that there are functional connections (through a technique called functional connectivity analysis) from the DN to other areas that are responsible for cognitive control and might underlie our **creative abilities**. This research suggests that simulation may underlie creative thought. Thus, the existing evidence suggests that imaginative simulation plays a central role in our mental life. Moreover, the DN may coordinate imaginative simulations via interactions with other circuits in the brain. All this evidence is suggestive, and further experimental investigation will need to test this hypothesis.

**Note: "…..the brain's default network (DN), a set of functionally connected brain regions including ventral medial prefrontal cortex, the posterior cingulate cortex, the inferior parietal lobule, the lateral temporal cortex, the dorsal medial prefrontal cortex, and the hippocampal formation (Buckner et al. 2008)."*

Lakoff is suggesting that simulation of future possibilities underlies our creative thought. The DN is the part of the brain that consumes more energy during the period when other regions are consuming fewer energy resources (i.e. sleeping). Lakoff suggests this as an area for further research. Perhaps this is the location Bourbon is seeking as the ***"Replacement for the Soul"***

The best book-length treatment of experimental research on human simulations that we know of is Benjamin Bergen's (2012) Louder Than Words. We strongly recommend it, just as we strongly recommend Jerome Feldman's (2006) discussion of simulation in From Molecule to Metaphor.

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The Takeaways What we are providing here is a general approach to how brains think. Our approach integrates research over four different fields: neuroscience, cognitive science, linguistics, and computer science. These fields are each developing, so we expect details of our approach to develop as well over time. That is part of the excitement of the endeavor. Indeed, neuroscience is developing so fast that new neuroscience will likely lead to new accounts of the neural mind in a number of respects. Despite ongoing developments, we feel sure that certain aspects of our current approach are deeply correct:

- Thought is physical and is constituted by neural circuitry.
- There is no meaningful thought without embodiment.
- Complex thought is integrated, not just some collection of features.
- There is a big difference between an integrative mapping and a general integrative circuit.
- A simple integrated mapping occurs between two schemas (or frames) and is limited in that way. A general integrated circuit can integrate many different neural structures.
- Thought is not localized in brain regions that happen to "light up" in functional magnetic resonance imaging. Instead thought "adds up" via integration over cascade circuits.
- Neural circuitry used in the sensorimotor system that evolved via animals has been exapted (repurposed) for use in human thought.
- X-Nets, image schemas, force schemas, frames, and conceptual metaphors are real embodied modes of thought, central to all human conceptual systems.
- Bear in mind that there are not many basic circuit types in our neural computational model. We believe that the ones we cite are all there are (or at least come close) to what is needed neurally for thought.
- Fixed thought circuitry is "packaged" integrated circuitry that is constantly used to structure thought.
- Optimization in the neural systems occurs via least energy use for a given purpose, the shortest connections needed, and convergence zones, where

neural circuits converge in a way that optimizes energy use for given needs of the organism.

- A crucial way to understand how brains think is the use of structured neural computation to model both the functional effects of the neural system and the details of thought and language. The bridging computational model uses two scientific metaphors—the neural computation metaphor and the cognitive computation metaphor—to carry out the computational modeling and, by this means, to pair neural circuitry with thought and language.
- Computational modeling is useful and often necessary when researchers are attempting to precisely characterize the neural system and what it does in thought and language. When such researchers are dealing with thought and language, any neural computational system must have the right kind of structure so that it can map onto the structure of thought and language and also onto the neural system.
- The **simulation of experienced reality** is constantly going on in the human brain, and imagining beyond what is experienced goes hand in hand with it. What are called “mental spaces” by cognitive scientists are simulations

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Computer programs written by specialists and used by scientists are necessary to do the computations. A high ratio of oxygenated to deoxygenated blood while carrying out a task might show up on a brain map as red. The color red is in the brain map, not in the brain. The precise blood ratios to be colored red is determined by the neuroscientists. Because of the expertise of the neuroscientists, such maps can reveal much that is significant. From the outset we have distinguished between the map and the territory: between our neural computational bridging theory (the “map”) and the actual use of thought and language by human beings (the “territory”). Our theory is the result of more than four decades of research in four fields: neuroscience, computer science, cognitive science, and linguistics. We have relied on the metaphors of “connections” and “circuits” ubiquitous in neuroscience. Our neurocomputational models of the functional structure of brain “circuitry” are based on generalizations over what is necessary to model the circuitry needed for ideas, which has been studied in cognitive studies in cognitive linguistics and experimental embodied cognition. The circuitry types discussed throughout this chapter—gestalt circuits, conditional circuits, coordinating circuits, mutual inhibition, disinhibition, gates, binding circuits, integration circuits, and cascades—are modeling structures used in our theory of the neural mind. They are the most general modeling structures required by our bridging theory, which contains a single computational dual model, "dual" because it simultaneously models both thought and language on the one hand and the corresponding neural circuitry on the other hand.

