

Generalized Integration Networks

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"Blends" is often used to refer to a type of data that was discovered in the early nineteen nineties,¹ in which very visibly two or more inputs are partially mapped onto each other and selectively projected to a new mental space in which novel structure can emerge. Famous examples of such blends are *The Buddhist Monk*, *Regatta*, *Nixon in France*, *Complex Numbers*, *The Image Club*. As it turned out, far from being exceptional, marginal, or genre-specific, such blends are all over the place, and especially visible in fields as different as scientific discovery, humor, advertising, or religious rituals.

What warranted a new category for this kind of data was the impossibility of fitting it into any of the known mapping schemes, in particular the source-target scheme of metaphor theory as understood at the time, or analogy, or metonymy, or simple framing.

Methodologically, the abundance of previously unnoticed (and hence never analyzed) "blending" data suddenly offered a wealth of empirical resources to study with precision the cognitive operations of mapping and integration that made such blends possible. As the principles of conceptual blending became better understood, conceptual blending itself became a legitimate tool of discovery and analysis. It is striking in this regard to look at the evolution of Lakoff and Núñez's work on the cognitive basis of mathematics, which became the excellent book *Where Mathematics Comes From*, published in 2000. This work started out as an exploration of the metaphorical underpinnings of mathematics, but it ended up offering powerful analyses of mathematical conceptualization in terms of conceptual blends.² Even the central "basic metaphor of infinity" was later correctly reanalyzed by Núñez as a conceptual blending template.³

The systematic study of *integration* as a cognitive operation made many useful descriptive distinctions possible. So, within the data referred to as "blends", there were many different products depending on the types of inputs, the links between them, the choices for projection, etc. Corresponding types of blends were distinguished, or rather aligned on a graded continuum, going from simplex blends to mirror blends to single-scope and double-scope blends, all dividable into further subcategories.⁴ Blends could also be classified along other dimensions for various purposes.⁵

The description and classification of this new data was pretty much uncontroversial and widely viewed as innovative and useful. But a deeper project is to explore the role of integration and compression in meaning construction beyond the very visible blends that brought these cognitive operations to our attention.

In the present paper, I will point out some useful generalizations that emerge from the study of integration, along with some of the pervasive fallacies that stand in the way of making such generalizations. Through the analysis of attested data, I will discuss the notion of "generalized integration networks" and how they allow the construction of a multiplicity of surface products in human thought and action.

I. Three fallacies

Fallacy 1 : DIFFERENT SURFACE PRODUCTS RESULT FROM DIFFERENT COGNITIVE OPERATIONS

When the new surface products known as "blends" were first displayed, they were contrasted with familiar surface products and mapping operations that have been around forever: frames and framing, metaphors and metaphorical mappings, "logical" counterfactuals and counterfactual mappings, analogies and analogical mappings. Common sense and intellectual tradition associate a specific type of mapping with each specific type of surface product. Metaphorical mappings produce metaphors, analogical mappings produce analogies,⁶ and so on. In fact, the words "metaphor," "analogy," "metonymy," are ambiguous: they can refer to the surface product or to the mapping that supposedly produced it. So it seems to make sense to see "blends" as one additional type of surface product, and to see "blending" as the specific mapping pattern associated with the newly discovered product.

This leap from product to process is fallacious. There is usually no isomorphism between the surface products as we see and classify them in everyday life and the underlying principles that produce them. Hence, once we have the evidence for integration (operation) as provided by blends (data), it's an open question whether that operation applies in more familiar data.

Fallacy 2 : IF IT'S NEW, IT'S GOING TO COST MORE

This is a triple fallacy, which applies equally when by "new" we mean "newly discovered" or when we mean "newly acquired" (through evolution or through learning).

The automatic assumption is that the newly discovered data (blends in the case at hand) must somehow be more exotic, less typical, than the familiar products already comfortably, if not always neatly, categorized. And along with that assumption also comes the corollary that more exotic phenomena demand extra cognitive effort, special machinery not normally used, but available for out of the way (or even perhaps outlandish) human behavior in exceptional (marked) genres such as sarcasm, humor, spirituality, mathematics.

But this reasoning is also fallacious. New data may indeed reveal cognitive operations; it does not follow that such operations are confined to the new data (Fallacy 1), or that they are necessarily exceptional, atypical, or costly. In the case of blends, the data provides overwhelming evidence for the operation of conceptual integration and the general principles that govern it.⁷ Humans happen to possess this capacity, including its double-scope manifestation, arguably indispensable for many singularities of human behavior (language, religion, science, art). There is no reason to believe that using this capacity is cognitive costly for humans. In fact, it turns out that humans use it all the time, for better or for worse, and that they clearly enjoy activities that depend on it, such as humor, deceit, rituals, or fiction.

