CHAPTER 7

Three metaphors in social science

Use patterns and usefulness, separately and together

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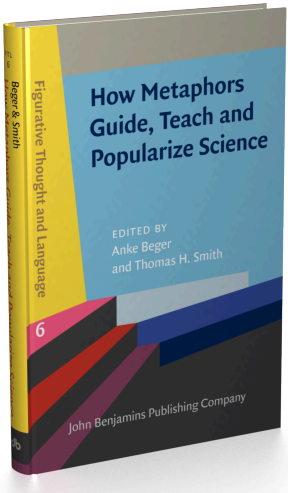

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CHAPTER 7

Three metaphors in social science

Use patterns and usefulness, separately and together

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Independent

Metaphors appear in scientific theories, guide scientists, teach students and fascinate the public. This chapter sketches a kind of vocation or métier for scientific metaphors in physics and then applies the same outline to three influential conceptual metaphors in social science – DATASET, SOCIAL FIELD, and DYNAMICAL SYSTEM, along with their respective sub-mappings. All three are in continuous use and often reliant on each other. Using corpora derived from recent social science literature I show how metaphors stimulate hypotheses, then are extended to account for results in successive rounds of observation and theory development, tracing the degree to which each metaphor is useful and retained over the years. Of special interest are supplementary metaphors introduced deliberately to summarize complex source domains.

Keywords: science metaphors, social science, field theory, datasets, dynamical systems

Introduction

With so much commentary on metaphor as used in the experimental "hard" sciences, it is opportune to provide some balance by expanding into the "softer" social sciences – long believed to be less rigorous, with loosely defined methods and highly speculative theories. To the degree that these beliefs are true, this reflects how social science is still at the stage where general principles are being sought and scientists are learning how better to investigate realistic social interaction.

Social science theories are many and varied and metaphors play a large role in their development and application. A metaphor influences how scientists think about their subject matter, how they frame it, the inferences they make and the substantive questions they ask. Once established, metaphors are used in pedagogy and popularization. Metaphors draw attention to some features while

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masking others, even introducing specialized terminology. They are likely to be key in judging whether the scientific answers and communications to the public are valid. Noting how some have a long career in science, are changed, perhaps abandoned, then re-applied, no metaphor can be assumed to remain static. Using current understandings of conceptual metaphor and corpus-based methodology this chapter attempts to add to our understanding of how scientific metaphors come into use and evolve.

Objectives of this chapter

Examining metaphors in social science offers opportunity to learn more about metaphor broadly, because theoretical understanding in social science is more tentative, more reliant on, and illustrative of, the generative and creative powers of metaphor. So in this chapter, as the social science theories are described and reviewed, I attempt to track several things:

First, the description of the various theoretical approaches should make clear that they are by no means entirely, or even mostly, metaphorical, but combine literal and figurative notions into a stew of reasoned argument, analogical comparisons, and unconscious (often metaphoric) assumptions. I focus on the metaphoric aspects, attempting to identify key or central metaphors, but making no claim to finding all.

Second, I propose a kind of framework for how metaphors in science first appear, guide the science, are modified based on observations, and might be retained and combined. This is the métier or vocation of scientific metaphor that appears below.

Third, and closely related to the second, is the goal of showing how scientific metaphors fulfill the tripartite functions of communication, cognition or reasoning, and the deployment of textual or language elements.

Finally, I try to show the general usefulness of the metaphors discussed, not only to scientists and specialists, but also to non-specialists.

1. Metaphor vocation or métier, and study method and organization

The following subsection outlines what I am calling the scientific metaphor métier or vocation (cf. Bowdle & Gentner 2005; Knudsen 2003, 2005). It uses an example from atomic physics that deals with "hard" science that may be easier to follow at this point. Many find the social sciences vague and confusing. For this reason, I apply the métier outline first to something more familiar so as to provide a template that I can then apply to social science.

1.1 Vocation or métier of scientific metaphor: Atomic physics example

Metaphors used in scientific discourse are seen here to have a career path which, in recognizing their importance in the conduct of science, I refer to as a vocation or métier. This shows how metaphors function differently to structure thinking at various points in their history, their usefulness to scientists and laypeople, or as tools of one theoretical school or another. A given metaphor is far from being simply present or absent in a discourse. It not only influences science, but also is influenced by science. So, as it is used, its functions or the roles it plays can change. These changes affect a metaphor's flexibility as a resource to manage emergent meaning, and a goal of this chapter is to give examples and begin to catalog not so much the specific source domains, but how they are used.

The description of such a vocation or métier is divided into three broad stages: the early application of a metaphor, its modification, and its continued use. Even metaphors that are used over a period of years may not pass through all these stages, sometimes they pass through the same stages repetitively, nor will they necessarily follow the order given. This exposition and the examples studied here are intended to offer a framework to better understand the diverse ways metaphors evolve and coexist, particularly in highly complex scientific fields.

Early application of a metaphor

A metaphor may frame discussion and suggest how things work, offering a way to think about the scientific topic in question.[1] A metaphor draws attention to important points, sometimes offering terminology for things or events that are observed but have no name. Look for scientific metaphors derived from culturally entrenched ideas (Kövecses, 2010), recent science or technological advances in other fields (Giles, 2008). Such a metaphor depicts a more complete, often idealized, macroscopic event than may have been scientifically observed (Brown, 2003). Using a metaphor, especially an entrenched and vivid one, may seem to offer literal knowledge (Wolff & Gentner, 2011).

For example, when electrons were observed to be in motion, the atom was metaphorically portrayed in terms of the long-accepted Copernican model of the solar system: Electrons were metaphorically understood to be very small objects (particles) moving around a larger nucleus (Lerner, 2016).

1. Metaphor functions are identified in the introduction to this volume and by several authors, including Low (1988), Gibbs (1994), Goatly (1997); condensed to three functions by Steen (2008, addressed later); summed up by Denroche (2015).

Mapping to observations

Having been tentatively introduced as a macroscopic framework, scientists may take advantage of conceptual and inferential structure and attempt to map the metaphor's features to what might be observed at a more detailed or microscopic level (cf. Justi & Gilbert, 2002). Taking this step means the metaphor is being used for more than a general frame or vague perspective. For the moment, at least, it is theory constitutive, provides "epistemic access" (Boyd, 1993, p. 485; see also Hallyn, 2000; Steinhart, 2001), and its structure will be put to work inferring details and proposing hypotheses. For scientists this ideational work guides subsequent scientific observation; for teachers and students these mappings can be pedagogically valuable (see Aubusson, Harrison, & Ritchie, 2006; Harrison & Treagust, 2006).

In the example, counter-balanced, less massive planets in orderly orbits are metaphorically mapped to moving, negatively charged electrons; the much heavier, stationary sun is mapped to the positively charged atomic core or nucleus; the counter-balance of gravitational and centrifugal forces is mapped to the balance of positive and negative electrical charges; and the whole metaphoric system seems to operate according to Newtonian principles – an appealing formulation based strongly on our common experience of bodily movement. Investigators are thus primed as to what to look for next – electrons traveling in identifiable orbits around the nucleus.

Subsequent observations test metaphoric mappings

Although distinct orbits were not found – that is, planetary movement did not map well to electron movement and Newtonian mechanics failed – the solar system metaphor had been fully effective in prompting useful questions. Atomic particles turned out not to show characteristics of the tiny, revolving billiard balls expected; their motion was not reducible to a clear statement of position and momentum over time: the ontology of Newtonian movement in Euclidean space no longer would seem to apply.

Metaphor modification, changing the metaphor

To account for what is actually observed, to continue to be useful, a metaphor may be clarified, modified, or replaced. As scientists learn more detail about the target (Semino, 2008), the metaphor might be extended or elaborated (Lakoff & Turner, 1989), "helped" (see below), blended with other metaphors, (Fauconnier & Turner, 2002), closed (Knudsen, 2003), or replaced entirely. Change in metaphor can lead to change in language that may be more or less effective in generating hypotheses and communicating scientific insights (see, for example, Heywood & Parker, 2010).

In the example, a kind of metaphor replacement occurred. Characteristics of waves were detected – waves as had already been analyzed in the study of sound, fluids, and light, and for which mathematical formulations and computational tools existed. Building on conceptions well-established in these other fields, Schrödinger's wave equation took the place of the metaphor of orbital paths for each electron, and from this formula the relative probability of electron location is computed (Higbie, 2013; Freiberger, 2013). At this point the solar system metaphor lost most of its theory constitutive status, replaced by the wave equation.

Loss of simplicity

As scientists dig deeper, trying to comprehend new and diverse observations, they may put aside the initial metaphor, which might have been very simple and idealized, dependent on embodied or primary metaphors (Grady, 1997), to picture how things work. If the coherence of the idealized model or schema is disturbed and new – perhaps mathematical – terminology applied, this may be comprehended easily enough by specialists, but not necessarily by others (as exemplified by Halim, et al., 2013).

The detection of waves introduced aspects of quantum mechanics. Quantum mechanics was widely used by specialists but, unlike Newton's laws, was not something easily grasped through an embodied source domain. Potentially confusing, even disturbing, to scientists and students alike, quantum mechanics did not promise a clear picture of an electron's velocity and position as the framework of Newtonian mechanics leads one to expect. There was no longer a step-by-step physical account of particle motion, but instead an abstract and non-embodied conception of wave motion that conformed to a second-order differential equation.

Metaphor closing

As more micro-level detail is learned about a topic, the true, metaphoric qualities of a theory constitutive source domain fade because they no longer seem needed. Some or all mappings to the target have been replaced by literal knowledge (Semino, 2008); the familiar and favored metaphor "closes", is no longer generating ideas (Knudsen, 2003), even while its lexical representations might still be retained as literal descriptions (even dictionary definitions); it seems to have lost its metaphoricity (no longer mapped to the metaphor source domain) and "died", perhaps becoming a "law" or formula. If the structure of the metaphor is implied and continues to convey ideas fundamental to a scientific topic it may be called a "background metaphor" (Blumenberg & Savage, 2010).

In specialist literature "orbit" became technically defined in terms of discrete energy levels. In losing its solar system metaphoricity, the solar system metaphor closed, becoming a background metaphor. It was still depended upon

to characterize electron motion, such as their going around the nucleus, even as the wave metaphor and Schrödinger's wave equation was employed, as described further below.

'Helper' metaphors

After a simple, idealized metaphor has been superseded, scientists and science writers whose audience is learners or lay people, often borrow or invent what I choose to call "helper" metaphors. These are direct, intentionally-used metaphors, often novel forms of conventional ones, that offer a different point of view of the topic under discussion, providing "scaffolding" (per Vygotsky: Verenikina, 2008, p. 1; also see Denroche, 2015; Talmy, 1988) or "stepping-stones" (Steinhart, 2001, p. 7) in communicating a perspective that non-specialists can grasp.

In the example, the idea of orbits was sidestepped and an "electron fog" was introduced. Electron location and velocity metaphorically understood as 'fog' changes a learner's perspective, perhaps by invoking the difficulty of locating objects through a foggy atmosphere. In fact, the fog metaphorically represents a probability distribution of possible momentary electron locations, so the "fog" has no substance. In this way a learner is "helped" to transition from a Newtonian to a quantum mechanics perspective. Similarly the idea of electrons randomly "jumping" between energy levels "helps" a learner begin to understand how the abstraction "principal quantum numbers" is used to describe an electron's state. Helper metaphors, however, ought to be seen as expedients, because one or more key mappings is erroneous or misleading. You would be entirely misguided if you tried to observe the density of the fog or the force and direction of the jumping.