In chapter 4 we will be applying our theory of the neural mind to language. We will be asking whether the circuitry types used in modeling ideas and thinking—gestalt circuits, conditional circuits, coordinating circuits, mutual inhibition, disinhibition, gates, bindings, integration circuits, and cascades—can also adequately model language, which is used to express and communicate such ideas. As in the study of ideas, we will consider general neural mechanisms: Hebbian learning, STDP, best fit (understood as a least-energy condition), and so on.
As in normal scientific practice, we will be using a blend of map and territory, that is, a blend of neural modeling and the linguistic phenomena modeled. On one level, this enterprise is descriptive: we ask whether our tool kit of neural circuitry types is sufficient to adequately describe the general circuitry needed for neural models of language. But because the tool kit of circuitry types is derived from research on ideas, not on language, adequate description rises to the level of explanation. A priori, it is conceivable that the repertoire of circuitry types needed for language could be entirely or significantly different from those needed for thinking with ideas, for example, before language is learned. If on the other hand the circuitry types needed for thinking are also adequate for describing language, then we have an explanation: preexisting circuitry types for ideas are all that is needed for a neural account of language. What we need to do now is this an explanatory hypothesis. In this book, we will limit ourselves to English and to a nontrivial collection of English grammatical phenomena.

This picture of brain activity is based on decades of research but not confirmed by detailed circuit maps or schematics such as we have in electrical engineering. The neural structure in the human brain is too microscopic for that. Future research may be capable of providing the *needed measurements. Lakoff claims that his model of neural activity is sufficient as an explanation of language. He states that language does not need any other subsystems than those he has described so far.*

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Since language expresses and communicates ideas, much of the idea circuitry must be present before language is learned. This fact about language learning therefore makes empirical sense of the question we are starting with: Which of the circuit types, together with the neural tool kit discussed in chapter 3, that are present before language are also used in language, and is the circuitry needed for ideas also sufficient for the language used to express those ideas?

Here is the sequence of neural changes needed for thinking: 1) animal circuits inherited from ancestors 2)many animal circuits eliminated from not being used 3) remaining animal circuits used to build language circuits 4) language circuits used for thinking.

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Sound symbolism arises because we use embodied image schemas, which are part of thought, to conceptualize the structure of our mouths as we speak. As a result, certain types of sound combinations can have image schematic meanings. For example, -ip words such as “drip,” “clip,” “slip,” “dip,” and “nip” have, as part of their meanings, a short path to a sudden stop, which is what happens to the airstream in your mouth when you pronounce -ip words. In other words, a central aspect of meaning—image schemas—is used to structure form—phonological form—when applied to our mouths! Sound symbolism uses a meaning-to-mouth correlation, with image schematic meaning fitting the mouth! In sound symbolism, meaning is embodied in a direct manner.

Neural mechanism	Use in thought
X-Nets used for sequence circuitry for bodily motions	In aspects of meanings, events and actions are understood metaphorically as motions
X-Nets used for monitoring and control of complex sensori-motor actions	Carry out the monitoring, control, and sequencing of complex thoughts
Gestalt circuits, in which the activation of the whole circuit has a greater effect than the activation of its individual subcircuits	In gestalt schemas and frames, the meaning of the whole is greater than the meanings of its individual parts
Binding Circuit, which makes the bound circuits neurally indistinguishable, thereby linking the circuits and creating an integrated circuit	Creates identity between conceptual elements in different thoughts, thereby linking the thoughts and creating an integrated thought
Activation circuitry, connecting activated neural ensembles and neural circuits	Activates connected ideas
Inhibition circuitry, which	Keeps existing ideas from being

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Lexical Items In simple cases, each simple lexical item is a construction, a gestalt doublet with a form role and a meaning role. Polysemy, where a single lexical item has multiple related meanings, is very common. Such cases are modeled by a doublet, whose meaning role is a central meaning, that has connections to members of a network of related meanings. Lakoff's (1987b, Case Study 2), covers the preposition "over" and provides a conceptual network with dozens of variations on the central meaning of the word. Examples include

The deer jumped over the fence,

There are over a million cases of covid in the United States,

The gas tank overflowed,

Please move over a little,

Pour chocolate over each cookie,

He lives over the hill from here,

The concert is over,

The soldiers are spread out over the hill,

Do it over, but don't overdo it.

Showing the systematic relationships among the dozens of meanings of "over" was a real intellectual achievement by Claudia Brugman (1981) her master's thesis "The Story of Over."

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A slight complication arises when the derivational morphology takes on a special related meaning. Consider "refrigerator," analyzed as re-frig-er-at-or, as in an active physical object in the form of a container that causes things inside of it to be cold again. That's close. It actually means a machine that either causes things (mainly food) to be cold again or just cool or cold enough to preserve their natural state. The frig- (as in "frigid") means "cold," the -at means "causes," and the -or means an "agent." It should be pointed out that "refrigerator" is not an arbitrary name for an appliance that does what it does. You would not call a tree a refrigerator, nor would you call a chair, a racetrack, or a dog a refrigerator. The meanings of the parts of "refrigerator" play crucial roles in the meaning of the whole, although the process is somewhat complex: a cascade of integrations is needed to put the meanings of the parts together in the right way.

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These relationships pick out the integrated parts of the larger integrated whole: "a large, delicious cup of coffee". The meaning of the sentence is a very complex integrated whole, and yet we understand it instantly. Integrations of this sort are commonplace. They are a normal part of how the neural system creates unconscious understandings that are integrated so quickly and naturally that we don't notice them consciously.

We don’t notice the complex circuits involved in language understanding because the electric currents operate so swiftly.

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The general point here is that all this complexity arises because of the history of English, which has incorporated words of both Germanic and Latinate origin. Because we think with the neural system in our brains, which works by activation and inhibition, that neural system has to incorporate words of both Germanic and Latinate origin, which work by different and mutually exclusive rules. Gating is needed to accomplish this neurally**.**

NYT JAN 16, 2026
By David Brooks
Opinion Columnist

Who are you? What’s going on deep inside yourself? How do you understand your own mind? The ancient sages had big debates about this, and now modern neuroscience is helping us sort it all out.

