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# Remarks in response to "Telling Alternative Stories: Heterodox Versions of the Prisoner's Dilemma: The Course Theorem, and Supply- Demand Equilibrium

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## Remarks

ROBERT BIRMINGHAM\*

It is the style of a Soul that comes out in the world of numbers, and the world of numbers includes something more than the science thereof.

— Oswald Spengler<sup>1</sup>

All of Professor Eastman's illuminating article merits study. Taking to heart Keynes' admonition that in the long run we are all dead,<sup>2</sup> however, I address directly, among its many inviting topics, only the Prisoner's Dilemma ("PD"). I display the PD in the margin as Figure 1. A game is a PD if and only if  $A > B > C > D$ .

I separately quote and discuss three fragments from the article, responding to each differently.<sup>3</sup> The first I criticize on technical grounds. The second I support and amplify. The third I

		Poncho	
		cooperate	defect
Clytemnestra	cooperate	B	A
	defect	D	C

Figure 1

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\* Professor, University of Connecticut School of Law.

1. OSWALD SPENGLER, *THE DECLINE OF THE WEST* 58 (rev. ed. 1928).

2. JOHN M. KEYNES, *A TRACT ON MONETARY REFORM* 88 (1920).

3. [Each reference to Professor Eastman's article will appear here set off in an italicized block quote. Ed.]

frantically wave a dead chicken over.<sup>4</sup>

*It should be noted that in the case for the compelling logic of the dominance principle, there is a central, politically and morally-fraught assumption. The same ambiguity applies to the dominance principle's decision theory counterpart, the expected utility principle. If the conditions of a Dilemma story are sufficiently restricted, dominance logic is compelling in the sense that one will indeed do "better," by getting a higher payoff, through following the dominance principle. Whether one should conceptualize what one is doing in a particular situation in terms of maximizing a payoff in a game, though, is an entirely different question, as to which there is no formal, amoral logic that applies. Game theorists try to fudge this problem by pointing out that the payoff one is trying to maximize may be understood as including the welfare of others as well as oneself, so that game theory need not be seen as presupposing narrow egoism. But once the relevance of the relationship between others' payoffs and one's own is admitted, the compelling force of dominance logic as a basis for defection in the one-shot Dilemma breaks down. One can simply decide that one does not wish to take advantage of others, and cooperate.<sup>5</sup>*

1. I simply propose a different window on the human predicament. Consider: I write this lying on my futon in my office. It is October. The leaves are turning. My office is in a gothic tower looking across to a crimson maple. I am writing on a new Micron Millennia Transport laptop with a 133-megahertz processor, a 12.1-inch screen, and thirty-two megabytes of RAM. It and I are listening to the middle movement of Mozart's clarinet concerto, K.#622, distinguished for its appeal to computers, at least while they run neural nets.<sup>6</sup>

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4. wave a dead chicken v. To perform a ritual in the direction of crashed software or hardware that one believes to be futile but is nevertheless necessary so that others are satisfied that an appropriate degree of effort has been expended. "I'll wave a dead chicken over the source code, but I really think we've run into an OS bug."

THE NEW HACKER'S DICTIONARY 445 (Eric S. Raymond comp., 2d ed. 1993).

5. Wayne Eastman, *Telling Alternative Stories, Heterodox Versions of the Prisoners' Dilemma, the Coase Theorem, and Supply-demand Equilibrium*, 29 CONN. L. REV. 727, 752-53 (1997). In quoting this passage, I have run along in the text a footnote of a single sentence beginning "The same ambiguity . . .," and omitted two other of Eastman's footnotes. .

6. Cf. RICHARD POWERS, *GALATEA* 2.2, 11-14, 235-36 (1995).

So we are pretty comfortable. Intermittently, however, we read a few pages of a new, unsettling book by Joseph B. McCormick and Susan Fisher-Hoch. Its title is *Level 4: Virus Hunters of the CDC*.<sup>7</sup> Many of the really awful viruses—Ebola, Lassa—are African. So the authors live often in the bush, treating patients, hunting rats, etc. It gets clear promptly that a hospital in Zaire, say, utterly lacks the amenities of a law school in the West End of Hartford:

Mama Yemo is a sprawling institution. Its design is typical of hospitals put up in the colonial era, with vast wards and high tin-roofed ceilings that had begun to grow weak with rust. Its cement floors were dark with the stains of countless miseries. Air circulation was supplied by ancient overhead fans and paneless windows. Each ward contained about thirty metal beds, which were rarely empty. Mattresses were stuffed with cotton or grass. Sheets were hard to come by. Meals for the patients were provided by their families, and, with staff in short supply, the families also assumed much of the responsibility for nursing care. Bathrooms were scarce and rarely worked anyway, creating a rank odor that greeted you when you walked in and dogged your every step until you left. The wards were generally choked with people afflicted with the most desperate illnesses. There were jaundiced, bloated, cachectic, comatose, and vomiting. Many had diarrhea. They arrived at Mama Yemo with unhealed wounds, covered with crusts and pus, and emitting a terrible stench. They came in endless droves. Screams and moans echoed through the dank hallways. This is the face of disease and death for the world's poor.