Reiteration of process

Putting aside any such erroneous mappings, if the changed metaphor hasn't entirely closed, it suggests what to look for in forthcoming observations. As before, hypotheses are formed and the process reiterated. This example illustrates what can emerge from the back and forth interplay, often involving years of questioning, metaphor-influenced conceptualizing and testing through experimentation. More metaphor elaborations and extensions may be introduced to address unanswered questions, explain new observations, and new "helper" metaphors devised for learners.

Continued use of a metaphor

A scientific metaphor would be retained in use over years and decades if it is effective in one or more functions attributed to metaphor: communications, conceptualization, and lexicalization (Steen, 2008). More specifically, here are reasons we could expect a scientific metaphor to continue in use:

- It explains at least some scientific observations, such as results of some experiments.
- And does so in alignment with, or appropriately alters, the viewpoint of some constituency, including scientists, students, science writers, journalists, or the lay public.
- Or it has introduced language or terms that become entrenched and continue to be used.

In the example, some mappings of electrons as orbiting particles were retained to explain certain findings, even as the metaphor of electrons as waves gained ascendance; this will be taken up below.

The afterlife of metaphors

Changing or superseding an earlier metaphor does not necessarily mean that the simpler initial metaphor goes away. A metaphor may have appeal beyond its correspondence with the latest research and may be more easily believed than is the data. Scientists, scholars, as well as learners become dependent on it to summarize a topic or to make things memorable to students. Sometimes a metaphor once used by scientists to explain a particular subject, but later discarded, re-emerges as the best fit to certain observations (Knudsen, 2003).

Two or more distinctly different (sometimes incommensurate) metaphors may be in use simultaneously with regard to aspects of the same phenomenon. They coexist, and which metaphor is used depends on what in particular is being studied and for whom results are intended. A previously closed metaphor can be resuscitated or "re-opened" in non-specialist exposition or when applied to a different but seemingly related topic; that is, its metaphoricity is recovered and understood by some audiences (cf, Giles, 2008; Knudsen, 2003).

In the example, the introduction of the wave metaphor lead to better understanding of electron movement, but did not explain all observations that atomic physicists made. Diffraction experiments and photoelectric effects were better explicated by continuing to regard electrons metaphorically as objects or particles. Because no single metaphoric model would explain all observed aspects of subatomic behavior, both the particle and the wave metaphors are retained and used, depending on the focus of research. An electron, conceived as a particle, was nevertheless found to have wave-like properties; subsequently it was established that anything conceived as a wave also had some particle-like properties. This became known as the wave/particle duality (Nemitz, 2000).

Furthermore, both of these metaphors found roles in pedagogy – with the solar system metaphor (electron understood as object or particle in orbit) continuing to be used in physics texts as an introduction to subatomic motion, and the wave

idea (electrons understood as a billowing wave of energy with no mass) is also introduced to learners (Taber, 2013). Their simplicity as introductory stepping-stones gives them additional reason to live on.

1.2 Organization of the study in Sections 2, 3 and 4

The previous subsection gives the general outline of what I am calling the scientific metaphor métier or vocation. I chose the atomic physics example above because it is familiar to many and based largely on well-established science. The next three sections offer a more extended account, applying the métier outline to three distinct metaphors, all mapping to the same social science topic or target domain. The topic – social conflict, particularly fraught or volatile social conflict – is challenging to study and anything but settled.

Sections 2, 3, and 4, below, present successively the three contemporary social science approaches or theories as applied to this topic. In general these theories or approaches are described by their adherents in conventional terms – probably intended to be mostly literal, and documents containing these descriptions form the corpora for each section. But within them the metaphor scholar may identify important conceptual metaphors. I attempt to elucidate these metaphors with their sub-mappings, show how they map to known features of the theories, and identify hidden construals where I detect them. As the above discussion of the vocation or métier illustrates, it becomes possible to see how the metaphors enable scientific understanding, help generate hypotheses, guide ongoing scientific observations, interpret results, frame and explain all of this to non-specialists.

1.3 Method

The methodology used here is based on conceptual metaphor theory (Lakoff, 1993), and related work (Cameron, 2003; Charteris-Black, 2004; Eubanks, 2000; Fernandez-Duque & Johnson, 1999; Semino, 2008). Metaphor identification is based on procedures used effectively by others and consisted of manually identifying figuratively used words or groups of words, the strictly literal meaning of which is incongruous or outside the given context of the target; such figurative words are usually less vague, less abstract, more concrete or physical.

Adhering to the corpus approach to metaphor investigation which is, in general, the method used here, the intent is to find metaphors as they are actually used in the scientific discourse of interest. This manner of investigation does not survey all metaphors used in the discourse. The goal is to select those that appear to be truly exemplary in exploring, elucidating, investigating social processes.

To focus the study I first identified a social science topic of contemporary interest, as mentioned above: fraught or volatile social conflict, and I make use of the example of encounters between police and alleged crime suspects. Then I looked at three different theoretical approaches used in the scientific study of this topic; these can be identified as the database or dataset approach, the social field theory approach, and the application of dynamical systems theory.

For these three social science approaches or theories I selected scientific publications that generally described each, particularly as related to such conflictual encounters. These texts form three corpora, one for each approach or theory. Entire texts are used, omitting endnotes, appendices, and reference sections (see Appendix 1 for relevant details such as citations and text lengths).

I then identified the parts in each corpus describing relevant theory, and closely read those parts, looking for both conventional and novel metaphoric language. The central metaphor or metaphors for each corpus were sought, where the target domain remains essentially the same across the three corpora. This is not a word-by-word analysis, but requires comprehension of authors' theoretical arguments in their entirety or by major section. As detailed in Sections 2, 3, and 4, below, where there are numerous text examples for inspection, three central conceptual metaphors emerged – one in each approach or theory. Labeled per their source domains they are DATASET, SOCIAL FIELD, and DYNAMICAL SYSTEM. Once major metaphors were identified, key sub-mappings were then identified.

Of course, issues may arise regarding such an identification procedure, and whether the metaphors named are actually conceptual in nature – indicative of how the social scientists actually think – not mere lexical configurations illustrating how they use words. Such issues will not be resolved here by focusing on the precision of the methodology. My description of the vocation or métier of scientific metaphor, above, outlines ways that metaphor is useful in science, including how a metaphor communicates, adds to the language, and guides thinking; so the metaphors identified can be judged accordingly. Furthermore, the results given in Sections 2, 3, and 4 constitute additional criteria, when viewing the text extracts in particular, to judge whether the metaphors identified make sense in the context of related theoretical presentations.

2. The dataset metaphor in the study of social conflict in police-suspect encounters

For those who read the social science literature, a social scientist's comment to a reporter about his work on this rather troubled and contentious subject is not surprising: "You know, protesting is not my thing," he said. "But data is my thing.

So I decided that I was going to collect a bunch of data and try to understand what really is going on when it comes to racial differences in police use of force" (Bui & Cox, 2016).

Social science has been dominated by the use of tabulated data collected after the underlying social processes are completed. The form of datasets and how they are put together have their own logic, regardless of what the data supposedly represent, and so can influence how scientists think about their subject matter and the inferences they make. I argue in this section that the dataset, when heavily depended upon, is a metaphor for the actual social encounters or processes that are the subject matter of social science. The conceptual metaphor I propose at this point is stated as SOCIAL PROCESS IS DATASET. While any field of science could be said to be metaphorically understood as the methodology used in its research, this might be seen as a central mapping (Kövecses, 2002) and have special implications for social science.

Such methodological metaphors are consequential. As with all metaphors, they frame discussion and suggest how things work, encouraging both scientists and lay people to think accordingly about a scientific topic in question. This happens through the generation of indirect comparisons between metaphor source and target domains where valid inferences in the source are projected onto the target (Schön & Rein, 1994). Although no experienced social scientist will necessarily take such a metaphor literally, these ideas frame the discussion, and are given greater salience. I argue here that the metaphorical representation of social interaction as data or dataset projects a system of categorized discrete attributes, metaphorically understood as physical objects, among which are orderly, arithmetic, readily-computed relationships that are precise, clear, stable, and reliable, onto the target domain of human social interaction.

The dataset metaphor licenses inferences about the actual encounters that, because the scientists have little or no direct experience with them, are influenced not only by what the data supposedly represent but also by the properties of datasets – the methods of forming and manipulating them and their distinctive structure.[2]

In this section I identify the target domain of police-suspect interactions noting that they contain important features of conflict in social processes. These interactions involve conformity and compliance. A special case from the field of

2. It would not be entirely whimsical to simplify this to REALITY IS STATISTICS. "When scientists accepted the implications of the Uncertainty Principal and began describing reality in terms of statistics, the lay public got the idea that reality was actually like that" (Debate #17142, 2011). If respected scientists are perceived to believe certain metaphors are literally true, lay people may adopt such beliefs uncritically.

crime and law enforcement, of particular current interest in the United States, is when the police encounter people suspected of dangerous criminal acts and compliance can legitimately be coerced. Vested authority is expected to make reasonable, rational decisions about the use of brute force to get citizens suspected of wrongdoing to comply.

This is the example I will use to explicate the dataset metaphor. To focus the discussion further, I pose specific questions: Are the police more violent in dealing with racial minorities than with the majority white population? Is the level of violence rational in light of circumstances?

2.1 Looking for answers in official records: Early application of the dataset metaphor

Before getting more deeply into the scientific study of these questions, what do the "official" records say? Official records tend to be simple counts of events with minimal cross-tabulation of their characteristics. These resemble bookkeeping ledgers where essential accounting data is recorded, in this case the data is from police and court records about police and alleged criminal behavior. Journalists and many lay people look to such official data for answers and give them quasi-scientific status. Such records are organized as a very simple dataset, so the dataset metaphor (perhaps unconsciously) is operating when the numbers are seen, supporting the belief that they tell what we need to know about actual events. This promotes and helps conventionalize the SOCIAL PROCESS IS DATASET conceptual metaphor.

The official records say that, currently in the entire United States, there are approximately 1,000 deaths of citizens in encounters with police per year. Roughly 50% are black (for the nation as a whole, black people make up approximately 12% of the population and their rates of arrest and of incarceration are likewise disproportionately high). Together with examples of gruesome cases described in the media where black citizens were shot by police, it is not surprising that so many people embrace the official numbers and are convinced that violent acts committed by police towards blacks greatly exceed those towards other groups.

2.2 The dataset as tool of social science: The dataset metaphor and its sub-mappings

How datasets are formed

Social scientists, like the one quoted at the start of this section, undertake to collect more detailed empirical data and fully understand what it says before giving their conclusions. What do we need to know about datasets to understand what form the DATASET metaphor takes?

Police behavior when apprehending suspects is a real-life social phenomenon that might be studied holistically as a naturally occurring event. But this would require trained observers on hand to collect data where and when these encounters happen to take place. Also, being observational in nature, not experimental, there is no random assignment to control groups and key variables cannot be isolated. Consequently, the study of such encounters takes a form quite typical in social science. It is done in terms of static, surface data gleaned after-the-fact from official records already available or readily collected, and then numerically coded.

The data are organized into an array where, for example, the columns contain a number or code for each data item (or variable) in one encounter or case, and each row corresponds to all such data for an individual case. The arithmetic summaries of the dataset, taken over all individuals together, produce descriptive statistics (such as means, variances, frequency distributions, and correlation coefficients).

One or more of the data items represent the outcome of concern – here, police violence directed towards suspects. Social scientists want to figure out what has happened in the social situation and what might cause each outcome. Typically they manipulate these datasets, following accepted computational procedures, trying to predict outcomes (dependent variables) from data on predefined background and situational factors (independent variables). I am arguing that the dataset conceptual metaphor frames the thinking, and guides the research of these social scientists; this is most evident when the operations of three principal submappings are considered.