When my amateur fascination with neuroscience began, roughly two decades ago, the scientists seemed to spend a lot of time trying to figure out where in the brain different functions were happening. That led to a lot of simplistic shorthand in the popular conversation: Emotion is in the amygdala. Motivation is in the nucleus accumbens. Back in those days management consultants could make a good living by giving presentations with slides of brain scans while uttering sentences like: “You can see that the parietal lobe is all lit up. This proves that …”

But over the past several years the field of neuroscience seems to have moved away from this modular approach (each brain region has its own job).

Researchers are more likely to believe that the brain is a network of interconnected regions. They are more likely to talk about vast and dynamic webs of neurons whose connections link disparate parts of the brain.

Luiz Pessoa, who runs the Maryland Neuroimaging Center, recently offered a metaphor that helps a layman like me understand what's going on. In an essay for Aeon, he asks us to imagine a flock of starlings swooping and swirling in the sky. No single starling organizes this ballet, yet out of the local interactions between all the starlings a coordinated dance emerges.

As the brain is trying to navigate through the complex situations of the day, it is creating what Pessoa calls "neuronal ensembles distributed across multiple brain regions," which, like a murmuration of starlings, "forms a single pattern from the collective behavior."

This makes sense to me. Life is really complicated. To deal with a million unexpected circumstances, you wouldn't want a brain filled with just a few regions doing just a few jobs……..

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Summary This is a remarkable miscellany of grammatical phenomena. The question to be asked is why such a range of phenomena should exist. It is because the types of neural circuitry used for ideas also apply to the language that expresses those ideas, in many ways to create a wide variety of linguistic phenomena.

………………
Conceptual embedding can be accomplished by binding the gestalt node for a frame to a role node in a higher frame. For example, in "I know that Sam ate lunch", the knowledge frame contains the role of content. The eating frame is filled in with Sam as eater and with lunch as eaten and is bound to the content role of the knowledge frame.

Knowledge frame

Knowing Knower Content

Eating

Eater Eaten

How does the Brain " know" that it should connect its content role in the knowing frame to the eating frame? Is a "gating" node already there ready to be disinhibited? And is the knowing frame already connected to the "gate"?

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no noticeable effort despite all of the complex circuitry for the frames, bindings, integrations, and doublets involved. This is possible because (1) we already have fixed circuitry for the meanings of re-, use, -able, wine, and cork; (2) we already have the circuitry for combining them, although we have not discussed how this circuitry comes about during learning; (3) once learned, the circuit functions very quickly, on the millisecond scale; and (4) the circuit functions unconsciously, since we have no conscious access to our neural systems. **<u>Understanding language is incredibly complex yet incredibly fast and easy. By understanding how the neural system works, we can understand why incredibly complex language is incredibly fast to use and easy to understand.</u>**

Constructions Organize Thought

We pair meanings, with the forms that express them, in "constructions," formal structures that characterize how thought is expressed in natural language. Constructions thus allow thoughts to be communicated to others via linguistic form. But in doing so, constructions automatically play a remarkable role: they organize thought. Here's how. In the neural theory we are proposing, each grammatical construction is a special kind of neural circuit in the brain of a language user. The more any neural circuit is used, the stronger its synapses become. Each construction links two parts: a form and a meaning. When neural construction circuits are used, the synapses in both their form circuits and meaning circuits become strengthened. This effect of the use of constructions on their meaning circuits is important. Meanings tend to be complex, and conceptual complexity is made possible by combinatorial circuits, in particular,

- gestalts bringing together semantic roles,
- bindings creating identities,
- coordinations creating relations between circuits,
- integrations creating new circuits from old,
- conceptual metaphors applying the reasoning from one brain region to structure reasoning in another brain region, and
- cascades creating an overall unity out of disparate circuits across the brain.
- Each complex meaning is a circuit with a control node that activates or inhibits that circuit depending on its input. Constructions are circuits that link linguistic form circuits to complex meaning circuits. When a linguistic form is used in communication—either said, heard, signed, or written—its complex meaning structure is activated and thus strengthened as a whole. In short, the complex meaning structure in a construction forms a “packaged” meaning determined by how the construction’s form activates its meaning. When constructions vary, sometimes considerably, from language to language and over time, meanings will be organized (packaged) differently in different languages and at different time periods in the same language. That is how, by their function in expressing meaning via form, different constructions may organize meanings differently in different languages, at different times, or over different dialects in the same language. As we observed in chapter 2, embodied cognition experiments have shown that conceptual structure, including conceptual metaphor, leads to behavior that fits the concepts. This is expected, given our neural account of conceptual thought: neural circuitry for understanding language is also used to govern behavior. Given the link between language and thought, it is no surprise that previous theorists have attributed behavior differences to language differences.

perceptual-motor ground-embodied schemas		primary concepts
conceptual organization gestalt circuits		conceptual frames

conceptual coordination of processes	coordination circuits (X-Nets) to form cascades	coordinated activation of cascades and complex concepts
conceptual identity	neural binding circuits	composite concepts
conceptual mapping	mapping circuits	conceptual metonymy and metaphor
conceptual generalization neural optimization:	best fit to existing circuitry	higher-level concepts
conceptual variation	structured minimal additions and changes to existing circuitry	radial categories and polysemy
conceptual specialization activation of general	circuitry with specialized changes and additions	A more specific concept
conceptual integration	integration circuits	holistic concepts and imaginative ideas
conceptual simulation	the filling in of semantic roles in gestalt circuits and the coordinated activation of cascades	conceptualized situations and mental spaces

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The Point of the Example

Cognitive linguists for more than four decades have been pointing out the remarkable, highly structured complexities of grammatical and lexical constructions, many of which require conceptual frames, conceptual binding, and conceptual integration of the sort we have just given for reusable wine cork. These complexities are part of the cognitive unconscious, the 98 percent of thought and language that we have no conscious access to, since they are carried out via neural circuitry. Tens of thousands of such examples work pretty much the same way: unconsciously carried out by neural circuitry.

