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SIMLAW 2011†

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Professor Picker contemplates his own agent-based computer simulation game—SimLaw 2011. He uses this vehicle to describe how "organized decision making" may differ substantially from individualized decision making. The simulations are available on the Internet, and the article is best read with access to a computer. Then he analyzes the consequences that organized decision making may have on future decisions made by our biggest organization—the government.

Simulation games have been popular since the very beginning of computer use. I will date myself by saying that I played Adventure—a text-based fantasy search game—in college on a university mainframe. Nowadays, simulations are perhaps the most successful game form on PCs, ranging from Flight Simulator, to Adventure successors such as Tomb Raider, starring the tough but fetching Lara Croft, to fantasy sports games, such as NBA Live 2002, for pro sports wannabes. The current leader of the pack is the Electronic Arts collection of "Sim" games, including SimCity 3000, an update of the modern classic SimCity (now with "more disasters"); SimCoaster and SimThemePark, for potential theme park tycoons; and, most dramatically, "The Sims," a simulation family, where you get to "create and control people" (and build hot tubs at the same time). Not only are The Sims the current top-selling game, its "Livin' Large" and "House Party" expansion packs take spots two and three.[1]

But Electronic Arts does not sell SimLaw, and it is the possibility of simulating social settings and the role of law in those settings that is the focus of this essay. As described below, I want to focus on a particular kind of simulation, agent-based computer simulations. Over the next

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1. *See* Mike Snider, *Gamers Are Creating a "God Games" Frenzy*, USA TODAY, Aug. 2, 2001, at 1D.

decade, I believe that we will see agent simulations become an important part of social science. Agent simulations nicely link together two important developments, the rise of game theory as a standard tool in social science—including economics, political science, and international relations—plus the growing raw power of personal computers, whether standing alone or networked together.

The rise of game theory in economics is reasonably well evidenced by the growing number of textbooks that either focus on game theory or that rely on it when addressing a particular topic, such as industrial organization.[2] The growing power of computers is the stuff of Moore's law and of everyday experience. What is less obvious is what this means for computer analysis *relative* to other forms of analysis. The relative cost of using computer simulations is decreasing, so we should expect to see more of them. It is only getting marginally easier, however, to do the sort of solve-the-equation solutions—usually called "closed-form" solutions—favored by most economists. Experiments involving live subjects have always been difficult, and now are frequently subject to state or federal regulations.[3] To some extent, the costs associated with compiling and manipulating data are clearly dropping—tracking the drop in the price of computing power—but important areas of data are still quite inaccessible and expensive to obtain. Everything pushes in favor of computer simulations.

If agent simulation becomes important in social science—and there is growing evidence that we are on that path[4]—entrepreneurial legal scholars will seek to import these methods into the law schools. Almost by definition, young scholars, to be successful, have to do something different from those before them—there is no academic profit in writing the same articles that your predecessors did. New methodologies are the best source of great change, and new scholars, especially if they are computer savvy, are often better situated to experiment. So, as agent-based social science becomes a reality, it will become a reality for legal scholarship as well, though not without much difficulty.

In the balance of this essay, I will consider three topics. First, I will briefly address a piece of the behavioral law and economics critique of

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2. *See, e.g.*, DOUGLAS G. BAIRD ET AL., GAME THEORY AND THE LAW (1995); DREW FUDENBERG & JEAN TIROLE, GAME THEORY (1991); ROBERT GIBBONS, GAME THEORY FOR APPLIED ECONOMISTS (1992); ROGER B. MYERSON, GAME THEORY (1991); JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION (1988).

3. *See, e.g.*, STANFORD UNIVERSITY, THE HUMAN SUBJECTS MANUAL, *available at* http://humansubjects.stanford.edu/manual/index.html (the manual applicable to research at Stanford University).

4. For early applications of this method, see ROBERT AXELROD, THE COMPLEXITY OF COOPERATION: AGENT-BASED MODELS OF COMPETITION AND COLLABORATION (1997); JOSHUA M. EPSTEIN & ROBERT AXTELL, GROWING ARTIFICIAL SOCIETIES 165–71 (1996); and MITCHELL RESNICK, TURTLES, TERMITES, AND TRAFFIC JAMS 81–88 (1994). For more recent work, see, for example, the March 2001 issue of the *Journal of Economic Dynamics and Control*, which is devoted to agent-based computational economics. *See also* Randal C. Picker, *Simple Games in a Complex World: A Generative Approach to the Adoption of Norms*, 64 U. CHI. L. REV. 1225 (1997).

rationality. Second, I will sketch out how agent-based simulations capture decision making and offer four examples. A word of warning: You probably will not be able to read and understand the four examples without Internet access because the simulations and the charts associated with them are posted online.[5] Finally, I will try to tie the lessons of the simulations to issues associated with mandatory disclosure of information.