. . . The range of symptoms we saw in patients was staggering. In a country as poor as Zaire, the sort of medical support a patient with AIDS might by rights expect is quite unaffordable. These poor people suffered until their symptoms were so extreme that they had to come to the public hospital. These were the human tragedies we found before us. Some developed such exquisitely sore mouths and tongues that they were unable to eat. Those who could manage a few bites of food were suddenly stricken by cramps and disgorged a copious amount of diarrhea. Their skin would break out in massive, generalized eruptions. Infected fungating masses would appear inside and

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7. JOSEPH B. MCCORMICK & SUSAN FISHER-HOCH, *LEVEL 4: VIRUS HUNTERS OF THE CDC* (1996).

outside their bodies. When the infection didn't consist of voracious yeast cells, there were many other parasites ready to eat the brain alive. None of the victims could comprehend in any way what was happening to them or why. And we? All we could do was watch in horror, our roles as physicians reduced to scrupulous observers and accurate recorders of documentation.<sup>8</sup>

What are the lessons here? One imagines that I am happier than McCormick, much less his African patient. But strictly speaking such a claim is not verifiable, makes no sense: are two *As* greater than three *Bs*, sizes of *As* and *Bs* being indeterminate? It is methodologically sound to repudiate interpersonal comparisons of utility. I do not think that Eastman does this. Rather I think he futilely supposes that I am selfishly having a good time, that McCormick is sacrificing his own utility to help his patients or make the world a better place.

"love (lav), n.," the OED defines: "That disposition or state of feeling with regard to a person, . . . which manifests itself in solicitude for the welfare of the object . . ." The (partial) definition fits both our hypotheses about McCormick.

In Admiralty class we are reading *Sodomy and the Pirate Tradition*,<sup>10</sup> which chronicles many "instances of deepest devotion" between pirates and cabin boys.<sup>11</sup> Rounsivil, for example, was escaping from his foundering ship. His companion shouted to him to come back. He urged the other sailors in the small boat that was pulling away to turn it about, but they refused. So Rounsivil "jump'd into the Water, and swam to the Vessel, and there perished with his Friend, since he could not save him."<sup>12</sup> What is going on here of course is that Rounsivil is maximizing his utility in circumstances of limited opportunity. Suicide occurs, and must occur, whenever the discounted sum of anticipated happiness turns negative. Rounsivil is making his companion happy too, although that is incidental. They love each other, their utility functions being interdependent. More generally, pirate *A* loves pirate *B* if pirate *B*'s utility is an argument in pirate *A*'s utility function. Of course the

8. *Id.* at 167, 173.

9. THE OXFORD ENGLISH DICTIONARY (2d ed. on compact disc, version 1.10, 1992).

10. B.R. BURG, *SODOMY AND THE PIRATE TRADITION: ENGLISH SEA ROVERS IN THE SEVENTEENTH-CENTURY CARIBBEAN* (1995).

11. *Id.* at 130.

12. *Id.* at 131.

coefficient must be positive.<sup>13</sup> *Practitioner's Note*: In intimate contexts, it ordinarily pays off in utility to suppress, or at most proclaim only quietly and not insist on, these truths.

My point is that anything you do maximizes your utility (as you perceive it), else you would do something else. The claim is only a way to look at the world, being unfalsifiable. Clytemnestra, ostensibly playing a PD, unexpectedly cooperates. The observing game theorist would not easily concede to Eastman that she is not maximizing. Rather, the game theorist would hypothesize that he had misspecified her utility function, that he had constructed a PD where there is none. He knows, however Clytemnestra behaves, she is maximizing *some* function (actually infinitely many). Let the function maximized specify her utility.

So much for Eastman's misleading language, "One can simply decide that one does not wish to take advantage of others, and cooperate," insofar as it implies choice, or altruism in a stronger sense than accidentally throwing off external economies. Back in the hospital in Zaire, McCormick is deciding in a big way not to take advantage of others (Eastman). Or he is a creature of his preferences, having no more free will, or concomitant moral excellence, than a mousetrap<sup>14</sup> or a turnip (me). McCormick saves Africans; I train lawyers. He is doing good and I evil. I do not understand how Eastman can live with himself thinking that he could choose to be in Zaire not New Jersey but not so choosing.

Now look at my Figure 1. Eastman and I read its payoffs antithetically. For me they represent the players' total utilities; for Eastman, only selected utilities. He calls "fudg[ing]" the idea that "the payoff one is trying to maximize may be understood as including the welfare of others as well as oneself." It includes the welfare of others only if and insofar as one loves them. To do it my way is better because it makes games determinate. From Figure 1, I can tell what its players are going to do: defect. With the payoffs as he understands them, Eastman looking at Figure 1 has no idea what the players are going to do.

*Illustration.* Two ways to say the same thing. *Eastman*: Clytemnestra "can simply decide that [she] does not wish to take advantage of others, and cooperate."<sup>15</sup> *Me*: Clytemnestra loves Poncho.