The architecture of neural networks that make up our brain are delicately disrupted in FW forcing us to accommodate by delightfully flirting with our *personal lexicons. It puts us back to the time we first learn to understand language. Instinct drives some people to respond positively to this dilemma and probe forward to reach a conclusion to the challenge.*

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Meaning is an essential part of natural language. This should be obvious. People do not go around speaking word sequences that are not and are not supposed to be meaningful. Nor are books, newspapers, and newsletters published consisting of word sequences that make no sense and are not supposed to be meaningful.

But what about FW?

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gestalts bringing together semantic roles,

- bindings creating identities,
- coordinations creating relations between circuits,
- integrations creating new circuits from old,
- conceptual metaphors applying the reasoning from one brain region to structure reasoning in another brain region, and
- cascades creating an overall unity out of disparate circuits across the brain.
- Each complex meaning is a circuit with a control node that activates or inhibits that circuit depending on its input.
- Constructions are circuits that link linguistic form circuits to complex meaning circuits.
- When a linguistic form is used in communication—either said, heard, signed, or written—its complex meaning structure is activated and thus strengthened as a whole.
- In short, the complex meaning structure in a construction forms a “packaged” meaning determined by how the construction’s form activates its meaning. When constructions vary, sometimes considerably, from language to language and over time, meanings will be organized

(packaged) differently in different languages and at different time periods in the same language. That is how, by their function in expressing meaning via form, different constructions may organize meanings differently in different languages, at different times, or over different dialects in the same language.

> *Theoretical and without solid experimental evidence but probably correct. Perhaps future instruments will allow for collecting evidence to support this theory. Present instruments can detect signals from general regions of the brain but not at the neuron level - no "schematic" circuit diagram.*

Article from the NYT stating AI is perceived as a GOD.........https://www.nytimes.com/2026/01/23/style/ai-algorithm-god-religion.html?smid=nytcore-ios-share

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Following the initial evidence for embodied cognition in the mid-1970s, linguistics researchers who had been studying meaning in grammar since the 1960s joined the then-nascent cognitive science movement and began developing cognitively based approaches to meaning in grammar known as construction grammar. The basic idea behind construction grammar is that we have conceptual systems characterizing conceptual thought, and language is a matter of pairing linguistic form with meanings from conceptual systems. In speaking, we express conceptual thought in linguistic form. In understanding, it is the reverse: we interpret linguistic form as communicating conceptual thought. The relation must go both ways: thought to form and form to thought. Hence, the idea of language as "pairing" conceptual thought and linguistic form seems natural. In addition, constructions themselves can form composites in new ways, allowing us to create new linguistic expressions and new ideas corresponding to them.

To get a feel for why meaning is part of grammar, consider the following example:

- “Here comes the bus”.

The meaning includes a speech act frame with the following context:

- The speech act is pointing out. In this context, there is a speaker, an addressee (or more than one addressee), a location, an entity in that location, and a motion. The location is the perceptual field of both speaker and addressee. **The meaning of the sentence determines constraints on the grammar of the sentence:**

1. The sentence cannot be negated: *Here doesn’t come the bus. 2. There is no question: *Does here come the bus? *Comes here the bus?

Since (1) the motion of the bus is present in the context, a negation would contradict the context. Since (2) the speaker recognizes that it is happening, a question as to whether it is happening would not fit the context. Since (3) it is happening now, a past or future would be ruled out by the context. And since (4) it is certain in context, a question tag indicating uncertainty would not fit.

Conceptual function	Neural realization	Conceptual content
perceptual-motor grounding	embodied schemas	primary concepts
conceptual organization	gestalt circuits	conceptual frames
conceptual coordination of processes	coordination circuits (X-Nets) to form cascades	coordinated activation of cascades and complex concepts
conceptual identity	neural binding circuits	composite concepts
conceptual mapping	mapping circuits	conceptual metonymy and metaphor
conceptual generalization	neural optimization: best fit to existing circuitry	higher-level concepts
conceptual variation	structured minimal additions and changes to existing circuitry	radial categories and polysemy
conceptual specialization	activation of general circuitry with specialized changes and additions	A more specific concept
conceptual integration	integration circuits	holistic concepts and imaginative ideas
conceptual simulation	the filling in of semantic roles in gestalt circuits and the coordinated activation of cascades	conceptualized situations and mental spaces

thought is structured, and that the neural circuitry constituting ideas and thinking is correspondingly structured. Such structure comes from elementary forms of embodiment, that is, from primary schemas, X-Nets and coordination circuits, the physiology of emotions, and so on. The structure of thought also arises from the structured neural compositional mechanisms for forming complex neural circuitry: neural binding, neural integration, and cascades. A corresponding theme is that neural integration, which is needed for consciousness, makes much of the neural structure of ideas inaccessible to consciousness once they are integrated into wholes with inaccessible parts. Moreover, the speed and ubiquity of neural integration means that most conscious intentional behavior is the result of the integration of complex circuits and that it is relatively rare for structural neural elements to occur isolated—by themselves—in normal, everyday consciously intended and controlled behavior.