I. BEHAVIORAL LAW AND ECONOMICS AND ORGANIZED DECISION MAKING

The rational actor model that has dominated law and economics is now under attack. Instead of coldly calculating Homo Economicus, we are presented with a more realistic, more complex model of how decisions are actually made. To pick a prominent example, Jolls, Sunstein, and Thaler[6] focus on three aspects of boundedness: bounded rationality, bounded willpower, and bounded self-interest.[7] These phrases are not completely self-explanatory, but you undoubtedly get the gist without much more explanation. Bounded rationality and bounded willpower reduce the quality of the decisions that are made. A smarter person might have chosen not to smoke, while the boundedly rational person chooses to smoke. Bounded willpower means that I will not resist the piece of chocolate cake, even though in a different context I might express a preference not to eat the cake. In both cases, a decision is made that might be improved upon by a person who was less bounded. Bounded self-interest is quite different: it says nothing necessarily about the quality of the decisions that are made, but rather addresses what an actor really cares about when making decisions.[8]

The importance of this framework for law is yet to be determined,[9] but the hunch here is that this is an attempt to lay the groundwork for a more activist government. The superiority of private ordering in context

5. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/ (last visited Nov. 5, 2001). The movies are set up as .avi files. Your browser probably is already set up to play these and may invoke the Windows Media player. That will work, but the standard Windows Media Player does not support frame-by-frame play of movies. The best approach for fine-grained views of the movies is to download them from the website and open them using the Media Player that comes with Windows (but this is not the Windows Media Player—is that sufficiently confusing?). You can find the Media Player by running a search on your computer under the name "mplayer.exe" or "mplay32.exe." On my computer, it is located in the C:\\WINNT\System32 folder. I actually use the Windows version of Apple's QuickTime to play the movies, so that should work as well, on Windows or on a Macintosh.

6. Christine Jolls et al., *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471 (1998).

7. *Id.* at 1476–79.

8. *See* ELLIOTT SOBER & DAVID SLOAN WILSON, UNTO OTHERS: THE EVOLUTION AND PSYCHOLOGY OF UNSELFISH BEHAVIOR (1998).

9. For an extensive collection of articles, see BEHAVIORAL LAW & ECONOMICS (Cass R. Sunstein ed., 2000).

after context—whether assumed or proven—is used as a powerful stick to beat off government encroachment. Undermine the basis of those decisions and all of a sudden government intervention into otherwise private domains seems more plausible. That assumes, of course, that government decision making is less subject to boundedness concerns, but hold that issue for now. Boundedness does not uniformly suggest more law because bounded self-interest actually may reduce the need for law so as to reduce, for example, negative externalities. If I care about not imposing costs on others—an example of bounded self-interest—I may limit my own smoking so as not to subject others to the risk of secondhand smoke. The perceived need for a government response to externalities is driven by the assumption that the actor creating the externality will not care about it and will not internalize the cost imposed on third parties. If I did that instinctively, we might narrow the domain of law considerably.

In this essay, I consider only bounded rationality and make one key point: organized decision making may differ markedly from decision making by isolated individuals. "Organized decision making" includes decisions made by organizations, including the government, and also encompasses decisions made by individuals in consultation with others or with reference to the decisions of others. To understand the importance of boundedness, it is critical to separate decision making by isolated individuals—think of folks stuffed into one of those game show isolation booths forced to make decisions—from organized decision making.

For the isolated individual, the quality of her decisions will reflect, and will only reflect, her intrinsic ability to map data to desired outcomes. She may make repeated poor decisions and yet have no real chance for improving her decision making. We should pause to consider what a "poor" decision is. One idea is that a poor decision is one she regrets afterwards. The eaten chocolate cake falls into this category. A second idea is that the preferences of the individual could be better satisfied given a different, available choice. This is to choose inside the Pareto frontier, rather than at the boundary. A poor decision of the first sort will be recognized by the person making the decision, and she may be able to take steps to improve future decision making (such as avoiding contexts in which chocolate cake will be available). Poor decisions of the second sort—missed opportunities—by their very nature will typically go unnoticed and the individual will learn very little about how to improve her decision making.