Data are collections of objects

In a very basic way, the dataset itself is a metaphor: SOCIAL PROCESS IS COLLECTION, MANIPULATION AND INSPECTION OF OBJECTS. The variables are collections of objects (things, entities or events that can be thought of as objects) taken from records and numerically coded. Numbers so organized, and numeracy in general, can be considered metaphorical. Lakoff and Nuñez (2000) and Guhe, Smaill, & Pease (2009) have shown that addition, subtraction, multiplication, and division, and the objects on which these arithmetic operations are based, are conceptual metaphors. They argue that a person's bodily experience of interacting with real, physical objects shows that they can be grouped and manipulated, such as by adding them to or removing them from groups and by combining groups. The regularities experienced in doing this form metaphorically the concepts and operations of arithmetic. Patterns among variables, including calculations of statistical parameters (mean, variance, etc.), are discerned in the aggregated data and used to answer social science questions of the sort posed in the example here.

This method of study fits well with what has been called "substance-ontology" (Seibt, 2008), a set of presuppositions that underpin so much scientific thinking,

namely, that discreet, bounded, concrete things, pieces, objects and substances are primary. Furthermore, these objects or substances exist on at least two levels, hierarchically organized – the micro level of individual cases with concrete attributes, and the macro level where all cases are aggregated and generalizations made; in this conception the macro level is reducible to, and fully explained by, the micro level (Christen & Franklin, 2002).

Quantification is paramount in science

And a metaphoric mapping promotes this: PRECISION/ACCURACY IS ASSIGNING NUMBERS TO OBJECTS AND MANIPULATING THE NUMBERS. The objects are numeric quantities and codes, as just described above. Their numeric definitions are clearly communicated and engender certainty that they are real, concrete and enduring like substances, quantified and recorded, so the data is understood as empirical "fact." All interpretations thereafter are framed as fact. In this way observations not only achieve mathematical precision, but the dataset also exists in its own right so it easily becomes an object of study. This is the more salient because social scientists and the public rarely experience directly, or observe others experiencing, the domain of phenomena being studied, although they may have heard anecdotal accounts or seen videos. Nor is there any real or imagined physical model of the social encounters analogous to physicists' solar system model of atomic structure. Instead social scientists rely on the domain of coded data, of which their training and research experience has given them extensive, first-hand, grounded experience. The dataset is a proxy for, not at all the same as, the real events, but it provides mental access (Kövecses, 2006) to what happened in police-suspect encounters.

Although a proxy, the various elements of the dataset, numeric quantities and codes, correspond to a restricted subset of elements in the actual police-suspect encounters. In this sense there is a mapping between these two domains (Coulson & Oakley, 2003) where the dataset is an attenuated, concrete representation of a large and complex set of real-life events. The language of datasets – variables, averages, correlations – predominates over psychosocial terminology, as illustrated by textual extracts, below. This further argues that the specific organization of the dataset and its typical manipulations structure how results are communicated and understood; they influence the cognitive inference process and the formation of substantive questions.

Causation is central to scientific inquiry and is metaphorically understood CHANGE IS ONE ENTITY PUSHING ANOTHER SO AS TO MOVE IT. Causation is classically seen as one thing touching, pushing or banging into another (Lakoff & Johnson, 1999; Martin, 2003).[3]

Statistical relations among the variables are examined in an attempt to interpret cause and effect. If the outcome variable (police violence) and some other variables (e.g. race of suspect) co-vary, by both occurring in one case, and both not in another, and this pattern generally holds over large numbers of cases, causality is readily inferred. With the data collection and tabulation process as the source domain, movement (change) in variable A accompanied by corresponding movement in variable B is understood as A causing B. By examining the results of such tabulations the scientists answer questions such as, was coercion used with suspects of one race more than another, or did the aggressiveness of suspects influence coercion?

As Lakoff & Johnson (1999) point out, causality is metaphorically understood as an entity applying force to move another entity, producing change in the latter. Deprived of more direct apprehension, recasting such entities as variables in a dataset, one may subconsciously depend upon the mental image of physical force, as in classical mechanics, originating in one variable, impelling the co-variable into a certain state.[4]

To summarize, substance-ontology, classical notions of causation that it facilitates, together with the quantification and potentially precise evaluations possible, form practical tools for scientific exploration. The three sub-mappings just considered (1. SOCIAL PROCESS IS COLLECTION AND MANIPULATION OF OBJECTS, 2. PRECISION/ACCURACY IS ASSIGNING NUMBERS TO OBJECTS AND MANIPULATING THE NUMBERS, and 3. CHANGE IS ONE ENTITY PUSHING ANOTHER SO AS TO MOVE IT) express what is meant by SOCIAL PROCESS IS DATASET. These notions guide empirical observations and their interpretations.

2.3 Mapping to observations: How the individual case is understood from aggregations

So far we have seen that when social science is treated as calculation, one can easily be persuaded that the specific case derives from the general case, that future

3. The source domain of MOTION is based on the image schema structure source-path-goal and possibly direction (Radden, 1996).

4. To an unknown degree the dataset metaphor could inherit the logical structure (Feyaerts, 2003) of the causation as mechanical force metaphor; then the dataset metaphor licenses inferences such as movement (change) in variable A causes corresponding movement in variable B.

outcomes are summary calculations on past data, or aggregation of the entire dataset. This happens even though social scientists may be generally aware of the "ecological fallacy" (the fallacy of drawing conclusions about an individual case based on group averages; see Protnova, Dubnov, & Barchana, 2007, for general review). Such framing does not tell a true story, but it is communicated easily, seems to offer precise and scientific understanding, and so this rendition easily becomes conventional.

Add to this the exemplary nature of group statistics; they can be understood as prototypical, and the consequence is that actual, individual encounters or cases are easily inferred as conforming to the prototype. For example, use of force in an encounter is understood as percent of a given group who have experienced it in the past; part of the cause of violence is inferred to be variables coded for race and codes for the suspect's reaction to the encounter. When this is done, averages are construed as (mapped to) the typical outcome for individuals of a certain racial group, and percentages construed as probabilities that lethal or non-lethal violence will occur.

Corpus examples of scientific language talk about individual cases in terms of aggregated data. So we have, for example, the likelihood that the police will shoot a black man in a particular encounter interpreted as equal to the percent of black men in the entire dataset having been shot by police; the variance construed as the uncertainty of such an outcome. A table of descriptive statistics for all subgroups of encounters stands for the entire state of affairs regarding police-suspect encounters. Language in excerpts below may seem to be describing actual encounters, but are in fact referring to tabulation of data codes, only abstractly connected to behaviors that unfold in particular situations. Metaphoric mappings are reinforced even where the scientist interprets cautiously.

(1) …as the intensity of force increases …the probability that any civilian is subjected to such treatment is small, but the racial difference remains surprisingly constant

(2) …it's not obvious how to aggregate non-compliance into a monotonic index … A simple aggregation of the number of non-compliant activities is likely misleading.

(3) …blacks and Hispanics are more than fifty percent more likely to experience some form of force in interactions with police.

(4) …to explore whether racial differences in the frequency of officer-involved shootings are due to police malfeasance or differences in suspect behavior.

Specific hypotheses to be tested are suggested by the mappings, combined with general knowledge

Besides the argumentative influence of the dataset, scientists and lay people of the United States share general knowledge of the country's racial history. From activism and news reporting one can surmise that racial hatred, while by no means universal, is pervasive and those in power, certainly the white police, may tend to brutalize black suspects. Police behavior and race are issues followed closely by the media. People see marked variation in the outcome variable, police violence, in dealing with different racial groups.

Dataset metaphor and initial observations

Thus framed, one's attention focuses on the tabulations of average amounts or percentages of violent acts by police towards whites, blacks, and other groups. These simple tabulations strongly impact macroscopic perceptions of police behavior. What was actually found surprised just about everyone, namely, that black suspects were slightly less likely (but not to a statistically significant degree) to be shot by police compared to other races. These tabulations are considered the "raw data" for the outcome variable and termed "stylized facts".[5]

Dataset metaphor leaves important questions unanswered

Metaphoric mappings of the SOCIAL PROCESS IS DATASET metaphor, even when they seem confirmed by observation, aren't always persuasive. The findings contradicted deeply-held beliefs and many people remained unconvinced by the science. Besides those familiar with the "ecological fallacy", the everyday truism that "statistics lie" fed skepticism that the simple tabulations just discussed produce valid conclusions.

Correlated variables capable of obscuring results

A major limitation of the findings so far was recognized in terms of dataset structure, namely, that aggregated data will mix together the influence of diverse variables, confounding the statistics and obscuring subtle differences in outcomes. Race might co-vary with other factors not included in the dataset, and one or more of these correlated variables could even more plausibly be the cause of police violence. For example, the suspect being armed or aggressive or the encounter occurring at night or in a relatively lawless part of the city might be causative. Data on more variables was needed.

5. Economists use this term when rates are very consistent over time and over varying conditions, so that they are accepted as truth.

In fact, official data existed that, if properly organized, coded, and analyzed, should go beyond the "stylized facts" by taking advantage of another feature of datasets – statistical control – that allows selected sources of variance to be isolated in an effort to clarify questions about police violence in dealing with different racial groups. The research strategy at this point, therefore, was to include these additional variables in the dataset and proceed with enhanced statistical analysis.

More observational data to help uncover a link between race and police violence
Results of this research strategy were reported in a recent study of racial differences in police use of force by Fryer (2016). It was based on data from thousands of police-citizen encounters in several cities. Although video footage of some police-citizen interactions may be viewed, as before, the social situations being studied scientifically are reduced to data coded in terms of pre-defined, police-recorded attributes.

2.4 A metaphor modification and extension: *ceteris paribus*

The dataset metaphor as used so far needed to do more. It wasn't replaced but was pressed to greater service by extending it. This involved adding more variables and more cases. Fryer's research was central to this scientific effort. He doubled down on it by coding from available data more attributes descriptive of police-suspect encounters that might capture features that characterize the encounters or influence their dynamics. The attributes added to the dataset included suspected offense, race of suspect, date, time, place, use of lethal and non-lethal force by police, presence of firearms, duration of encounter, and various categories of peaceful, aggressive or violent acts and verbalization. This extended the research and the SOCIAL PROCESS IS DATASET metaphor.

(5) …65 pre-determined variables in six categories: (A) suspect characteristics, (B) suspect weapon(s), (C) officer characteristics, (D) officer response reason, (E) other encounter characteristics, and (F) location characteristics.

How to make "all things equal"
To gauge the influence of these variables, statistical manipulations are performed that isolate and remove the variance attributable to them. Such statistical manipulations are purported to show results "as if all things are equal" (*ceteris paribus*), to simulate a situation where the interference of all extraneous variables is nullified, making the causal relationship between the key variable (race) and outcome variable (police violence) stand out clearly.

Once this is done it is possible to see if race alone continues to be correlated with police violence. A positive correlation, though no proof of causation, is more

justifiably interpreted as such once the influence of the other variables has been removed. That is, if the race variable retains its correlation with police violence when all other variables are statistically held constant, this means that race is not a proxy for something else; race may therefore be considered to lead to police violence all by itself.