However, language is a major form of behavior in which elementary conceptual structure does make an appearance. This is not always an obvious or straightforward appearance but enough of one so that cognitive linguists have been able to disentangle them sufficiently that the conceptual structures in language become accessible.

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Some Metaphor Systems and Metaphors

We will begin with four conceptual metaphor examples and how they combine to form complexes. We will the use plus sign (+) to indicate composition. The four conceptual metaphor examples are

1. 1. Linear scales as paths of motion
2. 2. The spatial event structure system
3. 3. The object event structure system
4. 4. More is up, less is down

The Simplest Cases The first and fourth examples are the most basic:

1: Linear scales are paths of motion; more is ahead, and less is behind.

Examples: Jon's intelligence goes way beyond Bill's. Jon is ahead of Bill in intelligence. Bill is lagging behind Jon in achievements. Bill's grades are catching up to Jon's. In the past year, Bill's grades have zoomed ahead of Jon's. Bill improved for a while, but now he's going backward. Bill has a long way to go to catch up with Jon.

4: "More is up, less is down" is a specific metaphor using verticality.

Examples: Jon is at the top of the class; Bill is at the bottom. Bill's grades are rising; Jon's are falling.

1+4: Examples: Jon's grades have risen above Bill's. Bill has fallen behind Jon. Bill's grades have been dropping. Jon's grade point average this year started at 2.6 and has gone up 6 points to 3.2 but is unlikely to reach 4.

The examples of 1 alone (without 4) indicate motion but not verticality. Example 1 has ahead and behind but not above and below. Conceptual metaphors 1 and 4 both have quantity (with more and less) in their targets. They differ in their conceptual domains (motion and verticality). But their conceptual domains are compatible, and their targets are identical. Therefore, both metaphor mapping circuits can be active at once. Since each circuit is gated, both gates can be open simultaneously. We can see this in words. In "go up," "go" indicates motion, and "up" indicates verticality. The verbs "fall" and "drop" are both lexical integrations of motion and downward. The combination "fall behind" works because both "fall" and "behind" mean "less" but for different metaphorical reasons.

Complexities

The second and third examples add complexity:

2: The spatial event structure system, in which states are locations, changes are movements (to or from locations), causation is forced movement, purposes are desired locations (destinations), action is motion, progress is distance increase from source to destination, difficulties are impediments to motion, lack of progress is lack of motion forward, and regress is motion backward.

Examples: "How far along are you on your thesis?" "Is the going slow?" "Are you stuck?" "Are you close to finishing?" "Is there pressure on you to make progress?" "Is there anything standing in your way?" "The finish line isn't that far away." "Push yourself hard!"

In this metaphor system, the subject matter—the target—is purposeful action. The conceptual purposeful action frame that defines the target includes a desire, a purpose, actions (defining a course of action), progress, and possible difficulties. There are separate individual metaphors that make up this metaphor system. Each is a primary metaphor. Each comes into being around the world, person-by-person, by virtue of repeated correspondences in experience, given the nature of human beings and the nature of the world. In each case, we hypothesize circuits in two distinct brain regions that are activated by the distinct experiences. The activation spreads, forming a circuit. The repetition leads to synaptic strengthening by Hebbian learning.

Spike-timing-dependent plasticity determines the direction of the strengthening and hence which is source and which is target in primary metaphors. The source-to-target orientation of primary metaphors is preserved in composites of those metaphors. In daily life, satisfying purposes that arise from desires requires literally going to some destination. Whether it is an infant having to crawl to where her favorite toy is, a guy having to go to the fridge for a cold beer, a family having to drive to the shore for a day at the beach, or someone having to go to the bathroom to, we regularly have to go to some destination to achieve a purpose.

Actions require motion: moving the body in place or from place to place. A difficulty is something that gets in the way of achieving a purpose. In getting to destinations, difficulties are anything that impedes motion and/or limits progress. Each of the separate primary metaphors making up the system arises by the general neural mechanism that gives rise to primary metaphors. The result is called the spatial event structure system. Again, all of the targets fit together in a consistent frame. And all of the sources fit together into a consistent frame. This means that any of the metaphors in the system can apply together with no problem of interference. When two or more apply together, we get a complex metaphor.

1+2: Linear scales are paths of motion and event structure.

Examples: “He’s made very little progress on his thesis.” “He’s ahead of schedule.” “He’s behind schedule.”

There is a target frame that includes both the amount of progress required and the amounts of time and energy needed to achieve the purpose. That target frame—the amount required frame—is a binding of two frames: the purposeful action frame (the target for metaphor 4) and a frame for relative amounts (a linear scale that is the target for metaphor 1). The mapping circuit for metaphor 1 has connections to the amount part of the amount required frame, and the mapping circuit for metaphor 2 has connections to the purpose part of the amount required frame. The context is defined by which frames are evoked and used. The context could include only the purpose frame or the amount required frame, with its neural binding active. Both are possibilities that could occur, depending on whether the gate for the binding that links the two frames is open and activated or is inhibited. In language understanding, the understood context is shown in the language used. “Schedule” in the examples above indicates where on the path you are supposed to be at a given time. “Ahead of schedule” and “behind schedule” indicate that you have either made more progress than required by the schedule and are “ahead” of schedule or have made less progress and are “behind” schedule. “A lot of effort” suggests more effort than is required to be on schedule and thus that one is “ahead” of schedule. “Little progress” suggests not enough to be ahead or on schedule, and thus one is behind schedule. The word “schedule” is typically used with the amount required frame applying to effort for progress, in which case the amount of progress depends on whether the amount of effort required is more or less than what is needed. In a competition there are two or more competitors, but only one can achieve the given purpose of winning. In the race metaphor for competition, the competitors are in a race. Only one can win, the one who is ahead at the finish line. The race metaphor is usually used for a long competition in which there is a regular concern with who is ahead and by how much and who has what amount of resources left to use in the competition.