A second corollary of Fallacy 2 is that existing theoretical machinery (e.g. standard framing or source-target metaphor theory) should be used whenever possible and that "new" machinery should only be resorted to when all else fails. In other words, the fallacious idea that the newly discovered data and its cognitive underpinnings are more costly is mirrored by the equally fallacious idea that the "new" theoretical mechanisms

(conceptual blending in this case) are theoretically more onerous than the previously accepted theoretical apparatus.

Moreover, Fallacy 2 is applied to learning: a child (it is assumed) learns the "simple" operations first and the "complex" ones later. Cognitively costly operations are acquired later, according to this implicit extension. Again, there is no a priori reason to believe this. Eighteen month old children (and perhaps younger ones) produce and understand elaborate blends.

Fallacy 3: A WIDE-RANGING COGNITIVE OPERATION PURPORTS TO EXPLAIN "EVERYTHING"

Corollary: Such an operation explains "too much" and is unconstrained.

It is generally agreed that "visible blends" reveal the mechanics of integration more readily than other phenomena. The obvious question is "does integration play a role in phenomena other than visible blends?". Considerable attention has been lavished on this issue in the last twelve years, with unexpected but (with hindsight) unsurprising convergent results: yes, integration operates in the construction of a multitude of surface products, which may differ sharply from each other along many other dimensions. These surface products include for example analogical counterfactuals, mathematical notions like complex number, technological innovations like timepieces or computer interfaces, and also more familiar products like frames, metaphor, and grammatical constructions.⁸

Jerome Feldman, in his excellent work on the neural theory of language, writes:

"More recently, Mark Turner and Gilles Fauconnier (2002) have made a bold attempt to explain much of mental life in terms of the cognitive linguistic notion of conceptual integration (or blending) we discussed in chapter 24."⁹

The proper way to understand this comment is that we (Turner and Fauconnier) have indeed shown that conceptual integration plays a **necessary** role in human mental life as evidenced by surface products of particular interest to humans.

But "necessary" is not "sufficient." Billions of years of biological evolution precede the appearance of full-fledged double-scope integration. Integration is only a minuscule component of the stunningly complex organization of the embodied mind. To be sure, it is responsible for striking singularities which distinguish humans from other species in ways that are of particular interest to humans themselves, and therefore to human researchers.

II. An example: the smoking ears network

When we avoid Fallacies 1,2,3, we can look at any surface product in a more general way. Instead of trying to fit it into a conventional descriptive category (such as metaphor, counterfactual, etc.), we can look in detail at the succession of mappings and integrations that operate in order to yield the complete surface product. Typically, what we find is a **generalized** integration network, which combines conventional integrations available in the language and culture with novel integrations and emergent structure made possible by the context in which the surface product is constructed.

To illustrate this, I will discuss an anecdotal example in some detail.

The piece of data is taken from a column in the San Francisco Chronicle titled **'Bar Patrons Fume Over Smoking Law.'** The occasion for the newspaper column is the enforcement of the ban on smoking in the state of California.

"No Smoking" signs were tacked up in bars all over California yesterday, and hardcore smokers nursing a scotch or a beer were so angry that if they had been allowed to light up, the smoke would have been coming out of their ears.

1) The anger network

The excerpt from the Chronicle is immediately and effortlessly understood by readers, even though it triggers the construction of an elaborate "generalized" integration network. To build the network, a reader must have available the well-known conventional metaphorical network of "anger as heat in the body container." It has three major inputs, heat in a container, emotion, and body. I quote below from *The Way We Think* in order to sum up the main features of this network. Kovecses and Lakoff's analysis of the heat/anger metaphor is discussed in Lakoff (1987).

HEAT INPUT	EMOTION INPUT	BODY INPUT
<u>"physical events"</u>	<u>"emotions"</u>	<u>"physiology"</u>
container	person	body
substance/liquid		blood
pressure	degree of anger	blood pressure
heat	anger	body heat
steam	sign of anger	perspiration, redness
explode	show extreme anger	acute shaking, loss of physiological control
boiling point	highest degree of emotion	
orifice (lid, spout, ..)		orifice (ears, navel, mouth)

From WWT:

We have independently manipulable spaces for the emotion of anger and bodily states. We also have a conventional cultural notion of their relationship, based on correlation—people often do get flushed and shake when they are angry. We will call this notion the "Story of Emotion and Body."

In addition to the metaphoric mapping between Heat and Emotions and the vital relation connection between Emotions and Body, there is a third partial mapping between Heat and Body. In this mapping, steam as vapor that comes from a container connects to perspiration as liquid that comes from a container; the heat of a physical object connects to body heat; and the shaking of the container connects to the body's trembling.

The three partial mappings set the stage for a conventional multiple blend in which the counterparts in the inputs are fused, giving, for example, a single element that is heat, anger, and body heat, a single element that is exploding, reaching extreme anger, and beginning to shake. Once we have this blend, we can run it to develop further emergent structure, and recruit other information to the inputs to facilitate its development.