These manipulations vastly complicate the statistical techniques. Understanding these complications occupies the attention of scientists and their specialist readers, implying that to comprehend the statistics *is* to comprehend the social phenomenon. Social scientists often recognize how precarious these techniques are and that they thwart straightforward interpretations, but overall their statements foresee readers' forbearance and general acceptance of the approach. Their words evidence the dataset metaphor in operation as a conceptual convention and indicate its dominance in scientists' construal of their activities, even when hedging its interpretation:

(6) "We caution against a causal interpretation of the coefficients on the covariates, which are better viewed as proxies for a broad set of environmental and behavioral factors at the time of an incident."
(Fryer, 2016, p. 20)

'Helper' metaphors: CONTROL *and* PARTITION

But other metaphors are detected that may supplement this understanding. Where the "helper" metaphor more often is introduced to help learners or lay people understand complexities in science, the statistical machinations just described can be conceptually challenging even for specialists. The analytic procedures purport to isolate and remove the influence of real life factors from social interaction. Taken literally, this is mind-bending – on the order of biting an apple but somehow removing the sweetness in order to taste the "appleness". If the procedure were understood metaphorically as removing obstacles on the way to understanding, clearing one's line of vision to see better, or filtering contaminants from food, this might help. But there is no language found in the corpus to suggest such metaphors. Instead, where this dataset analytic approach is discussed, the extension of the dataset metaphor to include sub-mappings of "controls" and the "separating" out of confounding variables is illustrated lexically here:

(7) [results] adjusted for suspect behavior and other factors

(8) Adding precinct and year fixed effects, which estimates racial differences in police use of force by restricting to variation within a given police precinct in a given year

(9) we find no racial differences in either the raw data or when contextual factors are taken into account

(10) Adding controls for demographic and encounter characteristics

(11) Partitioning the data in myriad ways, we find no evidence of racial discrimination in officer-involved shootings

(12) [putting] Differences in quantitative magnitudes aside

(13) investigate the fraction of white and black suspects, separately, who are armed

(14) Panel B describes encounter characteristics for the full sample and then separately by race

"Controls" is a technical term for factors the variance of which is removed statistically, but it seems to retain metaphoricity by implying intent to direct the analyses of an observational study in a way resembling the use of "control groups" in an experimental study. "Partitioning," "separating," "putting aside," "taking account" is physical manipulation to express metaphorically how the social scientist tries to rid the analyses of confounding effects. ("All things being equal," "other variables held constant" or similar phrases are not found in the corpus; I employ them here because they are common in statistics texts and dictionaries.)

Results of extended dataset analysis appear in reports

The results of this further analysis are – with all other factors being equal – that police shootings of suspects are rare as expected. But not at all as expected (yet corresponding to the "stylized facts" from raw data as described earlier) black suspects were shot slightly less often than whites. Non-lethal police violence towards black suspects (such as pushing, throwing to the ground, use of handcuffs, batons, tasers or pepper spray), however, was significantly more frequent than towards other racial groups.[6]

Metaphoric confusion

Understanding of these results depends heavily on the dataset metaphor, and my review shows that it communicates effectively with a public for whom datasets are conventional; it leads one's thinking in certain helpful directions. But it is ultimately confusing, leaving the non-specialist to try to understand an abstract discussion and highly technical mathematical statistics. Specialists and non-specialists alike

6. Scholars reacted to Fryer's unexpected results with methodological criticisms, but did not challenge the dataset approach (which is nearly universally accepted; e.g. Feldman, 2016).

are asked to accept that the dataset adequately represents the social encounters being studied. Further, by accepting the variance-nullifying statistical manipulations, they must imagine a situation even more divorced from reality, where race and only race has an effect on the outcome.[7]

Is there another way to understand the results? The rational investment metaphor

If the evidence does not indicate that the race of the suspect causes police to use lethal force, and indicates only some racial bias in the use of non-lethal force, to what extent may we conclude that police therefore use force primarily for good reason? This invokes investment economics as a metaphor to insert useful terminology and, ostensibly, to aid understanding: CHOICES IN SOCIAL ENCOUNTER ARE COST VS. BENEFIT EVALUATIONS.

(15) the patterns in the data are consistent with a model in which police officers are utility maximizers

(16) the net benefit of investment in compliance is lower for blacks relative to whites.

(17) a fraction of which have a preference for discrimination, who incur relatively high expected costs of officer-involved shootings

This metaphor is imbedded in the rational choice model in sociology and behavioral economics (also known as the rational actor model): entirely rational people doing what is best for themselves in their social context, acting in their own best interests regarding their goals and the means for reaching those goals, looking ahead and making mental calculations to find least costs, highest payoffs or greatest satisfaction. As applied to the questions posed here, rational choice theory postulates that both the police and suspects will maximize the utility of their actions – that is, satisfy legitimate needs while minimizing their risks. (Scott, 2012; for discussion of rational choice theory in the context of several other theories, see Eck & Weisburd, 1995). This corresponds closely to criteria used in court decisions: the question to be answered when judging alleged violent police behavior in court is, did the police do what reasonable people would do under the circumstances?

7. There is no such actual encounter where these other factors are absent. "Nobody ever was or ever will be in a position to observe … *ceteris paribus*." (Rothbard, 2011).

Dataset metaphor leaves questions unanswered
This conclusion asserts rational choice in how the social encounters work, but this is not substantiated by scientific observations as captured by variables in the dataset, nor by characteristics of the dataset; it seems simply the default interpretation after the race hypothesis was largely disconfirmed. This conclusion may contribute somehow to the contemporary political debate about police violence, but is of little value to social science besides as an exceedingly elaborate demonstration of methodology and statistical virtuosity.

It is no wonder that journalists (Bui & Cox, 2016) describe Fryer's results in ways that explain neither what happened in various police-suspect encounters nor how the statistics of a dataset work; the following extracts show some of the mappings discussed already, but mainly they simply say what the data are.

(18) Surprising new evidence shows bias in police use of force but not in shootings

(19) Mr. Fryer found that in such situations, officers …were about 20 percent less likely to shoot if the suspects were black. This estimate was not precise, and firmer conclusions would require more data. But in various models controlling for different factors and using different definitions of tense situations, Mr. Fryer found that blacks were either less likely to be shot or there was no difference between blacks and whites.

Leaving important questions unanswered the dataset metaphor is challenged
Even the Herculean data-collection and analysis efforts described are not capable of capturing essential features of these critical police-citizen encounters. One wonders how the back-and-forth interaction of some police and some suspects actually result in shootings while others do not. Anecdotes of individual cases seem to vary widely, though their data points may be identical. The idiosyncratic dynamics of interpersonal behavior are implicated but remain unaccounted for. For example, how does training of police influence an encounter? Had they formed de-escalation habits? And did they use them? What was the level of fear in each party, and how was it expressed? To what extent did the individuals try to project reputations for toughness?

3. The social field metaphor in the study of social conflict in fraught and volatile encounters

Generally speaking, social behavior, including the decisions made and actions taken by police and citizens in an encounter, is influenced by many internal and

external factors and may include the entire spectrum of past and present experience. The encounter can be regarded as a multifaceted dynamic process. Scientists, students and others can be expected to want to know something about this process and how to find out more.

An understanding of social interaction, including alleged criminal behavior, is reflected when a properly constituted court of law hears an individual case. In court, rich detail is presented about the accused person and police officers, the alleged offense, the circumstances, along with a detailed testimony of what happened in the given police-suspect encounter. Both the more proximate, fast-changing, choice-relevant situational factors are considered, as well as long-lasting, time-stable individual differences.

A scientist who might attempt to take all such factors and dynamics into account for multiple cases would need clear theoretical guidance on what to observe and when, knowing that some of the most important factors (such as political power or social pressure) may not be readily quantifiable and must be derived qualitatively from patterns in events.

The discussion just completed above where the dataset metaphor is dominant resulted in interesting findings but leaves important questions unanswered. It is an account of empirical social science that uses after-the-fact third-party coding of predefined, surface attributes of each case. While most investigators continue to refine their datasets and methods of tabulation and analysis, other social scientists, though relatively few in number, take a different view of social conflict situations such as the police-suspect encounter. To discuss this I will use the same outline of scientific metaphor *métier* or vocation as already described to explore how metaphors structure thinking, their usefulness to scientists and laypeople, as well as how metaphors change.

3.1 Social field theory

Social field theory is the name given to theories originally propounded by Kurt Lewin (1951) and Pierre Bourdieu (1985). Such theories consider social situations with more of the broad sweep of proximate and distal influences, specifics of an encounter and its context. This portrays a web of forces that interact dynamically to move persons in a metaphoric space, towards or away from specific states or actions; when a multiplicity of these forces accord with each other the resulting thought or action will seem to be goal-directed; lack of accord may be interpreted as ambivalence, disorganization or even derangement (Vallacher et al., 2015). Furthermore, social field theory looks at sequences of events, thoughts and behavior and how they may or may not align at all relevant levels, such as personal, small group, institution, and culture, and how all these factors interact and change each

other over time. This potentially makes very complex social phenomena more intuitive and accessible (Martin, 2003).

Social field theory is the antithesis of "substance ontology" (Seibt, 2008, mentioned above) because the field is a matrix of entities (variously described as forces, perceptions, positions, resources) that has no mass and takes up no space, operates forcefully at close range or at considerable distance with no direct or indirect contact, and causes change without motion or mechanism; field theory seems to follow the spatial logic of fluid dynamics (Martin, 2003) – but there is no fluid. From this, and to some extent from that of gravity, magnetism, and electricity, is conceived multiple forces interacting over time, producing a variety of effects.

Ideally, field theory depicts a dynamically moving picture of fraught or volatile social interactions – a qualitative, processule rendition – in contrast to the snap-shot approach of quantifying a small number of static variables. When they theorize, field theorists offer a holistic approach that generally promises a full and complete accounting of the social field. Furthermore, they want to include fine-grained psychological functioning, such as habits developed through childhood and school, peer group socialization, and in general the life one lives. Field theorists particularly want to know how people change position in their social matrix, how they think and act at various points in time.

The idealized social field

In describing social field theory it is important to keep in mind that this is its ideal form – what field theorists might conceive in their wildest dreams. The absence of a corpuscular or mechanical medium to transmit forces, while at first seeming almost supernatural, relieves the social scientist from counter-intuitive claims about primary causes or the effects of a factor with all else held constant. The field metaphor offers a naturalistic, multivariate, contextually situated, everything-affects-everything process unfolding over time. Even fixed principles such as laws, rules and practices are situationally applied, accounting for patterns of both conformity and non-conformity. Note that the dataset metaphor is reliant on large numbers of cases and central-tendency statistics, that are presumed to show lawful regularities, so it is inconclusive about cases that deviate from the mean. "Field theory, in contrast, emphasizes that the regularity comes at the level of the situation and that the further one goes into a particular case, the more revealing it will be of general principles." (Martin, 2003 p. 35). Field theory clarifies general understanding by delving into the qualitative aspects of individual cases.

Consequently, causation, as conceived when the dataset metaphor is dominant and the researcher attempts to isolate causation to one or a few independent variables (see previous section), is de-emphasized or disappears altogether. It is replaced by *explanation*: a social phenomenon is explained when the interacting

elements of the social field in which it occurs, and the elements of layered or linked fields, are interpretable, their alignments (or lack thereof) are made plain and are understood (cf. Martin 2003, p. 44). This evokes the idea of "causal texture" (Tolman & Brunswik, 1935) or a causal whole, encompassing both people and their environment, that allows particular behavior or action to happen. The desired result would be to comprehend the personal and social conditions, together with organizational structure, that produce optimum police-suspect interactions. I propose a conceptual metaphor that underlies these theoretical considerations, stated as SOCIAL PROCESS IS FIELD OF FORCES WITH PARTICULAR POWER AND DIRECTION (shortened to SOCIAL PROCESS IS FIELD OF FORCES).

3.2 Application of the social field metaphor

Sub-mappings of the social field metaphor suggest how scientists' perspectives are shifted.