13. MARSHALL JEVONS, A DEADLY INDIFFERENCE 9 (1995).

14. Cf. JOHN HAUGELAND, ARTIFICIAL INTELLIGENCE: THE VERY IDEA 216-17 (1985).

15. Eastman, *supra* note 5, at 753.

We can trace the effects in Figure 2. Its left side is the Prisoner's Dilemma of Figure 1, except that I replace the letters with numbers des-

		Poncho					
		cooperate	defect			cooperate	defect
Clytemnestra	cooperate	1	0	Clytemnestra	cooperate	2	10
	defect	10	6		defect	10	12
		0	6			10	12

love  
→

Figure 2

ignating years imprisoned, the fewer the better. The left side of Figure 2 is as far as Eastman gets. That is, we cannot see anything from his representation. Clytemnestra mysteriously cooperates despite numbers. I have Clytemnestra playing a different game, that of the right side of Figure 2, where Poncho loves her back, and each loves the other equally with herself. So each suffers the sum of the years in prison at each outcome. I.e. if both players defect, each suffers  $6 + 6 = 12$  years; if either cooperates while the other defects, each suffers  $10 + 0 = 10$  years. The changed equilibrium, which I emphasize one can read off the representation, is that both players cooperate.

*In Schelling's course I learned about the Prisoners' Dilemma. I became a Prisoners' Dilemma enthusiast. It became a significant part of my mental furniture, of the way in which I interpreted the world and situated myself in it. . . . I talked to my parents about the Dilemma and its implications when I was home on winter break; I had an argument with my roommate about his leaving the lights on in which I invoked the Dilemma . . . . Defining a believer as one who not only accepts but is in some sense excited by or inspired by a particular understanding of the world, I became a believer in the Dilemma.<sup>16</sup>*

16. Eastman, *supra* note 5, at 735-36.



2. The Prisoner's Dilemma does cause epiphanies. Compare Gauthier's, described in *Morals by Agreement*:

The present inquiry began on a November afternoon in Los Angeles when, fumbling for words in which to express the peculiar relationship between morality and advantage, I was shown the Prisoner's Dilemma. . . . Almost nineteen years later, I reflect on a . . . voyage that is not, and cannot be, completed, but that finds temporary harbour in this book.<sup>17</sup>

The reactions of Eastman and Gauthier differ interestingly. Eastman grasps the PD at once and uses it. To a boy with a hammer, everything looks like a nail. Gauthier studies the PD itself, tries to understand it. Gauthier investigates what a hammer is. The difference resembles that between applied and basic science.

Eastman believes the PD important or he would not be writing about it. Let me speculate about how important it is. Evidently it is the basis of contract.

Here is how. Think of contract law as the alternative to love in solving the PD. Thus compare Figure 2 with Figure 3.

		Poncho				Poncho	
		cooperate				cooperate	
		defect				defect	
cooperate	1	2	→	cooperate	1	-1	
1	-2	-1	→	1	-1	-1	
defect	2	-1	→	-1	-1	-1	
2	-1	-1	→	-1	-1	-1	
Clytemnestra			→	Clytemnestra			
defect			→	defect			

Figure 3

The payoffs now are dollars, Clytemnestra and Poncho wanting more of them. They have contracted: to cooperate is to perform; to defect is to breach. The left side of Figure 3 is again a PD. Expectation damages change the game to that on the right side of Figure 3. Pretend that Clytemnestra, defects, Poncho cooperates. She must pay him 3 (his 1 at

17. DAVID GAUTHIER, *MORALS BY AGREEMENT* v (1986).

the upper left outcome plus the 2 he loses at the lower left outcome). Consequently at the lower left outcome the law leaves her with -1 (her 2 at the lower left outcome less the 3 she must pay Poncho.) Nobody breaches, unless the payoffs are different, like (-2, 5) instead of (-2, 2), indicating efficient breach.

Back to the hammer. Life is a big PD, that Hobbes says contract solves:

If a covenants be made, wherein neither of the parties perform presently, but trust one another; in the condition of mere nature, which is a condition of war of every man against every man, upon any reasonable suspicion, it is void: but if there be a common power set over them both, with right and force sufficient to compel performance, it is not void. For he that performeth first, has no assurance the other will perform after; because the bonds of words are too weak to bridle men's ambition, avarice, anger, and other passions, without the fear of some coercive power; which in the condition of mere nature, where all men are equal, and judges of the justness of their own fears, cannot possibly be supposed. And therefore he which performeth first, does but betray himself to his enemy; contrary to the right, he can never abandon, of defending his life, and means of living.

But in a civil estate, where there is a power set up to constrain those that would otherwise violate their faith, that fear is no more reasonable; and for that cause, he which by the covenant is to perform first, is obliged to do so.<sup>18</sup>

As Eastman carefully explains, The PD is a counterexample to the inference from 'Everyone maximizes her utility' to 'There is a Pareto optimum'. From the social contract down to local interactions, law treats it as an enthymeme, supplying the missing premise, 'There are no (noninternalized) externalities'. 'All law resolves PDs' is like 'Every event is caused'. True or not, it usefully guides practice. Finally note the curious and beautiful symmetry between the PD and the Coase theorem, which Eastman also features. Left alone to contract, the Coase theorem says, parties often achieve Pareto optima. I think that the PD and the Coase theorem partition the set of possible situations. Either we

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18. THOMAS HOBBS, *LEVIATHAN*, in *THE ENGLISH WORKS OF THOMAS HOBBS* 124 (1836).

have a PD and the law fixes it. Or the Coase theorem applies and we can work things out without (more) law. Eastman leaves this implicit.