For example, we might say,

—He was so mad I could see smoke coming out of his ears.

This derives from recruiting ears to the Body input and an orifice to the Heat input, and projecting them to the same element in the blend. We now have a new physiological reaction—smoke coming out of the ears—that is inconceivable in the original Body input. In the blend, it is fused with anger. Conventional expressions like "He exploded" can also prompt for new physiological reactions in the blend that are impossible for the Body input itself. In these cases, the notion of physiological correlates of emotion is coming from the "Story of Emotion and Body" inputs, but the specific content of the physiological reaction (smoke, explosion) is coming from the Heat input. This is a Multiple-Scope Network, with a conventional global generic space (Story of Emotions and Body) over two of the inputs and their vital relations, and with a systematic compression of those outer-space vital relations to uniqueness in the blend.

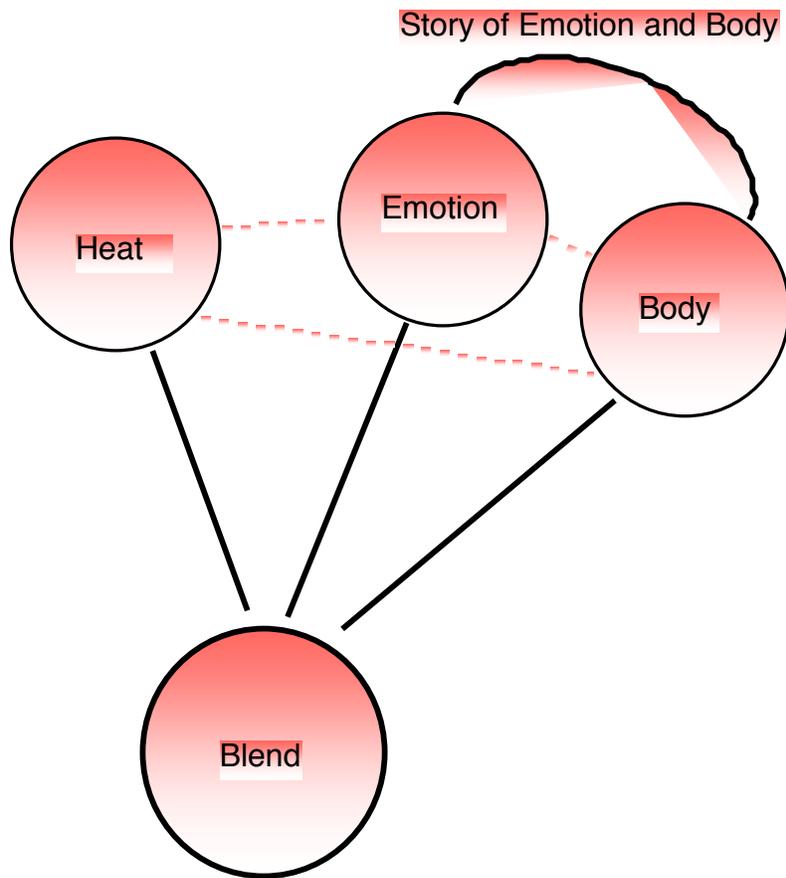
The blend remains linked to the inputs. A sentence like "He was so mad I could see smoke coming out of his ears" directly identifies structure in the blend, but inferences—smoke is a sign of great anger—are projected back to corresponding inferences in the Emotion input and the Body input: he was extremely angry and was showing physiological signs of it. (What these signs actually were in the actual human situation is irrelevant).

Expressions can refer directly to the blend, as in "He exploded. I could see the smoke coming out of his ears." This description, which would be inappropriate for any of the input spaces by itself, coherently picks out the integrated scene of the blend. Additionally, even when the vocabulary is appropriate for one of the input spaces, the blend can often use it in ways that would be ungrammatical for that input: for example, suppose the chef is angry and acts it out by boiling a pressure cooker until it explodes; although "anger" and "explode" apply to this scene, and although we could say the cooker "exploded with force," we cannot say it "exploded with anger." But in the blend, where the anger is pressure and heat and force, we can indeed say, "He exploded with anger."

Vocabulary from all three inputs can be combined when referring to the blend, as in "She became red with anger and finally exploded." Again, however, we could not say of a pan heated red by the angry chef that it was "red with anger."

Running the blend can produce elaborate emergent structure, as in "God, was he ever mad. I could see the smoke coming out of his ears—I thought his hat would catch fire!"

There are no burning hats in the heat input or in the anger input. Burning hats are emergent in the blend, which has the frame of somebody on fire. They imply greater heat/anger, greater loss of control, and greater danger.