Social field of elements with power and direction
The conceptual metaphor SOCIAL PROCESS IS FIELD OF FORCES broadens the scientist's view. As any metaphor does, it backgrounds certain issues, and shifts perspective to highlight others in complex interaction. Where the dataset metaphor plays up questions of categorical prediction – does race lead to police violence? – the social field metaphor emphasizes the entirety of a social process – how does police-suspect conflict unfold or how might it be managed? With the social field metaphor operating, the unique effect of a suspect's race on police violence attracts much less attention. The field metaphor renders a police-suspect encounter with so many salient factors interacting over time that attention is drawn to the rapid changes occurring in even very short-duration encounters; it renders a process of give-and-take with many opportunities to change course.

The image schema of "field" includes a multitude of personal, organizational or cultural influences such as persons, social units, or social structures that have various degrees of intensity or (non-physical) power depending on their assets. Assets are conceived metaphorically as objects or entities each of which has a valence, force, or source of directed power (such assets are labeled by Bourdieu as "capital"; note the affinity for understanding sociology metaphorically as investment economics). The field is the net result of the many valences pulling and pushing in particular directions (Martin, 2003).

Sub-mapping – POSITION
Points or positions in the rich and comprehensive, hyper-dimensional social field are reduced to two- or three-dimensions. Each person, social unit, and

social structure is metaphorically understood as a point on a field or terrain. Their relative positions on the terrain are mapped to differences in their origins, circumstances, local or mutual interactions. The proximity to others represents similarities among them. Language in the following extracts shows the operation of the POSITION sub-mapping.

(20) social background, career, military education, generation, age and so on, form the basis for analysis of the social field where the officers are positioned … concerning the officer's standpoints and positions

(21) Field: a system of relations between positions

(22) a system of dispositions that effect how people act, think and orient in the social world

Sub-mapping – POWER

The SOCIAL PROCESS IS FIELD OF FORCES metaphor, to review the description so far, invokes the notion of field or terrain, upon which are a number of entities that, in turn, are mapped to persons, social units, or social structures. Each of these possesses force or power (derived from assets as described above) the Newtonian force-mechanics interpretation of which is discouraged by field theorists' substitution of the word "valence." This is mapped to intensity and direction, further discussed below. The overall field is mapped to the net result of the many valences pulling and pushing (Martin, 2003).

The metaphoric mappings often show how certain qualitative and dynamic aspects of field theory in its idealized form trade off with the well-established quantitative characteristics of the dataset metaphor. Even as researchers who have adopted field theory proclaim their ideal – the absence of a corpuscular or mechanical medium to transmit force in Newtonian fashion – their language in the extracts below invokes force mechanics nonetheless as it shows the operation of the POWER sub-mapping:

(23) the power that state or non-state actors have … imputing great strength

(24) Social capital [assets]: relatives, friends, associations, memberships, relations etc.

(25) Cultural capital [assets]: cultivated language, noblesse … seen as a sub-part of the more general notion of "symbolic capital"

(26) Economic capital: material assets and knowledge of the rules of economy

Sub-mapping – DIRECTION
Valences (forces) have direction, and the various entities' valences align or misalign in diverse ways; this maps to support or interference with each other as they interact. If the topic or target of interest here is police behavior, the valences are conceived to be directed towards, and have a net controlling influence or effect on, what police officers do as they encounter a crime suspect, how they might then move along trajectories to future positions.

(27) the people towards whom the change is directed

(28) crime and crime control became central within the political and social arenas

(29) control through the criminal justice system as well as medical and psychological facilities, which are directed towards individual police officers

Sub-mapping – SEMI-AUTONOMOUS FIELDS
Semi-autonomous fields are metaphorically understood as physical layers – an organized physical structure or system with various levels. Even though what is within the bounds of each level and how it is organized is independently determined, the layers provide some kind of mutual support and stability. In social field theory this maps to two or more social field terrains and within the boundaries of each are certain independently determined customs and rules. The levels relate to each other hierarchically from macroscopic/general to microscopic/specific.[8] These excerpts exemplify the use of certain terms and suggest how the SEMI-AUTONOMOUS FIELD conceptual metaphor operates:

(30) semi-autonomous fields are defined by their boundaries and ability to create rules or induce compliance to them

(31) These social systems create rules, customs and symbols, and are simultaneously influenced by external rules, decisions and forces

(32) understanding how police officers, who belong to particular social fields, comply with and resist

To what extent do social field theory metaphors guide observations?
The SOCIAL FIELD metaphor, and its sub-mappings of POSITION, DIRECTION, POWER, and SEMI-AUTONOMOUS FIELDS, are capable of guiding investigations and

8. The overall structure of fields is mapped to overall structure of behaviors in Bourdieu's idea of "Habitus" (Latinized 'habit', dictionary definition: general constitution, especially physical build).

suggesting hypotheses. I was not able to find examples in the literature of social field theory applied specifically to investigate violence in police-suspect encounters. But I have found field theory scholarship, as applied to the use of legitimate force to coerce compliance, focusing most often not on incidence of violence, but on reform of police and military institutions in ways that properly regulate such force; such texts form the corpus for this section (see Appendix 1). These applications of social field theory offer in-depth understanding of police and military planning and of reform of these complex social systems, particularly social conflict as it arises in such reform projects. Social field theory is well suited to comprehend change from previous patterns. For scientists it is generative in the sense that it prompts investigators to consider multiple standpoints, including objective perspectives simultaneously with subjective ones. Students and the lay public can then be given a bigger picture than the recitation of statistics would portray.

Some evidence of the afterlife of dataset metaphor

To test hypotheses generated by the social field metaphor, the researcher tries to characterize all relevant fields, capture organizational characteristics and the perceptions of the people involved. To do this, observations are performed, along with interviews and even focus groups, to apprehend individual and group norms, attitudes, beliefs, values, goals, and behavior. It is daunting to take full account of all social field information as it emerges over the relevant time period for the cases involved.

This practical reality impacts research strategies in the use of social field theory. The requisite amounts of time and other resources can be prohibitive. Additionally, the strong mandate in science to quantify and predict, will influence field scientists' priorities. So the field theory researcher may be obliged to put the information gathered into the form of a dataset, a well-known research tool as discussed in the previous section. Unavoidably the dataset metaphor is reincarnated, coexisting with metaphors indigenous to social field theory.

Possible metaphoric contradiction

In describing their methods for apprehending the social field under study, the scientists' language (see excerpts below) gives evidence of the social field metaphor as expected. But some investigators also give lists of psychosocial traits and states to be measured. This suggests that they may be planning to collect coded data that can be plugged into a dataset. Others overtly refer to such a dataset. This can implicitly undermine field theory's more inclusive purview and invoke the physical force causation metaphor described in the previous section.

(33) researchers have relied on qualitative methods …to capture the nuances of organisational norms and values,

(34) framework of cultural knowledge within organisations … important factors are public perception of the police, crime and violence levels, feelings of insecurity …

(35) To understand the …social climate, objective characteristics …must be measured

(36) The aim of the study has been to create an empirical data base

'Helper' metaphors

A metaphor found in social field theory scholarship that is to assist understanding, although it may oversimplify, is the dramaturgical metaphor, ROLE, along with some of its conventional sub-mappings, such as a learned sequence, manner of acting, individual subjective experience, fulfilling a function, responding to demands from outside:

(37) the role considered to be core skills, cognitions and affect … It includes, accepted practices, rules and principles of conduct that are situationally applied, and generalised rationales and beliefs. In other words, it is the manner in which police officers' chiefs and colleagues expect law enforcement officials to conduct their work.

(38) these actors and their continuous involvement play a crucial role in …

Another "helper" metaphor is that of the GAME (social, not game theory), which organizes understanding of a field and how it works using conventionalized sub-mappings such as competition, rules, fairness, prize-winning, object of game.

(39) [game captures] the field's ability to provide goals while being a site of conflict

(40) fields differ from board games, however, in that the struggle is both over and within the rules

(41) alignments between actors oriented to related prizes

The social field theory metaphor is retained for certain uses

Social field theory inspires many researchers with a promise of understanding the entire social field. Unfortunately most researchers do not undertake (no doubt could not find the resources to undertake) the sweeping and inclusive investigations that the theory seems to call for, but instead tend to reduce how they represent the social field to small combinations of factors. In that way the promise of social field theory is not fulfilled.

While social field theory posits large numbers of interacting factors and a multi-level structure ranging from macroscopic generality to microscopic specificity, it resists the formalization required to empirically predict specific outcomes. Since the formalization is lacking, the theory, underpinned by metaphors as described above, succeeds in offering big-picture perspective, but fails to provide the kind of predictive power that can be reduced to a formula or that might ultimately be considered lawful. The FIELD metaphor with its sub-mappings of POSITION, POWER, DIRECTION, and SEMI-AUTONOMOUS LEVELS re-purposes existing terminology and communicates specific meaning, making it more cognitively useful. But even with help from these metaphors, the theory has thus far generated few clear or specific hypotheses as to how field elements interact over time to produce such macro events as occur in fraught or volatile social encounters.

Field theory metaphors leave important questions unanswered
Social field theory research, producing broad understanding and eschewing clear prescriptions for policy initiatives, leaves questions unanswered. Governmental authorities and scientific funding agencies often want more specific guidance than is provided by the general understanding and explanations of social field theory. Because it has fallen short in this way different tools might be needed to unlock its potential, which may include computer simulation modeling. Lewin and Bourdieu had no access to these tools and so perhaps their theories had to wait until such methods had been sufficiently developed.

4. The adaptive dynamical systems metaphor in the study of fraught and volatile social encounters

Challenge to other metaphors. Both the dataset metaphor and its approach, and the social field metaphor with its approach, seemed ineffectual in accounting for an event such as police violence in encounters with crime suspects. Reasons are numerous, but one that stands out is the assumption common to both the dataset and social field theory approaches, that outcomes are linearly related to independent variables, and this is always likely to fail:

> Despite the assumption of linear causality embedded in the last 400 years of science, it is almost impossible to predict specific outcomes in any nonlinear social system; their dynamics are too complex… However, *general patterns* of thoughts, feelings, actions, and so on can be determined.
>
> (Vallacher et al. 2015, p. 77, emphasis added)

4.1 Basic form of dynamical systems metaphor and its application

To better predict and explain the higher-order event (the outcome of a tense social process) social scientists are motivated to look for another approach. Violence escalates, for example, in only some cases or seems to appear spontaneously, idiosyncratically, almost by accident. Of perhaps greater importance are the equally unpredictable instances of calm, acquiescence or collaboration that characterize the non-violent cases.

Adaptive dynamical systems theory had already been developed to address non-linear dynamics, instability, sudden changes, over- and under-response, and chaotic tendencies in physical sciences such as astronomy and meteorology. Its usefulness in these and other complex fields was noticed by some social scientists. Having been primed by social field theory to consider the social matrix of interacting elements (as discussed in the previous section), some social scientists were able to re-conceptualize the encounters as part of an adaptive dynamical system.

The dynamical systems approach shares with social field theory the notion that social process is a FIELD OF FORCES, in two or more layers. As in social field theory, the field and its layered composition are not directly observable as such, but their metaphoric structures are mapped to observable phenomena.

The layers are ordered HIERARCHICALLY and range from macroscopic, or more abstract elements (interpersonal, group or societal interactions), to microscopic, or more concrete elements (individual thoughts, feelings, behavior). This multilevel field corresponds with conventional ideas of hierarchy in social psychology (Lawler, Ridgeway & Markovsky, 1993). By incorporating these figurative elements a complex of integrated elements interacting over time is invoked. It is a simple step to propose a conceptual metaphor for the fraught or violent social process stated as SOCIAL ENCOUNTER IS ADAPTIVE DYNAMICAL SYSTEM.