*You want to see writing in law and economics done differently, with less mathematical mumbo-jumbo, much less Chicago ideology, and more emphasis on problems outside the narrow context of pecuniary interest. You think that plenty of other people would like it done differently, too (i.e., you and the others could have welfare of 3 if you did it differently, compared to 1 if you keep on doing it the usual way). But there is a dilemma. You don't want to go first (the one who does it alone gets 0, while the one who sticks to the conventional way of telling rational-choice stories gets 5). If only you could cooperate . . . but here as ever, you may find yourself condemned to a worse outcome than you could have had if you were not so wedded to a narrow and counterproductive though apparently impeccably logical view of rationality . . . .*<sup>19</sup>

3. Yet we witnessed, in Part I, Eastman himself privileging the narrow context of pecuniary interest, with the aspersion, "Game theorists try to fudge . . . by pointing out that the payoff one is trying to maximize may be understood as including the welfare of others as well as oneself." Including the welfare of others is love, the least pecuniary interest. Eastman arbitrarily excludes it.

The big difference between us, though, is that I prefer more mathematical mumbo jumbo. The OED defines: "mumbo jumbo . . . 1. A grotesque idol said to have been worshipped by certain tribes or associations of Negroes. . . 2. *transf.* a. An object of unintelligent veneration. . . . b. Obscure or meaningless talk or writing; nonsense," as in "A mumbo jumbo of meaningless words and phrases," from the *London Times* of 1955.<sup>20</sup>

Eastman uses 'mathematics' loosely, meaning logic or formal representation. I guess then that he is saying that we respect mathematics too much, that we are stupid in respecting it, that mathematics is hard to understand, and, perhaps, that it is nonsense. To counter these accusations, I show, in *A*, how formality helps explain; and, in *B*, that story

19. Eastman, *supra* note 5, at 823.

20. THE OXFORD ENGLISH DICTIONARY, *supra* note 9.

telling, which Eastman would substitute for formality, can lead us far from the truth. Finally *C* throws in case law, which at some remove Eastman and I are writing about.

A. You are a contestant on "Let's Make a Deal." The big deal (Nettles, Greg's chocolate lab, coveted by Allison) is behind curtains 1, 2, or 3. You are trying to choose that curtain. Tentatively you choose perhaps 2. Monty Hall (MH) knows which curtain Nettles is behind, intends not to disclose her. He opens a curtain you did not choose, perhaps 1. No Nettles. MH can always do this because at least 1 or 3 does not conceal her. He invites you to switch curtains. You think, there are two curtains, Nettles is as probably behind either, it is a matter of indifference whether I switch. But this reasoning is incorrect. Counterintuitively, you should switch, and choose 3.

Bayes' theorem explains why you should switch. I write a form of it promoted by Salmon:<sup>21</sup>

$$P(T_1/E) / P(T_2/E) = (P(T_1) * P(E/T_1)) / (P(T_2) * P(E/T_2))$$

The  $T_i$ s are competing theories. In this instance, one or the other is true.  $T_1$ , the first theory, asserts Nettles is behind curtain 2.  $T_2$ , the second theory, asserts she is behind curtain 1 or curtain 3.  $E$ , the evidence, is that MH opens either curtain 1 or curtain 3 without finding Nettles. Translate the '/'s inside the parentheses by 'given that'. The others indicate division. The  $P(T_i/E)$ s are posterior probabilities (posteriors): probabilities that the theories are true taken after  $E$ , after MH opens curtain 1. Hence the first posterior is the probability Nettles is behind curtain 2, given that MH opens, for instance, curtain 1, without disclosing Nettles.  $P(T_1/E) / P(T_2/E)$ , the left side of the equation, is the ratio between the posteriors. We are calculating this ratio. The  $P(T_i)$ s are prior probabilities (priors): probabilities that the theories are true taken before  $E$ , before MH opens curtain 1. The  $P(E/T_i)$ s are likelihoods: probabilities of  $E$ , that MH opens curtain 1 or curtain 3 without encountering Nettles, conditioned on one theory or the other being true. In English, the equation states, 'The ratio of the posteriors of the competing theories equals the prior of one multiplied (\*) by its associated likelihood, divided by the prior of the other multiplied by its associated likelihood'.

To calculate the ratio of the posteriors, the left side of the equation, you must identify the two priors and two likelihoods on its right side.

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21. Wesley C. Salmon, *Rationality and Objectivity in Science or Tom Kuhn Meets Tom Bayes*, in *THE PHILOSOPHY OF SCIENCE* 256 (David Papeneau ed., 1996).

Both priors and a likelihood are straightforward. Before E, the probability is  $1/3$  that Nettles is behind any curtain. Accordingly  $P(T_1) = 1/3$  and  $P(T_2) = 2/3$ . Also, the easy likelihood,  $P(E/T_1)$ , is 1: if Nettles is behind curtain 2 as  $T_1$  asserts, the probability is 0 that she is behind either curtain 1 or curtain 3. That leaves the difficult case,  $P(E/T_2)$ .  $T_2$  asserts that Nettles is behind curtain 1 or curtain 3. Pretend MH does not know which. Then  $P(E/T_2) = 1/2$ : Nettles is as likely behind the curtain he opens as not. Now E: MH opens curtain 1, and Nettles is not behind it. Then  $P(T_1/E) / P(T_2/E) = (1/3 * 1) / (2/3 * 1/2) = 1$ . The right side of the equation is  $1/3$  divided by  $1/3$ ; the posteriors are equal. Nettles being as probably behind curtain 2 as curtain 3, it does not matter whether you switch. But MH knows where Nettles is and does not open that curtain. Hence  $P(E/T_2) = 1$ . Then  $P(T_1/E) / P(T_2/E) = (1/3 * 1) / (2/3 * 1) = 1/2$ : Nettles is twice as probably behind curtain 3 as behind curtain 2. You double your probability of winning her if you switch.