2) Counterfactual "zoloft" networks

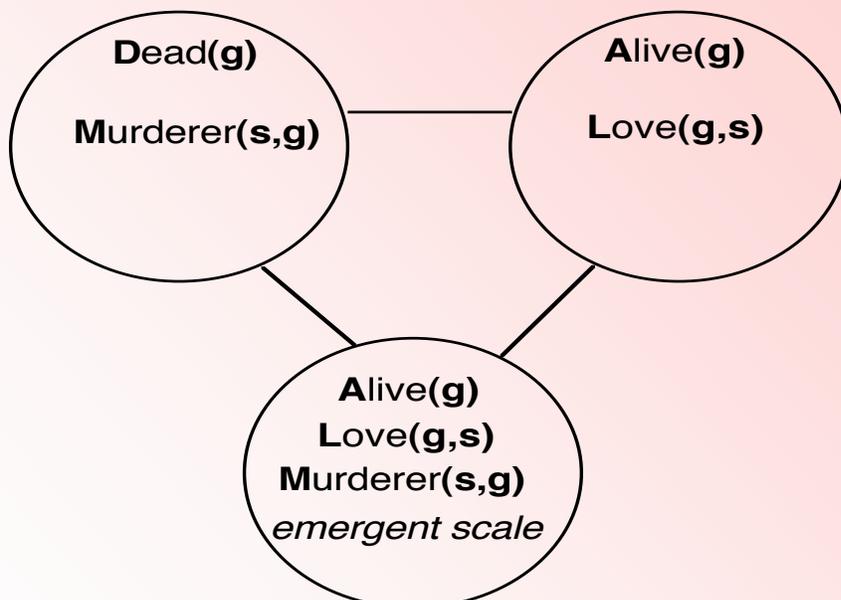
The newspaper column takes for granted the reader's mastery of the culturally sanctioned anger network, and proceeds to build a counterfactual "*if they had been allowed to light up ...*" This is not a conventional network, but it conforms to a more general counterfactual blending template in which the blended space seems to incorporate incompatible pieces of information. Such networks are used fluently by subjects in many situations, and have been discussed by Coulson (2001) in the case of "abortion rhetoric." I am calling them "zoloft" networks for present purposes, because of the following typical example of such networks provided by the so-called Zoloft defense case.¹⁰

In the Zoloft defense case, a teen-ager had murdered his grandparents. When the time came for him to be sentenced, his father pleaded for leniency and invoked the grandparents his son had murdered, saying:

"if they were still alive, they would also plead for mercy for their grandson."

Two inputs are blended: one in which the killing occurs, and the grandparents are dead, and one (counterfactual) in which nothing happens. In the latter, the grandparents are alive, they love their grandson as always, and he has done nothing wrong.

In the diagram below, **s** refers to the son/grandson, **g** to the grandparents.



The construction of the network is fairly straightforward. Some elements are brought in from the "reality" input: the grandson has been found guilty of murder and is being sentenced; other elements are brought in from the counterfactual input: his grandparents love him and wish him the best. Emergent structure in the blended space is created in interesting ways. First, since the grandparents love their grandson and think highly of him, it follows logically that they plead for leniency. Secondly, a background cultural frame is covertly activated:¹¹ pleas in favor of a convicted criminal carry different weight depending on who makes them. At the very top of the scale of credible advocates for the criminal (or indeed more generally for a culprit of any sort) is the victim of the crime. A victim can offer forgiveness, and/or plead effectively in favor of the offender. The underlying folk model includes a scale on which it is normally the victim who demands the harshest punishment, so that the actual punishment should not be more severe than what the victim demands. In the blended space of the zoloft network, the grandparents' support for their grandson in ordinary circumstances becomes the dead victims' support for the convicted murderer. The blend allows the scale to emerge with the dead grandparents at the very top.