4.2 The adaptive dynamical system metaphor and its sub-mappings

This metaphor is considered in terms of three sub-mappings: LEVELS AND TIME, LINEAR AND NON-LINEAR MOVEMENT, and EQUILIBRIUM. These are necessary and specific characteristics integral to the operation of adaptive dynamical systems and some, in turn, have additional metaphoric sub-mappings operating within them.

The sub-mapping of LEVELS AND TIME

In contrast to the dataset or field theory approaches, the dynamical systems approach prompts the scientist to consider the macro level of the social scientist's interest – the societal level of interpersonal or group behavior, together with

the micro level – the internal psychological processes of the individual. (Other intermediate levels might also be identified but none are discussed here.)

Dynamical systems theory postulates a degree of independence and autonomous ordering of elements within each level such that the activity within a level coalesces and organizes itself. Sometimes, but not always, this gives rise to surprising patterns at another level that are not reducible to this self-organization. The exact form of such organization at one level, or how it gives rise to new patterns at another level, are not directly observable.

Unexpected macro level outcomes, that may occur due to non-linear relationships, are said to *emerge*. This word is used in the sense of a shoot that emerges from a seed, or a rainbow emerging after a storm. Violence in police-suspect encounters can be considered as a phenomenon that emerges from a mix of factors interacting in a non-linear fashion. This suggests another metaphoric mapping that might be stated as EMERGENCE IS APPEARANCE OF IRREDUCIBLE NEW PATTERN. It asks how the organization at each level develops over time and influences organization at other levels.[9]

(42) visualize the emergence of social structures due to dynamic processes

(43) higher-level properties and behaviors emerge from the internal workings of the system, the process is commonly referred to as self-organization

The concept of emergence is named and minimally described, using conceptually limited language in these excerpts.

Mapping LEVELS AND TIME to observations

For purposes here, the macro level is mapped, for parties to a fraught or volatile social encounter, to their mutual interaction and the micro level is mapped to psychological dynamics – what each individual may be thinking, feeling, or processing internally.

9. The metaphor suggested by the word "emergence" comes from its dictionary meanings: something that appears, comes into view, unfolds, issues forth, arises, becomes known, or becomes important; and from mappings of the underlying metaphors of vision, procreation, or the contents coming out of a container. While adding color, these figurative meanings have little generative effect. The semantic richness in *emergence* is lost and, as a metaphor, it can be said to be closed. It has introduced a useful term the practical, literal understanding of which depends on its definition in complexity science: emergence is a higher-order property or behavior that comes about from the complex interactions of lower-order elements, but which cannot be reduced or ascribed to the properties of those elements. (see Christen & Franklin, 2002, for a full explanation of the concept of emergence, its possible roots in vitalism, and relation to reductionism).

The micro level is often neglected in traditional social science, for example, in sociology or behavioral economics; or it is represented by snapshot summaries, one-time attitude assessments, or demographic categories. Psychological dynamics can vary from case to case depending on individual differences, situational factors, and the temporal arrangement of events. Traditional social scientists study large numbers of cases, use central tendency statistics, and expect the variation due to micro level psychological dynamics to cancel out. Dynamical systems investigators, on the other hand, attempt to monitor these processes at both levels, at many points in time, and take these data fully into account.

For the corpus used in this section, lexical evidence appears that some, but not all, of the metaphoric features just mentioned are employed to structure this kind of social science. Investigators are prompted to note how much activity at one level seems connected with change at another. In the following extracts, language is found that invokes a vertical, high-low metaphor (BETTER, STRONGER, MORE IMPORTANT IS HIGHER). It associates high with macro and low with micro, implying that high level or macro properties are of greater importance, yet offering little else about how authors in this corpus think about these levels; the spatial and structural aspects are named but not conceptually elaborated.

(44) functional independence of a system's lower-level elements …promote meaningful changes at the macro level

(45) promotes progressive integration of system elements into a higher order structure … patterns due to the particular confluence of forces at any point in time

(46) properties at a macro level cannot be derived from properties of the system's lower level elements

At this point it is revealing to add the metaphor of time passing on a continuum, which gives a sense of movement and some context for unforeseen activity:

(47) not as a moment-in-time, but rather as a process unfolding in relationships across time

(48) Over time, the initial response may become amplified in intensity, diminished in intensity, or follow a more complex time course such as periodic oscillation or chaos

Because of the conventional, entrenched metaphors TIME IS DISTANCE and CHANGE IS MOVEMENT, the passage of time implies change. Investigators, now primed to ask about changes at both micro and macro levels over an expanse of time, are better attuned to outcomes that seem to occur spontaneously.

Sub-mapping: LINEAR AND NONLINEAR MOVEMENT

How are we to understand these spontaneous outcomes? Dynamical systems are well known to involve non-linear relationships, which are difficult to observe in action or to detect statistically. While the notions of linearity and non-linearity can be applied quite literally when talking specifically about observed psychological dynamics or social behavior, they are applied figuratively as sub-mappings of the FRAUGHT AND VOLATILE SOCIAL ENCOUNTER IS ADAPTIVE DYNAMICAL SYSTEM metaphor. These sub-mappings can have multiple implications, where movement is over a metaphoric system terrain, a dimension of which is time, and which might progress in a straight line, a curve, or in some squiggly form. Metaphoric implications, along with literal ones, are evidenced in corpus examples below. The metaphoric sub-mappings do not help predict when such movement, or its form or direction, might be observed; still the implications alert a researcher to possibilities:

(49) whether a linear or a nonlinear trajectory is observed in conflicts characterized by increasing provocations

(50) the hysteresis [being stuck in recurring pattern] associated with nonlinear systems

(51) Even a slight change … will promote a change in the system's trajectory

(52) momentary thought, feeling, or action represents a punctuation point in a continuous flow of events that interact over time, producing a complex trajectory of points

The notions of linear and non-linear movement in all of its variety suggests that the social field, while sometimes flat, can include curving terrain that may resemble hills and valleys. This metaphoric representation appears in the "helper" metaphor described later.

Initial scientific observations related to LEVELS AND TIME

Dynamical systems research in social science focuses investigators' attention, over the duration of an encounter, on both the macro level of social interaction, and each person's microcosmic, internally generated patterns of emotion and thought. General findings accord with the metaphorically conceived macro-micro distinction, and show the micro patterns to have clear but quite complex influence on macrocosmic outcomes (Vallacher et al., 2015). Later we shall see how this provides opportunities for further observations and interventions in social interaction.

Sub-mapping: EQUILIBRIUM

Not found in the dataset or field theory approach, a basic feature of dynamical systems includes intervals of turbulence usually followed by quiescence, or chaos followed by orderliness; dynamical systems tend to settle into some kind of equipoise that prevails over time. Such an equilibrium may be sustained, or may lapse into escalating instability should a disruptive event occur or someone act provocatively. That is, on the one hand, if micro elements of a system (the emotions, desires, intentions and behavior of parties to the encounter) become volatile or disruptive, dangerous or destructive outcomes can result. On the other hand, if the turbulence is somehow endured, the system eventually slows, reaching a stable or cyclically regular state (cf. homeostasis metaphor in Johnson, 1987).

The dynamical system in equilibrium can be mapped to the social interaction; the metaphor might be identified as SOCIAL DYNAMICS IS QUIET/NOISY MOVEMENT. The dynamics of equilibrium in systems theory evokes the image of ongoing movement that is slow, smooth, quiet, perhaps repetitive, maintaining a kind of balance. On the one hand, small stresses or pushes from outside may disrupt the pattern, making the movement momentarily turbulent; this maps in general to deviation from the norm, irregular action, and in social science to non-cooperation, non-compliance, argument, threats. If the system recalibrates and outside forces dissipate, stability can be restored; this maps to restoration of calm, restraint and compliance.

On the other hand, strong, continuing pushes from outside, perhaps combined with internal weakness from fatigue, can result in loss of this quiet state as the system must make more extensive adaptations and seek some steady state different from the previous one; this maps in general to change in relative position, encroachment, escape, destruction, and in social science to aggression or violence. Below are lexical examples of how social science theorists use this EQUILIBRIUM metaphor when drawing parallels to dynamical phenomena in other scientific domains:

(53) In ecology, the concern is how animals interact to generate and maintain a balance between predator and prey

(54) bodies such as planets and moons influence each other to produce stable orbits

Notice once again the implication of process over time. The metaphor encompasses an entire social encounter; it prompts investigators to observe the system jointly formed by potentially conflicting parties from beginning to end, to look for evidence of balance maintained or lost, oscillations, perturbations, weakening, and different degrees of outside influences over the duration of the encounter. In

textual examples given, researchers who have adopted adaptive dynamical systems theory use language that indicate their implicit mapping of LINEAR AND NONLINEAR MOVEMENT and SOCIAL DYNAMICS IS QUIET/NOISY MOVEMENT to the kinds of interaction found between parties in conflict:

(55) display resistance to change in their behavioral options in the face of increasing provocation by the other person, until a threshold was reached, at which time they would switch from a relatively conciliatory behavioral choice to a more aggressive choice

(56) dynamical systems tend to display periods of stability and resistance to change, punctuated by periods of disassembly

(57) an external force may diminish, perhaps rapidly or perhaps slowly, or it may become intensified …the process in question can display different equilibrium tendencies

(58) tends to maintain that state despite forces and influences that have the potential to destabilize it. An external influence may perturb the system and move it to another state, but the system will return fairly quickly

If a disruption or provocation is prolonged or repeated, the system adapts and can self-organize, forming a new equilibrium. This macro level pattern then exerts a "downward causation" that tends to reorganize and limit micro level elements so as to perpetuate the new equilibrium. Sometimes the state of the system will alternate between the two. The notion of "downward causation" is conceptualized metaphorically as an organizational pattern appearing spontaneously and that configures, limits and restrains.

(59) Once a higher-level state emerges by means of self-organization, it constrains the behavior of the [microcosmic] elements that give rise to it

(60) From this disassembled state of affairs, however, the system is primed for self-organization and the emergence of a new higher-order state that provides a different dynamic configuration of the lower-level elements

Metaphor thus far confirmed

Observations of people in conflict largely validate these metaphoric inferences. At the micro level, when the people involved display relatively quiet emotions and deliberate attempts to control their behavior, this is followed at the macro level by acquiescence, giving and following of instructions, and relative calmness. Social science research shows that small perturbations – ones not large enough to disrupt – can heighten activity level to the point that inertia or stagnation is overcome, attention, learning, and creativity occur, and change becomes possible (Vallacher

et al., 2015). But if more severe perturbations push individuals out of equilibrium, resulting in prolonged aggressive behavior, participants adapt and cope at this more aggravated level, stimulating and heightening micro level emotions and actions needed for fight or flight; this may continue to a violent conclusion.

Metaphor usefulness: Questions posed that lead to dynamical interpretation of psychological experiments

Most psychological experimentation reported in the academic literature is not carried out from a dynamical systems perspective but uses a model such as group conformity or rational choice. For example, the rational choice model predicts proportional response to stimuli (a linear function of provocation) – if subjects are provoked mildly, a rational response would be relatively mild, compared to when provoked strongly, when the response is expected to be stronger. Yet results often show unexplained non-proportionate (nonlinear) responses.

Reasoning from the adaptive dynamical systems source domain, what conditions might investigators look for that would explain when responses are proportionate vs. non-proportionate, that is, over-reaction, under-reaction, or proportionate responses to strong perturbations? Reasoning from this metaphor, to the degree that cognitive dynamics are well-established and integrated, the individual's cognitive trajectory will be more stable and predictable. This strengthens the equilibrium state in the face of threatening perturbations, leading us to expect more carefully regulated and linearly proportionate responses. If, on the other hand, one's cognitive dynamics are minimally structured, the trajectory may diverge.