B. Eastman wants less mathematics. He would substitute stories. "Providing more and different stories should be the goal," he says.<sup>22</sup> My goal is fewer and identical stories. To support my preference, I exhibit some horrible, independently entertaining results of unconstrained storytelling.

I. The best story, being the least plausible, is that the ancient Greeks misappropriated Egyptian culture. The story contravenes history not mathematics, but is on point if lack of rigor is what counts. I let Lefkowitz report:

Dr. Yosef A. A. ben-Jochannan was invited to give Wellesley's Martin Luther King, Jr., memorial lecture. Posters described Dr. ben-Jochannan as a "distinguished Egyptologist," and indeed that is how he was introduced by the then president of Wellesley College. But I knew from my research in Afrocentric literature that he was not what scholars would ordinarily describe as an Egyptologist, that is, a scholar of Egyptian language and civilization. Rather, he was an extreme Afrocentrist, author of many books describing how Greek civilization was stolen from Africa, how Aristotle robbed the library of Alexandria, and how the true Jews are Africans like himself.

After Dr. ben-Jochannan made these same assertions once again in his lecture, I asked him during the question period

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22. Eastman, *supra* note 5, at 825.

why he said that Aristotle had come to Egypt with Alexander and had stolen his philosophy from the library at Alexandria, when the library had only been built after his death. Dr. ben-Jochannan was unable to answer the question, and said that he resented the tone of the inquiry. Several students came up to me after the lecture and accused me of racism, suggesting that I had been brainwashed by white historians. But others stayed to hear me out, and I assured Dr. ben-Jochannan that I simply wanted to know what his evidence was: so far as I knew, and I had studied the subject, Aristotle never went to Egypt, and while the date of the library . . . is not known precisely, it was certainly built some years after the city was founded, which was after both Aristotle's and Alexander's deaths.

. . . The trouble was that some of my colleagues seemed to doubt that there was such a thing as historical evidence, or that even if evidence existed, it did not matter much one way or the other, at least in comparison with what they judged to be the pressing cultural issues and social goals of our own time. When I went to the then dean of the college to explain that there was no factual evidence behind some Afrocentric claims about ancient history, she replied that each of us had a different but equally valid view of history.<sup>23</sup>

2. The physicist Sokal perpetrated the best fraud, composing *Transgressing the Boundaries*<sup>24</sup> as a spoof, then submitting it to a leading postmodern literary journal, *Social Text*, published by Duke University Press. Stanley Fish, among other things a legal scholar, heads the Press. Its editors published the article. I restrain myself to exhibiting two of Sokal's satirical treasures.

i. Sokal uses adverbs like 'lucidly' effectively. "Unfortunately, Heisenberg's uncertainty principle has frequently been misinterpreted by amateur philosophers,"<sup>25</sup> Sokal asserts. He continues,

As Gilles Deleuze and Félix Guattari (1994, 129-30) lucidly

23. MARY LEFKOWITZ, NOT OUT OF AFRICA: HOW AFROCENTRISM BECAME AN EXCUSE TO TEACH MYTH AS HISTORY 2-3, 4 (1996).

24. Alan D. Sokal, *Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity*, 14 SOC. TEXT 217 (1996).

25. *Id.* at 231-32 n.2 (quoting GILLES DELEUZE & FÉLIX GUATTARI, WHAT IS PHILOSOPHY? 129-30 (Hugh Tomlinson & Graham Burchell trans., 1994)).

point out,

in quantum physics, Heisenberg's demon does not express the impossibility of measuring both the speed and the position of a particle on the grounds of a subjective interference of the measure with the measured, but it measures exactly an objective state of affairs that leaves the respective position of two of its particles outside of the field of its actualization, the number of independent variables being reduced and the values of the coordinates having the same probability. . . . Perspectivism, or scientific relativism, is never relative to a subject; it constitutes not a relativity of truth but, on the contrary, a truth of the relative, that is to say, of variables whose cases it orders according to the values it extracts from them in its system of coordinates.<sup>26</sup>

ii. Sokal quotes Campbell and Campbell-Wright, campaigning for feminist algebra, charging, "mathematics is portrayed as a woman whose nature desires to be the conquered Other,"<sup>27</sup> then adds,

Just as liberal feminists are frequently content with a minimal agenda of legal and social equality for women and "pro-choice," so liberal (and even some socialist) mathematicians are often content to work within the hegemonic Zermelo-Fraenkel framework (which, reflecting its nineteenth-century liberal origins, already incorporates the axiom of equality) supplemented only by the axiom of choice. But this framework is grossly insufficient for a liberatory mathematics, as was proven long ago by Cohen 1966.<sup>28</sup>

The Axiom of Equality is ' $\forall x(x = x)$ ', that is, 'For all  $x$ ,  $x$  is equal to itself'. It is about self-identity, not social equality. A set is more or less a collection. The Axiom of Choice<sup>29</sup> asserts the existence

26. *Id.*

27. Mary Anne Campbell & Randall K. Campbell-Wright, *Toward a Feminist Algebra*, in *TEACHING THE MAJORITY: BREAKING THE GENDER BARRIER IN SCIENCE, MATHEMATICS, AND ENGINEERING* 127, 135 (Sue V. Rosser ed., 1995).