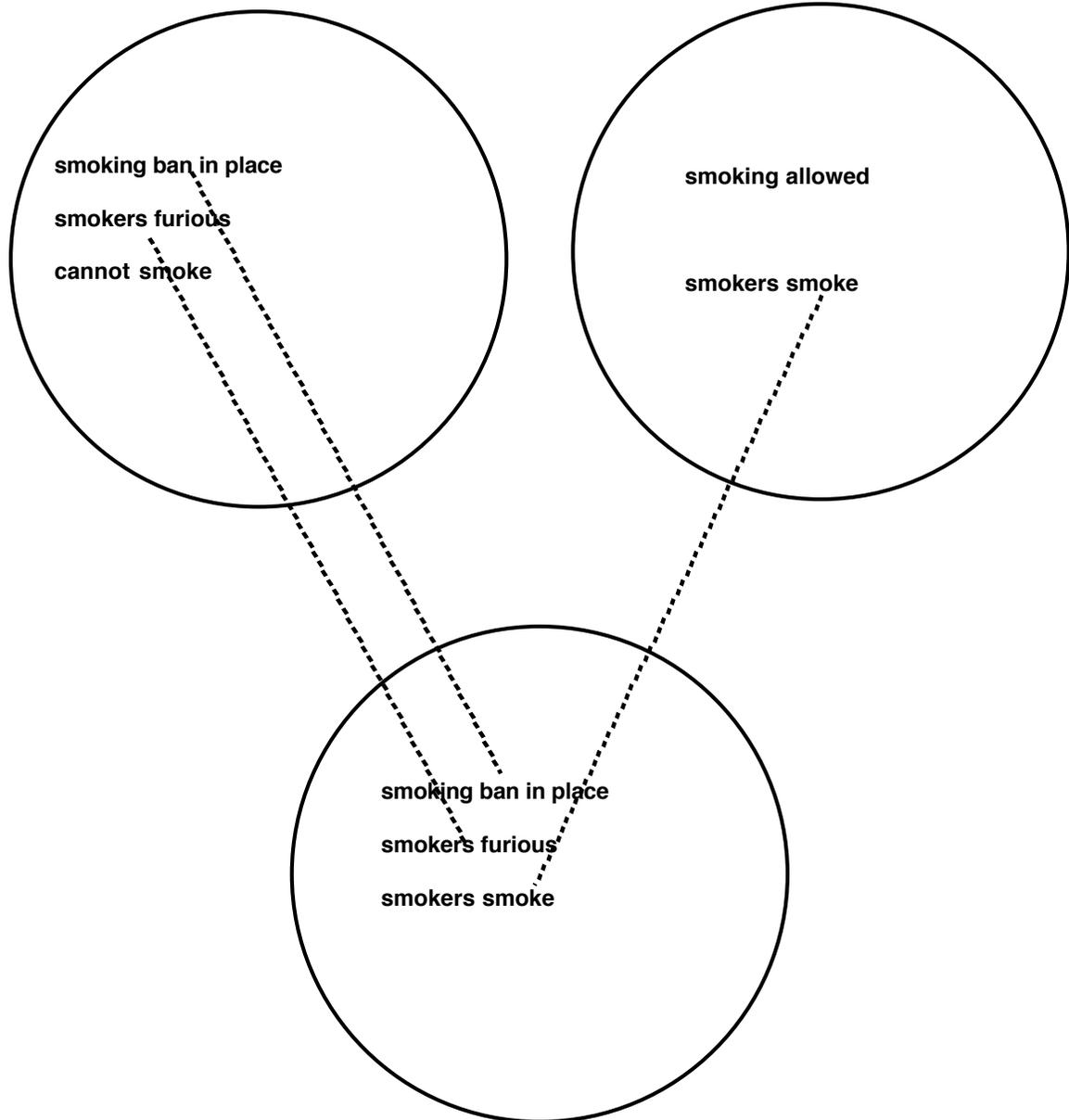
The blended space seems of course "illogical": if the grandparents were alive, there would be no murder, and therefore no sentencing. But as in many other blends that we use routinely, this apparent incongruity is not an obstacle to the emergence of the desired scale and the argument in favor of leniency that it provides.

3) Smokers' Zoloft network

The same zoloft blending template is used in the fuming smokers column. From one input NS (reflecting the real situation at hand: **no smoking**) we project the smoking ban (analogous to the murder in Zoloft), and the anger it triggers, and from the other (counterfactual) input YS, in which smokers smoke, we project the fact that they smoke, in order to obtain an emergent form of their anger, at the top of a scale of angry reactions. In the blended space Z of this zoloft network, the ban on smoking is in place causing smokers to be enraged, and they are allowed to smoke.