1+2+4:

Examples: “Bill’s income has fallen far behind Jon’s.” “The Dow climbed above its previous high”. “Stephen Vogt’s batting average slipped so much that he was traded”.

More is up (example) adds a vertical dimension to 1+2 that comes with words such as “fallen,” “slipped” and therefore “fell behind,” and “climbed,” which are all lexical integrations of 2+4. The use of “income,” “stock prices,” and “batting average” adds a linear scale (metaphor 1) of amounts and comparisons. 3: The object event structure system, in which attributes are possessions, changes are movements of possessions (acquisitions or losses), causation is transfer of possessions (giving or taking), and purposes are desired objects.

Examples: “He has a headache.” “He has a lot of intelligence.” “That noise gives people headaches.” “He got a headache.” “The aspirin took away his headache.” “His headache went away.” “Dementia robbed him of his intellect.” “He slowly lost his intellectual abilities.”

2+3:

Examples: “The table has a book on it.” “He has a lot of strength in his legs.” “He hasn’t an idea in his head.” “He got to Chicago.” “She got into Harvard.” “John got a crazy idea into his head.” “Get me to the church on time.”

These are all integrations, commonplace integrations. In the two event structure systems, the targets are the same. Changes, causes, and purposes are obviously the same. A state and an attribute are both something about a person: their happiness, their confidence, their energy level, and so on. The words “state” and “attribute” are etymologically derived from their corresponding conceptual metaphors: a bounded region of space (for “state”) and an object given (“tribute”plus “at,” from “ad-,” meaning “to” in Latin). “Properties” are metaphorically understood as possessions that one can have, gain, or lose. Examples 2 and 3 have the same targets and different sources (location in space or object possession). There is similarity in some of the metaphorical sources. In both cases, causation is forced motion (bodily movement or object transfer). Also in both cases, a purpose is something desired, and purpose achieved for a person is being in a resulting location (via movement) or acquiring a possession (via object transfer). The phrase “get to” is an integration of two different metaphors for achieving a purpose: (1) a change of possession (“get”) and (2) a change of location (“to”). Both are used to indicate a goal, namely achieving a purpose by either (1) metaphorically acquiring a desired object (“get”) or (2) metaphorically reaching a destination (“to”). This identity of metaphorical targets for two different metaphors allows for integrations, both conceptual and lexical. English has a construction of the form “X has Y located at X,” a conceptual integration of “X has Y” and “Y is located at X.” The grammatical form contains both “have” and a preposition indicating a location associated with X, hence The table has a book on it and He has a lot of strength in his legs. “On” is the literal location between the book and the table, while “in” is the (metaphorical) location between his strength and his legs. The construction that combines “get” with “to” or “into” is a particularly interesting form of integration. The metaphor used with “get” is “achieving a purpose is getting a desired object.” In He got to Chicago, there is a subject matter (target) meaning that he was going to Chicago, which was a purpose that he achieved. The “to Chicago” is literally about motion to Chicago. The “get” indicates the achievement of a purpose, which was going to Chicago. “Get to” integrates these two meanings linguistically to form a single linguistic expression that conceptually integrates the meanings of the two linguistic expressions. This integration works metaphorically as well. Consider “He got to the end of the book”, in which the “process is motion” metaphor applies to the process of reading. The “to” is used metaphorically, not about literal motion but instead about the metaphorical “end point” of the process (conceptualized metaphorically as motion) of reading the book (where finishing reading is reaching the end of the process). The metaphor yielding the achievement sense of “get” has a metaphorical source domain of active acquisition. But there is also a source sense of “get” as being a passive recipient of an acquisition, not an active acquirer, as in “I got your letter”. The metaphorical version of this, via the conduit metaphor, is “Jon happened to get a crazy idea into his head” and “I got the joke”. In other words, a crazy idea metaphorically “entered” his head, with Jon as the passive metaphorical recipient. The same happens in the phrase “received ideas.” Here the recipient is not doing anything active to create the ideas but instead is only receiving ideas created by others. The cause-change integration circuit discussed above has, as a special case, the causal use of this “get.” We can see it in sentences such as “Get me to the church on time”. It is an instruction to bring about the achievement of my purpose of being at the church on time.

Any single cascade circuit for both of these uses at once would use integrative circuitry, integrating two or more metaphors.

This discussion starting on page 284 explores the role of metaphors in our language and in our thinking. It shows how deeply metaphoric constructions are embedded in our language. It’s not something we are aware of because language comprehension is so automatic. Reading FW interrupts that automatic process and throws us back to our five year old days. Did Joyce see his daughter’s struggle with her illness in these language issues? Was he aware of the role of metaphors in our language?

Isn’t there a metaphoric similarity between the dog getting his bone and the student getting into Harvard?