28. Sokal, *supra* note 24, at 242-43 n.54 (citing PAUL J. COHEN, *SET THEORY AND THE CONTINUUM HYPOTHESIS* (1966)).

29. GREGORY H. MOORE, *ZERMELO'S AXIOM OF CHOICE: ITS ORIGINS, DEVELOPMENT, AND INFLUENCE* (1982).

of a set that contains exactly one element from each set of any set of sets. It is "probably the most interesting and, in spite of its late appearance, the most discussed axiom of mathematics, second only to Euclid's axiom of parallels which was introduced more than two thousand years ago."<sup>30</sup> But it is unconnected to the abortion debate. The continuum is the set of real numbers, that is, the set of sets of integers. The "pressing problem" of the size of the continuum is "the deepest that contemporary mathematics presents to the contemporary philosopher of mathematics."<sup>31</sup> The presupposition is that infinities come in different sizes. The of integers are  $\aleph_0$ . The continuum is  $2^{\aleph_0}$ . The second smallest infinity is  $\aleph_1$ . The Continuum Hypothesis asserts  $2^{\aleph_0} = \aleph_1$ . The 1966 paper by Cohen cited by Sokal completes the proof, begun by Gödel, that the axioms of set theory do not decide the Continuum Hypothesis. Nothing social turns on this independence.

Sokal does not fake the quotations. Deleuze and Guttari, Campbell and Campbell-Wright, write what he accuses them of writing. Sokal's own text is intentionally mumbo jumbo in a bunch of the defined senses. But it blends into *Social Text*. That it lacks salience there casts doubt on the other contents of the journal. Think of a clock striking: a thirteenth stroke makes suspect the first twelve.

3. Imagine McCormick maximizing his utility in Zaire. Rats carry Lassa fever. McCormick is in the field counting and killing them. Meanwhile, in *Animals and Women*, something of an antithesis to a public health manual, Dunayer confides, "Over the years, seventeen rats have been my adopted friends. All were highly sensitive . . ."<sup>32</sup> She concludes, "Humans' gross misunderstanding and relentless persecution of rats causes me particularly sharp anger and grief."<sup>33</sup>

*Animals and Women*,<sup>34</sup> a book of essays also published by Duke University Press, seems, like the rats, to be a vector of disease. The collective argument of these essays is that, both women and animals having been oppressed, and women having won partial independence, they must help liberate animals.

Chickens get equal time with rats:

30. ABRAHAM A. FRAENKEL & YEHOShUA BAR-HILLEL, FOUNDATIONS OF SET THEORY 47 (1958).

31. Penelope Maddy, *Believing the Axioms (pt. 1)*, 53 J. SYMBOLIC LOGIC 481, 482 (1988).

32. Joan Dunayer, *Sexist Words, Speciesist Roots*, in ANIMALS AND WOMEN: FEMINIST THEORETICAL EXPLORATIONS 11, 25 n.13 (Carol J. Adams & Josephine Donovan eds., 1995) (hereinafter ANIMALS AND WOMEN).

33. *Id.*

34. See David Sexton, *Men Are Beasts!*, WALL ST. J., Aug. 12, 1996, at A9.



Viva was not only strong-willed and alert; she was expressive and responsive. One of the most touching things about her was her voice. She would always talk to me with her frail "peep" which never got any louder and seemed to come from somewhere in the center of her body which pulsed her tail at precisely the same time. Also, rarely, she gave a little trill. Often after one of her ordeals, in which her legs would get caught in her wings, causing her terrible confusion and distress, I would sit talking to her, stroking her beautiful back and her feet that were so soft between the toes and on the bottoms, and she would carry on the dialogue with me, her tail feathers twitching in a kind of unison with each of her utterances.<sup>35</sup>

C. Eastman explains the case law better than I, although it is a close thing. The heavy ideological content of the PD for Eastman is absent from the cases. His theories of utility and decision predict opinions better than mine. Judges, especially Easterbrook, can benefit from his lucid explanation of the PD.

The PD appears increasingly often in case law: not at all before 1978, thirteen times by late 1996. In Figure 4, I exhibit the temporal distribution of the appearances of the PD and their quadratic least-squares fit. Extrapolating, by 2030 ten cases annually will mention the PD. Suppose the number of cases decided each year doubles every

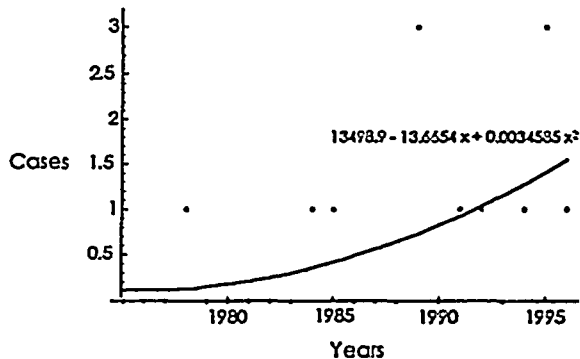


Figure 4

35. Karen Davis, *Thinking Like a Chicken: Farm Animals and the Feminine Connection*, in *ANIMALS AND WOMEN*, *supra* note 27, at 192, 194-95.

fifty years. Then every case will mention the PD by 300000. This year being a long way off, circumstances may have changed.