Input NS

Counterfactual Input YS



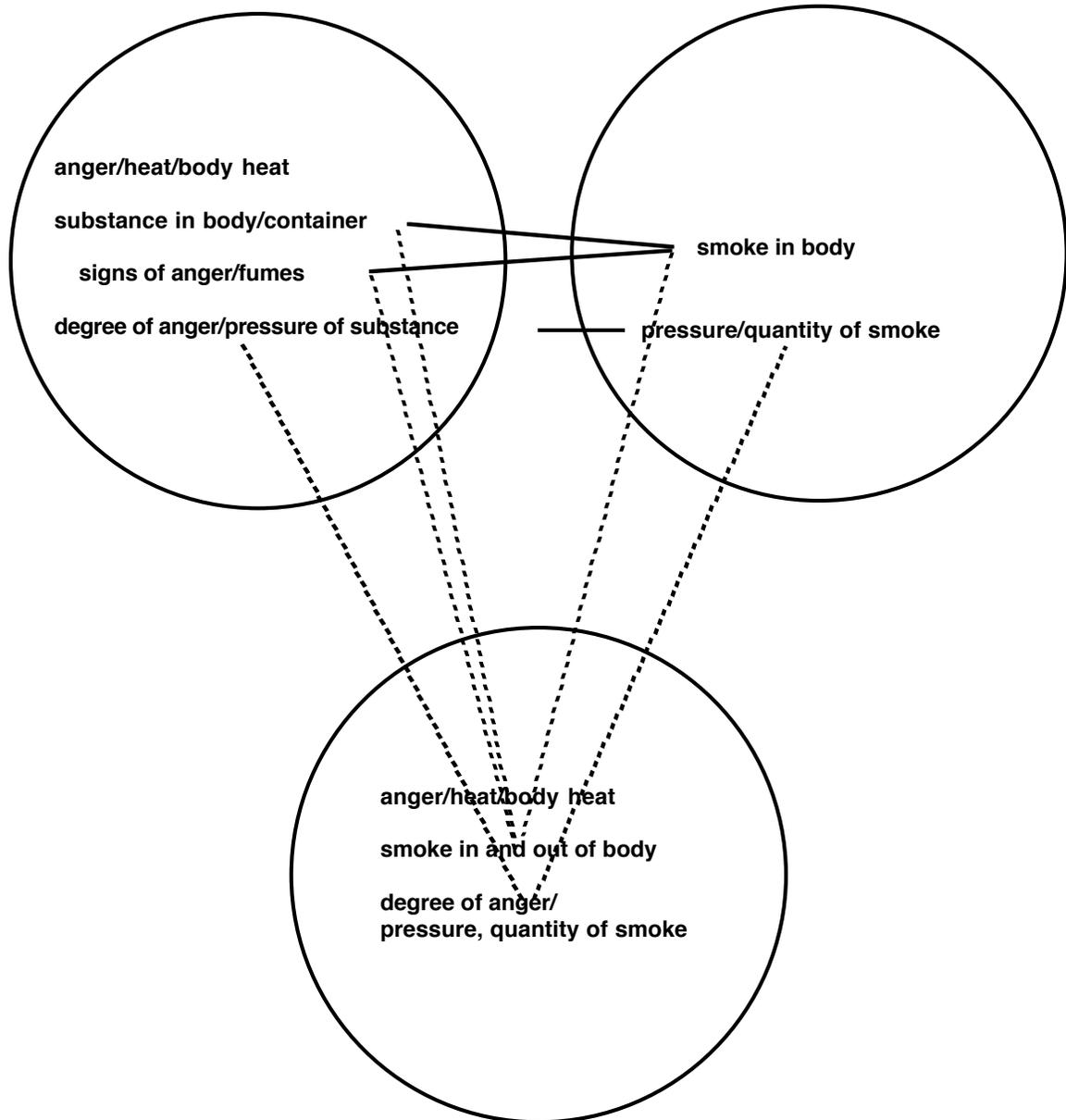
4) Angry smokers network

However, all this is not enough to account for the observed data. In the conventional metaphorical blend of anger, we do have the property that the greater the heat, the more steam, smoke or fumes will come out of orifices in the container, and in the blended space this yields the emergent property that great anger/heat in the body/container will cause steam/fumes to come out of orifices in the body/container: *He was fuming/steaming (with anger). He was so mad, you could see the smoke coming out of his ears.*

But this metaphorical smoke is not tied to any actual smoke in the body. What happens in the Fuming Smokers column is that a novel mapping is created opportunistically: the fumes from the anger network can be mapped onto the smokers' smoke. This mapping triggers a novel integration, the SMOKER'S ANGER network in which the smoke in the smokers' body is fused with the metaphorical fumes from the smokers' anger. One input is the blended space of the conventional ANGER network, where metaphorical heat is fused with body heat and with the corresponding emotion, anger; the other input is the frame of SMOKING, with a person inhaling smoke into their body. Furthermore in the blended space of this new integration, smoke is now the substance contained in the smoker's body. In the input of SMOKING, the smoke inside the smoker's body is not the result of some other substance heating up within the body; it is produced by an external heated object (burning tobacco) and then inhaled and exhaled by the smoker. In the blended space of the SMOKER'S ANGER network, the substance under pressure in the body and the smoke emitted as a result are fused. This is a *cause-effect* compression.

INPUT A (=H/E/B)

INPUT S

BLENDED SPACE
OF ANGER NETWORKCONVENTIONAL
SMOKING

BLENDED SPACE S/A OF SMOKERS' ANGER

In the blended space constructed through this elaborate process, the smokers display their anger in a supremely visible way: we see the smoke from their burning tobacco coming out of orifices in their body.

But the situation described in the newspaper is one where a ban on smoking has just been put in place. This makes smokers angry but prevents their anger from being seen since they have no smoke to work with. The zoloft network Z described in 2) comes to the rescue: it allows the construction of a further counterfactual blend Z/SA in which the ban is in place, and yet the smokers can express their anger as specified by the SMOKERS' ANGER network (i.e. by expelling tobacco smoke through their ears).

This is achieved by blending Z (the zoloft blended space in which the ban is in place, the smokers are angry, and they are allowed to smoke) with SA , the ANGRY SMOKERS blended space. In Z/SA , the ban is in place, and the smokers' rage can manifest itself at the top of the anger scale: smoke coming out of the ears.