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Summary How is it possible for human conceptual thought, especially abstract thought, to expand and be understood without bound and for that unbounded range of complex thought to be expressed in language? Here is what this section contributes to a possible answer. Structured embodied meanings arise via many connections between the brain and the body: primary schemas, X-Nets and coordination circuits, the physiological connections that form emotions, etc. Embodied idea circuits in the brain are formed via gestalt circuits, mapping circuits, binding circuits, coordinating circuits, integration circuits, and physically realized cascades of such neural circuits. Binding circuits, integration circuits, and cascades create neural control structures throughout the brain, which can be extended over time. The ability to form composite neural circuitry applies to ideas, constructions, lexical items, and linguistic forms. This section has shown how the ability to form composites of ideas, especially metaphorical ideas, can extend indefinitely to create an unlimited range of new meanings, ultimately grounded in connections to the body.
A moral: The metaphors we see in figurative language—linguistic metaphorical expressions such as “the fiscal cliff” and “the glass ceiling”—are anything but simple; they are conceptually complex. The same is true of expressions that on the surface don’t seem metaphorical, such as “She got into Harvard” and “The table has a book on it”. A thorough analysis of primary metaphor systems is required in order to understand not just language that is obviously metaphorical but also much of everyday language that looks literal yet is conceptually metaphorical, with the metaphors functioning conceptually and unconsciously.

The bold formated passage above is worth reading for the FW group. Can we find examples of obstructions to metaphorical interpretation in FW. Alternatively can we find multiple metaphors opened up in the word swamp of FW.

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“Over’s” Grammar What the Brugman and Lakoff analyses missed was the fact that the radial senses of “over” are distributed over several grammatical categories. To get a sense of the problem, consider the following examples: • “Look over the manuscript, but don’t overlook anything”. Here the “over” in “look over” is a verb particle, while the “over” in “overlook” is a prefix. To see that there are many senses of “over” for a given grammatical usage, consider these sentences. “Over” is a verb particle in all of them:

- Turn the pancake over.
- Turn the page over.

* Turn the evidence over in your mind.

- Turn the evidence over to the FBI.

To get an idea of how senses of “over” are grammatically distributed, take a look at this list:

Preposition:

over the fence,

over her divorce,

over lunch,

over the hill,

over the hole.

Prefix:

overshoot,

overthrow,

overflow,

overindulge,

overwork,

overcook,

overlook,

overestimate

Verb particle:

send it over,

think it over,

turn it over,

look it over,

take it over,

do it over

Final state:

The play is over,

He’s over! (after he has walked over the Golden Gate Bridge),

Over and out! (as said by walkie-talkie or ham radio operators)

Noun:

an oversight,

an overlook,

the overflow,

the leftovers,

apple turnovers
Adjective:
overworked,
overcommitted,
overweight,
overcooked,
overdetermined,
leftover (as in leftover vegetables)

From the point of view of their phonology—their sound structure—and their status as words, verb particles are instances of prepositions: over, in, out, up, down, and so on. Semantically, verb particles are integrated with the meanings of verbs to create new meanings. Grammatically, they either immediately follow the verb or occur right after a direct object (or the first of a double-object pair). Their ordering depends on the size of the direct object. If the direct object is short, the particle follows (as in "He looked it over"). If the direct object is long, the particle precedes it (as in "He looked over the documents found by the FBI"). And if the direct object is medium-size (say, two words long), it can occur either before or after (as in "He turned over the papers to the FBI", "He turned the papers over to the FBI.")

I don't think there is any simple way to encode "over" as a dictionary definition and get it right for all the examples in the above extract. So how are we able to get it right with our wired computer, the brain? ....We have a great many wires and a great many neurons. As the sentence unfolds neurons are fired and turned on to open those gates that allow the electric signal to flow to the correct set of subnets for the right choice of "over".

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Language Types and Embodiment
We have pointed to two major ways in which concepts arise from embodiment, that is, from the ways our bodies work and the ways we use our bodies. 1. Our brains have X-Nets (neural networks that "execute," that is, perform actions) for coordination and control, which characterize events and actions and the manner in which they occur and unfold. 2. Embodied image schemas characterize our structuring of vision and motion, have topological and force-dynamic properties, and also allow for the shifting of viewpoint. The dynamics of X-Nets capture the

manner, aspectual, and dynamic features of the action, while the dynamics of image schemas draw attention to spatial and structural state changes (e.g., exiting or entering a state).

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The aspect of language that is conscious is small relative to the cognitive and linguistic unconscious. Their timescales are utterly different. The neural unconscious functions at the millisecond timescale, while the conscious use of language functions at the hundred millisecond timescale and requires successful neural integration of disparate unconscious circuitry, often from different brain regions, and requires a longer timescale. The idea of a "language module" or "language organ," as proposed by Noam Chomsky, is dead, killed off by our understanding of the neural mind. So is the "warehouse theory" that memory and knowledge are "stored" in a single local region of the brain. Embodied conceptual structure may be triggered locally, perhaps prefrontally, but embodied meaning is carried out globally by neural cascades going through multiple convergence zones across the brain and connecting multiple brain-to-body brain regions. Different, often incompatible, cultural worldviews develop across cultures and subcultures. Communication is worldview-dependent because we can only understand what our brains allow us to understand, namely what fits our worldviews. The reason is that worldviews are carried out by neural circuitry, and we can only understand what our neural circuitry allows us to understand. In short, our neural circuitry can be seen as a filter on our understanding of reality.