This accords with findings: For example, it has been shown that bringing a person's conscious attention to micro-level behavior (his or her own internal dynamics) will predispose one to accept macro-level explanations or justifications (Vallacher et al., 2015). The dynamical systems metaphor suggests that self-reflection on one's own processes will reinforce and stabilize cognitive structure, perhaps by activating feedback loops. Positive and negative feedback loops reinforce each other progressively and are thought to be integral to adaptation and self-organization. More and varied feedback loops are known to strengthen integration of the overall system. An equilibrium that results might be expected to be more resistant to perturbations. As already shown above, in language used by systems theorists, some of this reasoning can be detected:

(61) whether a linear or a nonlinear trajectory is observed in conflicts characterized by increasing provocations

However, experiments indicate a possible interaction with one's generalized need for closure (intolerance of ambiguity, complexity, nuance, and uncertainty; see

Kruglanski & Webster, 1996). Individuals impatient for closure are found more likely to over-respond (respond non-linearly) to perceived uncertainty or threat. Those with low need for closure, on the other hand, tolerate ambiguity and respond more proportionately (linearly), and are judged to be more constructive. In describing need for closure, terms are used that might describe conditions of equilibrium in a dynamical system:

(62) [with high need for closure] there is intolerance of nuance and little patience for having all the pertinent facts

(63) [with low need for closure] tolerance of ambiguity, complexity, nuance, and uncertainty

Left to future research is the question of whether tests used to measure need for closure are actually assessing the stability and integration of one's cognitive structure, as suggested by the EQUILIBRIUM and *LINEAR AND NONLINEAR MOVEMENT* sub-mappings.

"Helper" metaphor: ATTRACTORS

So far in this section I have offered the overall metaphor FRAUGHT AND VOLATILE SOCIAL ENCOUNTER IS ADAPTIVE DYNAMICAL SYSTEM and have used several sub-mappings that further describe the social encounter: MULTI-LEVEL MACRO–MICRO STRUCTURE, TIME, LINEAR AND NONLINEAR MOVEMENT, and EQUILIBRIUM, including other semantically rich notions such as system perturbation, emergence, self-organization, and trajectory.

Together, these mappings offer a useful semantic network. Additional help in thinking about this complexity comes from another metaphor used by systems theorists, a notion that largely summarizes those just listed, known as ATTRACTORS. I am suggesting the conceptual metaphor SOCIAL ENCOUNTER IS A BALL ROLLING ON ATTRACTOR TERRAIN. I term this a "helper" metaphor because it helps one think readily of the entire subject matter in a relatively coherent way; but one can see that the sub-mappings, if followed too closely, are epistemologically troubling. Here is a description, with sub-mappings indicated (see Figure 1):

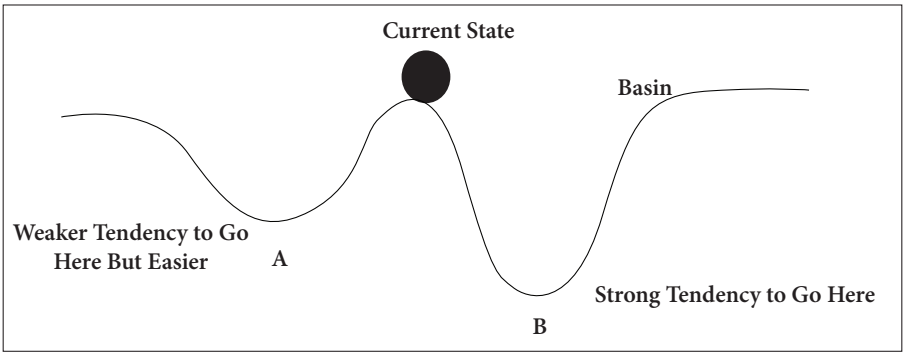

Figure 1. Dynamical system with two attractors (A and B)

Mapping "helper" metaphor to observations

A dynamical system moves on its landscape like a ball might move on a hilly surface that includes flat and inclined areas and distinct basins. The ball maps to the system's (the social encounter's) current macro state (such as calm, assertive, violent); the distance traveled maps to successive points in time; the landscape with its hills and valleys maps to micro conditions as encountered over time. These mappings suggest that one think of the macro or current state of the system (mutual behavior of police and suspect) as something that can move/roll/travel (that is, change), entering or leaving distinctive topological regions (types of interaction). With this metaphorical view, the question is, where would it go? This metaphor helps us interpret the kinds of conditions that can lead to psychosocial stabilities, resistances, instabilities and changes in individual cases and aggregate results. So, what factors predispose movement along this trajectory and what alternatives exist for where the system might ultimately come to rest?

Valleys or basins in the landscape (A and B in Figure 1) map to areas of equilibrium. In this example there are two such regions on the landscape, one characterized as forceful, aggressive or violent behavior (B in Figure 1 is easier to enter and more difficult to leave), and the other as relatively peaceful or non-violent behavior (A). A basin exerts the pull of gravity, depending on where the system is currently located, down its walls, and this maps as tendencies to equilibrium.

So some regions seem to attract the system, causing the ball, if it is nearby, to enter the region and stay there and to return should it be pushed out; this maps to how macro patterns of behavior, when repeated, structure and constrain, in the manner of "downward causation", future micro behavioral sequences in the social encounter such that they repeat, resist change, or are difficult to alter.

Multiple basins map to alternative equilibrium states (such as calm compliance or aggressive resistance). The rim of each basin maps to system boundary conditions where volatile turbulence can occur; the slope of the walls maps to ease

of entry or exit; the depth maps to the stability of the equilibrium or whether, after small or brief changes, the system will simply return to the same attractor even though others may have been available.

The tendency of dynamical systems to find and move towards an equilibrium creates a trajectory. The trajectory is not only formed by internal factors metaphorically understood as the hills and valleys of the terrain, but also by external influences that change system state (such as the sound of gunfire that might provoke momentary police assertiveness or suspect resistance, aggressive goading, bystander/mob intervention, severe weather or, on the other hand, assurances of safety). These influences propel the system in one direction or another, and with sufficient force alter the trajectory by overcoming the effect of gravity and contours of the terrain. This could push/escalate the system out of its current non-violent attractor basin (A in Figure 1). If the external force is of short duration, energy dissipates, and if the basin is wide enough and the slope steep enough, the system tends to return to the attractor after disruption. If it is of longer duration or greater force, it could push the system into another attractor (B in Figure 1), corresponding to escalation involving high aggression or fighting.

This metaphor and its various features are detected in the language of systems theorists when they are speaking about ATTRACTOR dynamics.

(64) An artificial gravity relentlessly pulls those participants downhill into a valley

(65) The location in that landscape represents some characteristic of the conflict, for example, the emotional states of the participants

(66) conflict acts like a gravity well into which the surrounding mental, behavioral, and social-structural landscape begins to slide

(67) the system … can escape … and settle in [another attractor] … if enough force is employed to move the ball up the hill and into the valley

(68) lasting changes in the state of the system, meanwhile, correspond to changes in the structure of attractors

(69) negative events and interactions may fail to disrupt peaceful relations but gradually create and deepen a latent negative attractor

(70) the positive attractor loses its stability and the relationship abruptly moves to the extreme values defined by the negative attractor

(71) promote a large change in the system's trajectory if this change represents a state that falls just outside the original basin of attraction and within a basin for a different attractor

(72) Each element can be stimulated and perpetuated along its current path through reinforcing feedback loops between elements, where one element stimulates another along its current trajectory and this element, in turn, stimulates the first – thus making a loop.

(73) Escape out of the valley, and therefore out of the conflict, is possible only if additional forces or a change in behavior get the participants past the top ridge that forms the valley, or a deeper more favorable valley opens up within their reach.

Computer applications that depict systems as shown in Figure 1 allow the user to watch the results of system dynamics over time and to experiment by altering internal and external influences (Vallacher et al., 2015); this can provide new grounding for the dynamical systems metaphor that consolidates complicated verbal descriptions such as appear above. Exposing people to systems concepts has been shown to induce a systems-thinking mindset (Thibodeau et al., 2016).

Epistemological confusion likely

As a "helper," the attractor metaphor facilitates rapid appreciation of dynamical systems, and generates scientific and practical ideas. But students should be aware that it contains errors in what it teaches.

The account given by attractor dynamics neatly depicts a system stabilizing as a ball rolls into a depression, or attractor. This metaphorically substitutes movement for change, space for time, rest for stability, and gravity for force or propulsion – portraying a comprehensive and lucid dynamic. However, what has been learned from this metaphoric depiction about the complexity of the state of the system, the processes of dynamical interaction, adaptation, feedback, and self-organization that operate over time? All of these are backgrounded by the rolling ball metaphor. This metaphor explains little about the internal and external sources and flows of force or energy, activation of feedback loops or how attractors are formed and changed when these are depicted metaphorically as the simple pull of gravity (Smith, 2015).

4.3 Metaphor retention: Usefulness in posing questions and in assisting practical applications

How a dynamical system works is known in detail from the results in solving differential equations or running computer simulations. Such systems possess distinct features not found in the dataset approach or social field theory. As has been described above, the theory and many of its metaphorical aspects have generated helpful social science hypotheses. Because there are so many factors in a system

interacting in a multiplicity of ways, empirical scientific investigation understandably proceeds step by step. Observational and experimental studies of various conflictual social encounters largely support the mappings as described above, and computer simulations demonstrate dynamical system behavior conceptualized as attractor dynamics. Notwithstanding certain cautions as mentioned, these results argue for retention of the metaphor in studying social processes.

The FRAUGHT AND VOLATILE SOCIAL ENCOUNTER IS ADAPTIVE DYNAMICAL SYSTEM metaphor, with its sub-mappings, is promising as a pedagogical tool, particularly for students already familiar with the mathematical and computational means of investigating dynamical systems. For the general public, the ATTRACTOR as a "helper" metaphor offers access to what might initially appear daunting; it can be found in popular accounts of such topics as fractal images and brain science. An additional argument for retention of the metaphor comes from its possible practical applications, for example, in training those who actually deal with intense conflict. To the degree such training is found effective in shifting perspective and conceptualizing situations accordingly, trainees may learn to pay attention to multiple factors, regulate responses to provocation, and recognize emergent regularities.

5. Review, discussion and guidance on the use of metaphors in science

SCIENCE IS EXPLORATION, as a phrase (if not usually identified as metaphor), is reliably found in introductions to science and attempts to inspire students (e.g. Sagan, 1986; Fredericks, 2000). This is a version of the journey metaphor, but with only a hint of where one might be going. While EXPLORATION may animate novices, scientists will probably find metaphors of greater use if they more clearly suggest direction.

As presented here, the initial metaphor to explain the atom actually did have an objective, because it mapped from the solar system to atomic particles and directed scientists quite specifically to find electrons moving in orbits. The dataset metaphor in social science is less specifically focused yet suggests how the scientist can look for statistical relationships with which to piece together concepts and attempt to quantify causation. The social field metaphor radically widens the context, diffuses the social scientist's attention, frustrating prediction but promoting attention to qualitative dimensions. By accepting an adaptive dynamical system as metaphor the social scientist puts prediction aside in order to glimpse the operation of multiple cognitive and social feedback loops, near chaotic interaction, and periodic attraction into self-organized states.

By reviewing use of these central metaphors one sees how social science has attempted to mimic the apparent precision of physical science and track the most macro level tendencies in large social groups. But to account at the micro level for individual cases or to deal with unstable social situations, scientists are better advised to look for the non-linear, multi-causal complexity underlying social reality. Of course it was physical scientists who set this course, first having great success predicting motion of large objects using Newtonian formulations, then discovering dynamical systems to explain the fine details and to understand physics at the nuclear level.