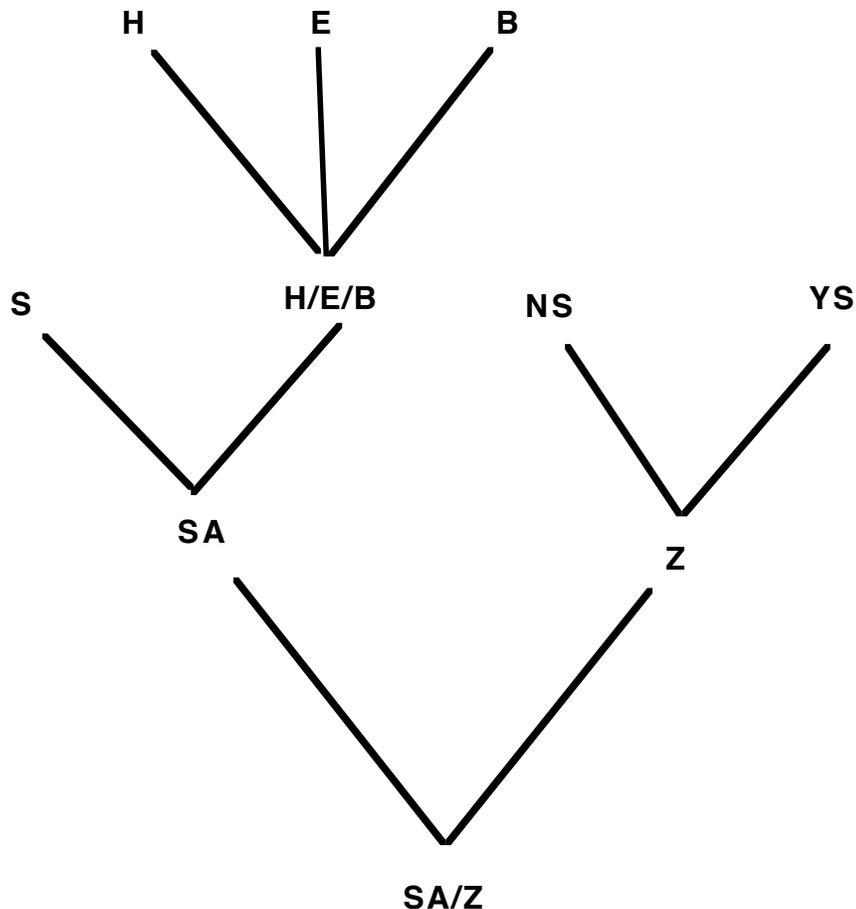
5. Full network

We end up with the full network diagrammed below. The H/E/B part of this network is the conventional culturally sanctioned anger network, with a metaphorical component (anger as heat) and a metonymic component (anger as its stereotypical bodily manifestations). The integration is successful because H (heat, pressure, and substance in a container) also maps naturally onto B (body temperature, blood and blood pressure) in a way that is neither metaphorical nor metonymic.

H/E/B (conventional anger) is blended with S (smoking) to yield SA (smokers' anger). This part of the network is not conventional: it is creative in context, drawing opportunistically on a contextually available correspondance between the metaphorical smoke in H/E/B and the real smoke produced by the activity of smoking. Moreover, its only purpose is to feed into the next part of the generalized integration network, the zoloft network, in order to convey the thwarted smokers' fury.

That sub-network is built by using the available zoloft template (integrating an actual input with its counterfactual alternative). The input space NS, in which the ban is in place causing smokers to be furious, and preventing them from smoking, is blended with the counterfactual input space YS, in which they are allowed to smoke. In the blended space Z of the zoloft sub-network, the ban is in place, smokers are furious (projection from NS), and they smoke (projection from YS).

Z can now map onto SA, since both are cases of furious smokers who smoke. In the resulting blend, Z/SA , the ban is in place (projection from Z) and the smokers' fury is manifested by smoke coming out of their ears (projection from SA).



III. Discussion

The surface product exhibited in the newspaper excerpt is the result of several successive integrations. Is it a "metaphor"? Clearly, yes, but not a conventional one, and not simply a source to target mapping. Is it a "counterfactual"? Clearly, yes, since it builds on a counterfactual situation where smokers can smoke in spite of the ban, but it is not a case of building an alternate possible world. In possible worlds, smoke does not come out of the ears of smokers even when they are supremely angry. In possible worlds, smoking cannot be simultaneously banned and allowed. Is the newspaper statement contradictory or unintelligible? Clearly, no. On the contrary, it cleverly conveys the writer's point: that smokers are furious, frustrated, and unhappy. Is the piece of data a "blend"? Clearly yes, and indeed a very visible one.

So, this surface product cannot be classified in a single category, or linked with a single mapping pattern. Understanding it requires the careful study of the multiple integrations that operate and of the established networks or network templates that are recruited effortlessly for its construction. It is not a "blend" as opposed to a "metaphor" or a "metaphor" as opposed to a "counterfactual." It shares features with all of them.