Consider reading this as conclusion to " The Neural Mind"

P. 47 Soul

From Soul-Making to Person-Making
The issue here is less about being bound to instinct or being free to make rational, ethical choices than of how to frame and understand our lives and our living as able to illustrate proverbs and to be, at the same time, an expression of the indifference of nature. We are the rose and the cold wind. An ethics that is accepted as simply a consequence of our evolution cannot account for this evolution and our biological ethical predicament in facing and being bound to natural indifference or non-intentionality. It is our biological predicament that frames our ethical sense of our inevitable loss, our being bound to our biology. It is the meaning of the fact that things do not mean that troubles Keats and Adams. The only meaning that would count here, that would fit the intentional into the non-intentional, would be an account of us that includes both domains. The sense of losing our humanity and becoming morally inhuman is different from losing the sense that humanity is humanity, the sense that we have no way of making ourselves intelligible to ourselves as human beings, as the kind of thing we are. Of course, what intelligible' means here is what Keats, Adams, and Pollock all attempt to explain—a judgment about that is already a judgment about what we are and what our needs as human creatures are.
~ MY QUESTION HAS BEEN "How do we manifest ourselves ourselves relative to the constraints our understanding of nature has aspects of that manifestation?" The indifference of nature claims with what effect and how deeply is what Keats, Adams, and Polloc describe in their various pictures and theories. In my description of myself as human, what I am describing is neither given nor exhausted by any or all of my descriptions. That I am something that I exhausted by my descriptions of myself or anybody else's description of me tells us about the nature of description. This would always be regardless of our scientific understandings of nature.

Letter to the NYT Jan 3,2026

Research shows that people with dementia often harness metaphor to communicate experiences in their desperate bids to remain engaged. They might substitute an unexpected word for the conventional, or invent words and phrases. There’s a surprising magic in the patois of the condition.

One study looked at the narratives of nine people with early-onset dementia and identified over 1,000 metaphors they used to describe the illness. The study's author, Flaminia Miyamasu, an associate professor of medical English at Tsukuba University Faculty of Medicine in Japan, told me that many of the metaphors conveyed existential disintegration, images of "loss, fragmentation, vanishing." Others spoke of "monster, fog, violence."

olling the body and for the basics of human thought is present in the brains of children before they learn language. For a young child to function physically and socially in a child's environment, much of the circuitry for thinking and understanding basic experiences must already be present. In short, a significant amount of the human conceptual system is already in place before we learn language.......................crying, pushing the spoon aside, or spitting out the food. These are learned purposeful actions in response to perceived purposeful actions by the parent. Once learned, the action can be carried out via existing neural circuitry. Children learn early to perform actions with hidden purposes, such as refusing to get to get dressed for bed by starting to play intently and persistently with a toy. This is an action whose goal is not overt. Ideas for action are learned very early in life, as is their use in hiding covert purposes.

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Programmed Cell Death *in* Neurodevelopment

Yoshifumi Yamaguchi[1,2] bunbun@mol.f.u-tokyo.ac.jp · Masayuki Miura[1,3]

Neuronal Cell death# in children .....

Function of Developmental Apoptosis in the Nervous System

In mammals, it is proposed that the susceptibility to neuronal apoptosis is controlled at the various levels: protection by growth factor signalings, the amount of IAP protein, redox regulation of cytochrome *c*, and downregulation of the apoptosome machinery and executioner caspases during differentiation and aging (Braunger et al., 2013; Donovan and Cotter, 2002; Donovan et al., 2006; Ohsawa et al., 2009; Stoka et al., 2006; Vaughn and Deshmukh, 2008; Wright et al., 2004, 2007). Thus, distinct mechanisms that account for differential susceptibility to apoptotic triggers exist in a differentiation state and cell-type-specific manner.

…………..In keeping with these findings, the regulation of PCD and organ size regulation in vertebrates appears to involve more regulatory processes than in invertebrates, as detailed in the following section (Fuchs and Steller, 2011).

…….Thus, Bax-dependent PCD during postnatal brain development contributes to generation of sexual dimorphisms in these neurons (Forger, 2009). Interestingly, as mentioned previously, dying mammalian neurons can induce proliferation in cells that receive signals from the dying cells in some situations (Agasse et al., 2004; Magavi et al., 2000), which raises the possibility that PCD might be involved in remodeling or regenerative processes of nervous system in mammals. Precise lineage-tracing analysis with PCD mutants might be able to reveal the neural cell populations and the neural circuits whose size, formation, and architectures are regulated or remodeled through PCD during puberty and adolescence, the crucial periods for developing adult social behaviors in animals, including humans.

Conclusions

Recent studies highlight the old but essential concept of cell-lineage-dependent PCD during development. Such deterministic regulation of PCD contrasts with indeterministic life-or-death regulation, including competition for trophic factors, spontaneous genomic alternation, or "random" selection based on cell position and status. A combination of both regulatory processes is essential for proper development of a functional nervous system. In addition, recent studies have proposed that dying cells can actively affect the behavior of neighboring cells. However, it remains ambiguous whether PCD has such a function in the nervous system. Deciphering the full regulatory roles and functions of PCD, including newly described types of regulated cell death other than apoptosis, is required to derive a deeper understandings of PCD not only in development and metamorphosis, but also in the developmental stages of puberty and adolescence, during normal aging processes, and in various pathological conditions (Chihara et al., 2014; Fuchs and Steller, 2011). All of these biological processes are accompanied by substantial cell death, a robust and inevitable event in multicellular organisms.

I copied this material because I thought the Homo Sapiens might have been affected neurologically by the advent of language. I really have no evidence just a hunch.