The métier or vocation of each scientific metaphor discussed here makes clear that none of these central metaphors operates in a simple manner. Different sub-mappings apply in exploring different questions, all of the metaphors are subject to change as they are used, and they combine to compensate for their deficiencies.

5.1 Reviewing the target domain

Compared to the physical sciences, the social sciences may appear less strict, neither mathematically disciplined, nor genuinely scientific. The topic or target domain chosen here – highly contentious social encounters – is in fact a very rigorously studied subject in social science. The various theories brought to bear spring from many of the same conceptual insights as, for example, theories in astronomy, physics, and evolutionary biology.

To sharpen the discussion I chose social encounters characterized as fraught and volatile, and often used the example of police officers interacting with crime suspects at the time of, or very soon after, an alleged crime. Such encounters are fraught because so many factors and circumstances are in play, and volatile because of the potential for violence and harm. If science generally seeks to discover regularities, this topic is doubly challenging because violent outcomes, while of critical importance, are relatively infrequent and, as they arise from a wide range of triggering events, often defy comprehension. In this social science example the metaphors that might be most helpful are unlikely to be simple and prosaic, but more likely those with complex source domains.

The general outline of metaphor métier or vocation, used in the earlier sections, provides a framework for review by drawing our attention to each metaphor's initial form and the sub-mappings crucial in shaping hypotheses, modifications made, and the degree to which the metaphor is found useful and retained over the years.

5.2 Review of three metaphors in social science, their application, mappings and modifications

Reviewing the dataset approach in social science might be shown historically to have evolved from numeracy in the earliest days of trade and commerce – keeping track of possessions and currency, records of inventory and accounts arranged and manipulated very much as social science data is today; a simple and straightforward general-purpose scheme through which early civilizations managed and controlled a crucial and highly complex aspect of their lives, just as today social scientists use it to manage highly complex subject matter. One may presume a dataset to be theory-neutral because it is simply a collection of objects coded as numbers, whatever subject or topic it is applied to. But, by identifying metaphors inherent in the approach, built-in foregrounding and backgrounding of factors can be detected; for example, very simple notions of cause and effect are promoted while dynamic unfolding of rare events is backgrounded.

The dataset approach was presented here in terms of its key sub-mappings – SOCIAL PROCESS IS COLLECTION, MANIPULATION AND INSPECTION OF OBJECTS; PRECISION/ACCURACY IS ASSIGNING NUMBERS TO OBJECTS AND MANIPULATING THE NUMBERS; CHANGE IS ONE ENTITY PUSHING ANOTHER SO AS TO MOVE IT; CHOICES IN SOCIAL ENCOUNTER ARE COST VS. BENEFIT EVALUATIONS. The highly conventional CHANGE IS MOVEMENT mapping, very clearly operating in theorists' language, encourages what I try to show, in the social science context, as naive determinism.

In the very recent study of race in police-suspect violence discussed above, early dataset analysis showed, contrary to widespread belief, little effect and was inconclusive. The dataset metaphor, as it affected this study, wasn't revamped or replaced, but was expanded. The helper metaphors CONTROL and SEPARATION were added; these may have hurt more than helped, as some scientists and most learners struggle with the idea of separating out variance due to extraneous variables in order to control the statistical analysis. The results regarding race as linked to police shootings were again mostly inconclusive. This unexpected result was interpreted in terms of a rational choice metaphor.

This is not an indictment of the dataset approach or its underlying metaphors, but it does illustrate limitations of the dataset approach to explain complex social phenomena. When extensive dataset analyses are complete, both scientists and learners may know more about tabulation and statistical techniques, but still wonder about the subject matter – how the encounters of police and some suspects actually result in shootings while others do not. Anecdotes of individual cases seem to vary widely, though their data points may be identical.

The dataset approach is, of course, deliberately introduced, but the underlying SOCIAL PROCESS IS DATASET metaphor has become highly conventional and would not often be consciously recognized; it is closed as a cognitive aid for helping social scientists reason about their subject matter, while retaining metaphoric sub-mappings. The metaphor with its sub-mappings is clearly constitutive of the statistical theories used in social science and makes lexical contributions, such as the very specific statistical meanings of "probability," "holding factors constant" plus other statistics terms. But, unless used in conjunction with a strong subject matter theory, it is no more constitutive in explaining the social dynamics under study than, say, one's grocery list is to the intricacies of preparing and eating the Sunday meal.[10]

Reviewing the social field theory approach

Inspired by field theories in physics, social field theory contrasts sharply with the dataset approach. In general, social field theory is successful in communicating the field of forces notion – its hallmark – and this is a major contribution. As metaphor it stimulates curiosity and enables generations of social scientists to take a broader view by mapping the source domain of an observable physical force field to the difficult to observe non-physical dynamics of social process; By invoking the multitude of physical entities pushing and pulling on a physical plane or a matrix of forces operating in a hydraulic apparatus, the conceptual metaphor, SOCIAL PROCESS IS FIELD OF FORCES, guides thinking and promises detailed comprehension of what is happening using a new and insightful lexicon. But it offers few if any actual predictions. The social field theory metaphor is intuitively appealing and persuasive at least partly because it seems to accord with personal experience in the world.

The sub-mapping of SEMI-AUTONOMOUS FIELDS conjures up multiple levels of these fields of forces, with the layers sometimes reinforcing, sometimes inhibiting, each other. Additional sub-mappings – POSITION, DIRECTION, POWER – draw scientist's attention to regularities in complex dynamics while suppressing simplistic determinism. It is generative by prompting investigators, students and the lay public to see a bigger picture and consider multiple standpoints.

10. Consider whether a source domain of DATASET might better be thought of as a virtual interface (Preece et al., 1994. pp. 141–154) to the social process under study (target); the user (either scientist or learner) knows little of the actual workings of the social process, remains unaware of its structure and function, and the successful virtual interface doesn't help the user develop such understanding; instead the user becomes highly familiar with the structure and function of the virtual interface.

Terms from physical theories, such as "position," "relation," "directionality," "control," "power" and, of course, "field" have been re-deployed and continue to be part of the social science lexicon. But social field theory hasn't been formalized enough to gain wide acceptance among social scientists. It is not unusual to find investigators using field notions and much of the vocabulary of the social field metaphor, but employing datasets to structure their research.

Reviewing the adaptive dynamical systems approach

Dynamical systems theory, imported from "hard" sciences such as astronomy and physics, conceives of physical movement on an extensive physical plane, and maps it to the psychosocial realm. It coexists with, and profits from, both the dataset and social field metaphors which continue to live on in the study of adaptive dynamical systems. The enriched framework prompts investigators to see social processes with fresh awareness and to look for patterns not contemplated by other approaches.

Where field theory sought regularities from the pushing and pulling in vast fields of forces, dynamical systems theory attempts to account also for the irregularities, including chaotic, cyclic, and sudden transmutations. The central metaphor, SOCIAL PROCESS IS FIELD OF FORCES includes the sub-mapping HIERARCHICALLY ARRANGED LEVELS AND TIME, so investigators are primed to observe changes at both micro and macro levels over an expanse of time. Micro psychodynamical patterns, often neglected in traditional social science, have clear but quite complex influence on macro outcomes and can help explain unexpected or disproportionate behavior.

The central metaphor also has the sub-mappings LINEAR AND NON-LINEAR MOVEMENT, and EQUILIBRIUM. The notions of linear and non-linear movement suggest that the social field can be both flat and curving terrain, and include some areas where movement is rapid and others where it is slow, regular, or showing no change at all. The concept of *emergence* is important, and while it echoes certain metaphoric notions, there is no clear source domain; it has only its technical definition as irreducible change.

Even when the adaptive dynamical systems approach is used, investigators sometimes employ datasets in experimental or observational studies. The difference is that, when such cases are combined with other findings, they fit together with, and are best interpreted using, the systems approach. The theory of dynamical systems and its supporting metaphors encompass an entire social encounter, not a snapshot, prompting investigators to observe the system jointly formed by parties in conflict. This guidance counteracts dataset assumptions and helps avoid its pitfalls. An example discussed above is the dataset study of "need for closure"

interpreted in dynamical terms: as an indicator of micro level cognitive structure, "need for closure" inhibits more adaptable self-organization at the macro level.

What I show here to be conceptual metaphors (as best this can be substantiated in language use) are key concepts in the theory, making the metaphors theory-constitutive. They import terms (such as "non-linear movement" and "equilibrium") into the vocabulary of social scientists, building upon notions introduced by social field theory.

It is difficult to track changes in the metaphoric structure of dynamical systems theory when the theory is applied and tested through experiment and observation. Probably this is because the theory asserts the nature and qualities of change, putting scientists on the lookout, but making actual predictions difficult. When conditions are markedly altered, the theory warns of chaos and phase changes, but so far in social science it does not calculate where or when.

So the theory at present can be said to characterize situations and predict qualitative trends. With these qualifications, observational and experimental studies of various conflictual social encounters largely support dynamical system theory and its metaphoric mappings. SOCIAL ENCOUNTER IS A BALL ROLLING ON ATTRACTOR LANDSCAPE is a deliberate "helper" metaphor that communicates the dynamical systems subject matter efficiently and coherently (despite causing epistemological trouble if one attempts to interpret all of the analogical correspondences).

Thus guided, social science has made progress, as reviewed here, in understanding micro level cognitive and emotional states and investigators continue to be prompted to explore in greater detail, for example, patterns of feedback loops and non-linear change at the macro level. Developments in computer simulations of the ATTRACTORS metaphor stimulate theory development. Simulations also help training of practitioners, such as police officers who must deal with fraught and volatile encounters while suppressing fight/flight responses, observing trends among diverse factors, and calibrating their interventions; simulations ground submappings such as NON-LINEAR CHANGE and EQUILIBRIUM in actual experience. A great variety of unanswered questions continue to be posed, attesting to the generative effect of these metaphors and motivating their retention or continued use.

5.3 If one were to brief scientists, science popularizers, or science teachers about the use of metaphors, what might one say based on this chapter?

For scientists:

Look for metaphors you may not have noticed, and consider what they are saying about your subject. They may be part of the theory you are working with, your methodology, or may simply be implied by the language you use.

Are you using metaphoric language unrelated to your subject, perhaps confusing your audience or even contradicting yourself?

How narrowly focused are your metaphors, and is it the balance you want between micro and macro? Metaphors tend to favor macro events, perhaps omitting micro levels that will be important for more complete explanation or theorizing, even if causation cannot yet be demonstrated.

If you are developing datasets, or arguing from datasets, is there also a strong subject matter theory that guides your presentation of dataset results? Or, are you letting the statistics tell the whole story?

For journalists or those describing a scientific topic to the public:

Will you be using technical terminology and, if so, where does it come from and is it metaphoric?

Is there an existing narrative you will adopt and continue in use, or are you trying to present a new or different story line? Beware that you do not fall unintentionally into line with conventional wisdom, "established" facts, or some interest group's promotional strategy that is neatly imbedded in metaphor.

Have you tried out your choice of metaphoric language and asked friends or collaborators how it seems to affect their perspective?

Do you describe scientific findings as the results of data, the results of how things are theorized to work, or both?

For teachers of science:

Are you helping students identify metaphors in scientific materials, and showing them what the metaphors say as distinct from what observations alone might say?

Are students shown how metaphors might be taken literally, leading to epistemological confusion?

Do you use "helper" metaphors and, if so, teach also how each such metaphor is inaccurate? What are the unanswered questions that remain, either because it is disconfirmed or because the metaphor doesn't cover some observations at all?

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