Is attested data of this kind cognitively significant? Of course. Tens of thousands, perhaps millions, of readers of this newspaper column were able to perform the meaning construction with no conscious effort, no puzzlement, and presumably with pleasure, all of which attest to the universality of the processes involved. Is the cognitive construction a special one, to be distinguished from "ordinary" semantics? Certainly not, since as shown in the analysis it makes use of completely standard integration capacities, and recruits culturally entrenched networks and network templates.

Is the capacity for building generalized integration networks restricted to specific genres like humor? Overwhelming evidence to the contrary has now been advanced in countless studies by scholars looking at conceptual blending. They have shown for example that elaborate generalized networks of the type described here are culturally and psychologically elaborated in the evolution of mathematical concepts,¹² the technological development of instruments,¹³ of computer interfaces,¹⁴ of grammar for signed and spoken languages,¹⁵ of literary creativity in poetry, theatre, and literature,¹⁶ of courtroom practice,¹⁷ of religion and magic,¹⁸ or again of culturally significant and widely shared notions like the concept of "time."¹⁹

This very rich body of work, like the more accessible "smokers' fury" discussed here, dispels the fallacies mentioned at the outset of this paper. Using generalized integration, a capacity available to humans, is not more costly or exceptional than using other capacities, and simply interacts with them (fallacy 2). Integration is not a "theory of everything" (fallacy 3): it is a precise meaning construction operation that shows up in very diverse human products and exists in addition to, and not instead of, the infinitely greater body of biological and cognitive capacities available to us and often shared to some degree with other species. The surface distribution of products that we distinguish sharply in our everyday experience does not correlate with a corresponding distinction between the mapping schemes or cognitive capacities needed to produce them (fallacy 1): an operation like integration can be at work in all of them, and precise analysis of the generalized networks needs to be done for any observed data, just as chemical analysis needs to be done for any unknown chemical, without adding new elements or new principles to chemistry.²⁰

In order to construct and use generalized integration networks as humans do constantly in everyday life and also in the creative breakthroughs of art, literature and science, they need at a minimum the following capacities, not attested to date in other species: 1) the cognitive capacity for conceptual integration (double-scope, mirror, simplex, ...); 2) the cultural elaboration over cultural time of entrenched networks (e.g. elaborate metaphorical networks developed for time, anger, death, mathematics, event structure, elaborate grammatical construction networks); 3) templates for specific types of integration, such as the counterfactuals in zoloft networks; 4) the capacity to transmit and evolve entrenched networks and templates over generations through learning; 5) the capacity to conceive and build material anchors that stabilize networks and enable or facilitate their transfer and diffusion.

Notes

¹ Fauconnier and Turner (1994)

² Lakoff and Núñez (2000). See especially the sections on the number line, granulars and hyper-reals, the disk-line segment, negative numbers, and the entire part VI of the book, which gives a superb description of many successive conceptual blends in mathematics that end up giving meaning to the mysterious formula $e^{i\pi} = -1$.

³ Núñez (2005).

⁴ Fauconnier and Turner (1998)

⁵ Fauconnier and Turner (1994)

⁶ A pair of situations is not an analogy in any absolute or a priori sense. It becomes one if an analogical mapping is imposed on partial mental models for the situations.

⁷ Constitutive principles, governing optimality principles, and compression laws are discussed in *The Way We Think*.

⁸ See the extensive bibliography for such studies at <http://blending.stanford.edu>

⁹ Feldman (2006)

¹⁰ The defense in this case was called the "Zoloft defense" because it argued that the grandson under the influence of the anti-depressant Zoloft, was not aware of the import of his actions. This defense failed in large part because the defendant, in addition to stabbing his grandparents in their bed, had later set fire to their house to destroy evidence of his crime.

¹¹ This is a standard process in the emergence of novel structure in the blended space, as shown for example in the analysis of stock examples like *The debate with Kant*, or *Regatta*.

¹² Fauconnier and Turner (2002), Lakoff and Núñez (2000), Robert (1998).

¹³ Hutchins (2005), Williams (2005), Alac (2006).

¹⁴ Fauconnier (2000), Imaz and Benyon (in press).

¹⁵ Liddell (1998, 2003), Mandelblit (1997)

¹⁶ Freeman (1997), Dancygier (2006), Sweetser (2006), Fauconnier (2003), Hiraga (2005), Oakley (1998).

¹⁷ Pascual (2002)

¹⁸ Sorensen (1999), Sweetser (2000).

¹⁹ Fauconnier and Turner (in press)

²⁰ This is one important reason why notions like metaphor, metonymy, analogy, counterfactual, applied to surface products, elude rigorous definition. Real data does not fit neatly into such categories, and the categories get defined according to the definer's favorite prototypical features and do not provide the theoretical insight needed at a deeper level.

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