Of the thirteen cases, I look mostly at two by Judge Easterbrook, for two reasons; Easterbrook is articulate, and screws up. The articulateness first. "The couple, separated by the agents, then played and lost a Prisoner's Dilemma game. See *Page v. United States*, 884 F.2d 300 (7th Cir. 1989)," Easterbrook says in *United States v. Herrera*.<sup>36</sup> He does not describe the game, apparently assuming his readers know it. The case that Easterbrook cites, *Page*, does describe it, as we will see. Having decided *Page* too, he cites his own earlier description. The issue in *Herrera* is whether a sentence of fifteen years for drug offenses and assault is excessive. Easterbrook, calling it "lenient,"<sup>37</sup> decides not.

The couple who play and lose the PD are Geraldo and his wife Cynthia. Dissatisfied with her play, Geraldo "clobbered the back of her head with a hammer."<sup>38</sup> This sort of domestic dispute does not depend on the PD. Geraldo might have assaulted Cynthia for bidding two hearts or burning the broccoli.

No case explicitly decides the PD is legal. *United States v. Maddox* assumes legality, however, saying, "versions of the 'Prisoners' Dilemma' during plea negotiations are rather commonplace because they are effective and courts have held that they are constitutional."<sup>39</sup> For authority, *Maddox* cites only *Page*, using the introductory signal, 'See, e.g.,' which instills no confidence.

*Page* is not *great* authority for the legality of the PD. *Page* had complained that his appellate counsel was ineffective for not arguing that his trial counsel was ineffective. The alleged original ineffectiveness lay in not getting *Page* out of the PD. Easterbrook decides the case on the procedural ground that *Page* waived his objection by raising it too late. The closest *Page* comes to holding the PD legal is not holding it illegal, when offered the opportunity to do so.

Easterbrook, in *Page* in 1989, starts out trying to state the PD:

Students of strategy and bargaining cut their teeth on the game of Prisoners' Dilemma. Two prisoners, unable to confer with one another, must decide whether to take the prosecutor's offer:

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36. 70 F.3d 444, 445 (7th Cir. 1995).

37. *Id.*

38. *Id.*

39. 48 F.3d 791, 796 (4th Cir. 1995).

confess, inculcate the other, and serve a year in jail, or keep silent and serve five years. If the prisoners could make a (binding) bargain with each other, they would keep silent and both would go free. But they can't communicate, and each fears that the other will talk. So both confess. Studying Prisoners' Dilemma has led to many insights about strategic interactions. See Thomas C. Schelling, *The Strategy of Conflict* 53-80, 119-61 (1960; 1980 rev.).<sup>40</sup>

I find it interesting that Easterbrook, like Eastman, cites Schelling's easy, anecdotal, compelling book.

The case for illegality, while lost, is not insubstantial. The PD looks unconstitutional from my perspective. The Seventh Amendment likes confessions to be voluntary. I do not find anything voluntary about the PD. The prosecutor chooses whether the prisoners play it. If they play it they lose, that is, they confess. Thus their confessions look involuntary. In Eastman's PD, a player chooses to confess or not. Hence Eastman lacks my problem about constitutionality. Easterbrook lacks it too, so Eastman's theory explains Easterbrook's decisions better than mine does.

Admissibility is a bigger problem. Rule 402 of the Federal Rules of Evidence requires, for evidence to be admissible, that it be relevant. Rule 401 has just defined relevance as "any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence."<sup>41</sup> Confessions obtained through the PD lacks this tendency. Nearly canonical descriptions of the PD often begin, "Two people have robbed a bank and are apprehended by the police . . ." But the PD is independent of the guilt of its players, innocent prisoners, by its logic, confessing as readily as guilty prisoners.

Recall Bayes' theorem,

$$P(T_1/E) / P(T_2/E) = (P(T_1) * P(E/T_1)) / (P(T_2) * P(E/T_2)),$$

this time with  $T_1$  being that the prisoners are innocent,  $T_2$  that they are guilty,  $E$  that they confess. But everyone, guilty or innocent, confesses; consequently

$$P(E/T_1) = P(E/T_2) = 1, P(T_1/E) / P(T_2/E) = P(T_1) / P(T_2).$$

40. Page v. United States, 884 F.2d 300, 301 (7th Cir. 1989).

41. FED. R. EVID. 401.

The posteriors are the same as the priors. The evidence that the prisoners confess, changing no probability, is irrelevant under Rule 401.

What is engaging about *Page*, though, is that Easterbrook, a really smart, learned judge, misstates the PD. He is not even close. First, the players may communicate, as long as they cannot contract. Second, Easterbrook gets the numbers wrong.

Figure 5 is Figure 1 with Easterbrook's sentences superimposed. It is somewhat hard to figure out what these sentences are but here goes. Easterbrook says the players go free if neither defects: hence the 0s in the upper left. He says, I think, that defecting while the other cooperates gives 1. Finally, if a player defects, the other gets 5, whatever she does. I may misstate what Easterbrook intends; but any other interpretation takes us still farther from the PD.

		Poncho	
		cooperate	defect
Clytemnestra	cooperate	0      1	0      5
	defect	5      5	1      5

Figure 5

So here is what is wrong. In Easterbrook's game, nobody defects. The only difference in a player's payoffs occurs if the other player cooperates. Then the first player gets 0 for cooperating, 1 for defecting. These are years in jail and neither player wants them. Of course, in the real PD, everybody defects.

"[E]ach fears that the other will talk," Easterbrook says.<sup>42</sup> He explains defection by this fear, has a player reason, 'The other player might defect, hence I had better defect too'. This reasoning is right for the game of Figure 5, inapposite in the true PD. In the true PD a player *cares* whether the other player defects, in the sense that her utility depends on it. So she fears, in this noninstrumental sense of 'fears', that this other player will defect. This fear cannot explain her behavior because she defects with or without it.

By changing the payoffs from cooperating if the other player defects, call them 'D', I can fix Easterbrook's game so that what one player does matters to the decision of the other. The expected payoff from defecting is  $1(1 - p) + 5p$ ,  $p$  being the probability the other

42. *Page*, 884 F.2d at 301.

player defects; from cooperating,  $0(1 - p) + Dp$ . Let  $D$  equal 6, instead of 5, as in Figure 5. Now a player cooperates if  $p < 0.5$ , defects if  $p > 0.5$ , does either indifferently if  $p = 0.5$ . For  $D = 6$ ,  $p = 0.5$ , the expected loss is 3 years for cooperating or defecting.

But again, this is not Easterbrook's game. Neither is it the PD. So Easterbrook does not know what he is talking about. He should study Eastman's article to find this out. So should we all for deeper understanding of this game.

#### APPENDIX: HOW I LEARNED TO STOP WORRYING AND LOVE BAYE'S THEOREM

JOHN J. BRUDZ\*

Professor Birmingham's exposition of the Monty Hall problem is clear and correct to a level of precision foreign to the legal profession. Following the sound principle that nothing worth knowing should be clearly and unambiguously expressed, I will attempt to undo some of the damage by cluttering Baye's Theorem with a little unconstrained storytelling.

A brief recap of the problem: There are three doors, there is a prize behind one door, and nothing behind the other two. You choose a door, Monty Hall, who knows which door the prize is behind, shows you what is behind one of the doors you did not pick. It is empty. He then asks you whether you want to switch doors. You have read Professor Birmingham's article, so you know that according to some odd looking equations you should switch, but you can't seem to shake the feeling that something to the left of voodoo is pushing you to

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\* [Ed. John J. Brudz is a student at the University of Connecticut School of Law. Professor Birmingham asked Mr. Brudz to allow his explanation of the Monty Hall problem to be an appendix to Professor Birmingham's article because Mr. Brudz does a good job of it.]

switch, while good old horse sense clearly tells you that there can be nothing to gain by switching. You decide to stay, and two times out of three you lose. Why?

	Door 1	Door 2	Door 3
Outcome 1	X	O	O
Outcome 2	O	X	O
Outcome 3	O	O	X

**Figure 1: Three possible outcomes**

There are three possible distributions of the prize, it is either behind door 1, 2, or three. If X is the prize and O is, well, self explanatory, the three possible outcomes can be described as seen in Figure 1.

	Door 1	Door 2	Door 3
Outcome 1	X	O	O
Outcome 2	O	X	O
Outcome 3	O	O	X

**Figure 2: You choose door #1**

Each outcome represents a possible state of the world. You are either in outcome 1, 2 or 3. You can see that there are three X's in the diagram out of a total of nine spaces, showing what you know intuitively to be true, that an initial random choice will give you a 1/3 chance of winning.

You choose door number 1. You can see by the diagram that there is one chance for a prize (X) and two zonkers (O's) confirming once again your suspicion that you have a 1/3 chance of winning. At this point you can see that any door has the same probabilities as your door.

At this point Monty Hall opens a door and shows you a non-prize (a goat or perhaps a political pundit). You know that he will not pick a door with a prize, so there are only certain possibilities for him. There is only one door he can pick in the two outcomes where you do not already have the prize, and in the world where you do have the prize he has two choices, but it really doesn't matter which.

	Door 1	Door 2	Door 3
Outcome 1	X	O	O
Outcome 2	O	X	O
Outcome 3	O	O	X

Figure 3: Monty shows you a pundit

Monty Hall asks you if you want to switch. This is the point at which horse sense is correct, you now have a choice between two doors, the one you have and the other one, but common sense leads you astray when it tells you that there is an even chance between having the prize behind your door and the other one.

	Your Door	Other Door
Outcome 1	X	O
Outcome 2	O	X
Outcome 3	O	X

Figure 4: The crux of the biscuit

Figure 4 depicts the game now that the door Monty has showed you is out of play. There are now two chances to win behind the other door, and only one behind the door you already hold. There is a  $2/3$  chance that you will win if you switch and a  $1/3$  chance that you will win if you stay.

The key to this problem is to understand that Monty Hall is telling you more than you think he is. When you know that he will pick a door that does not have the prize, you know his choice will tell you

something, and in this case the information he gives you is enough to change your decision.

The Monty Hall problem shows an instance where the common sense weighing of evidence results in an erroneous decision. Short of jury instructions expositing Baye's Theorem, legal professionals need to be able to understand how to correctly analyze probabilities, and be able to explain to judges and juries exactly how evidence should be weighed.