Organized decision making holds out the possibility of substantial improvement. If, for example, the individual could compare her decision with that of an identically situated person, the opportunity that she originally missed might jump out at her. This is a relatively simple comparison: it involves evaluating the two choices made, determining which is better, and confirming that both of them were available to the original decision maker. The first person need not map out the entire opportunity set—that really does involve hard analysis that we should not demand of a bounded decision maker—but just makes simple two-point comparisons. Actually, neither person need map out all of the opportunities, but both can assess a single opportunity, choose that, and then compare notes afterwards. This does, of course, require some ability to convey to another your own experiences, and this is not a trivial task, but even that can be avoided if we just imagine that the conversation makes salient the choices made by others.

The possibility of organizing decision making should have dramatic consequences for the quality of the decisions that will be made. As is probably clear, a group communicating in the fashion just described will quickly search the relevant possibility space and locate an option close to the optimal solution. The ability to identify original solutions tracks most directly the isolated individual model of JST, though even there the correspondence may be relatively weak. Organizations put together teams to solve problems, and how those teams are organized will effect the extent to which the isolated individual bounded rationality problem percolates.

Put in the language of management consulting, an organization should be as good as its best decision maker, an idea captured in the notion of "best practices." Organizations need to identify solutions, identify that they have identified a solution, and communicate that solution throughout the organization. And this is tricky. This could be seen as just a problem of communication: the Austin, Texas branch of the firm has discovered the solution, and needs to communicate that solution to branches in Chicago and Palo Alto. The problem, however, is more complex. A decision is made and an outcome is observed: how do we know whether we can do better? As is well known, just searching around in the area near our candidate solution may fail to identify a better solution. You may have to go down, before you can go up.

II. AGENT-BASED COMPUTER SIMULATIONS AND ORGANIZED DECISION MAKING

I think that these ideas are relatively straightforward in the abstract, but I will attempt to make them much more concrete using an agent-based computer simulation. This technique is particularly effective for exploring heterogeneity, and this is what drives organizing better decisions, both for organizations and individuals. We can make clear the circumstances under which very simple decision rules lead to rapid convergence on optimal solutions. Each of the agents will be boundedly rational. They will do no more than make a selection at random, make selections from those observed, observe outcomes, and compare them. These are simple tasks, but when aggregated, they prove quite powerful.

Almost any stylized setting is arbitrary, but I will focus on a standard setting from game theory, the coordination game. The most basic coordination game has the following form:

FIGURE 1

		Player 2: Left	Player 2: Right
Player 1	Left	*1, 1*	*0, 0*
	Right	*0, 0*	*b, b*

Payoffs: (Player 1, Player 2)

We have two players, each of whom faces two options. If both players play "left," each player will receive a payoff of *1*. If both choose "right," each will receive a payoff of *b*. If they do not make the same choice—one plays "left" while the other plays "right"—they get nothing. This is known as a coordination game, for reasons that are probably obvious. The players want to coordinate their choices, and depending on the value of *b*, will want to coordinate on left or right.

The strategies left and right are obviously quite abstract, but we could translate this game quickly into any number of relevant situations. Consider a couple contemplating marriage and the possibility of a prenuptial agreement. In the prenuptial agreement game, the strategies are "don't ask" and "ask." Neither player wants to be the only one asking for a prenuptial agreement—it might be seen as a lack of commitment to the marriage—so the prospective partners want to coordinate successfully.

I want to generalize this coordination game to allow the possibility of many choices, rather than just two, and to introduce the reality that the best course of action may not be obvious to the players, but must instead be learned during the course of play. So, as in the basic coordination game set forth above, value is created by successfully coordinating with the other players, but value is also created by finding the right hidden target value.

The following payoff function is one way of achieving these goals:

$$f(s_i, s_j) = Z \min\left\{\frac{s_i}{s_j}, \frac{s_j}{s_i}\right\} \min\left\{\frac{s_i}{v}, \frac{v}{s_i}\right\} \min\left\{\frac{s_j}{v}, \frac{v}{s_j}\right\}$$

In this function, s is the strategy for agent i or agent j, v is the target value, and Z just scales the payoffs. Successful coordination between agents raises the value of the term in the first bracket (which has a maximum value of 1 when the agents make the same choice). Matching the target increases the value of the second and third min functions (which also max out at 1).

Players will play this game round by round. Think of each player as being in the center square of a tic-tac-toe board. In a given round, each player interacts with her immediate eight neighbors, though as players move around, she will not necessarily have eight neighbors, as some cells may be empty. She plays the coordination game we saw before with each, but she only plays one strategy per round. What she gets—her payoff—is determined by her choice and that of her neighbors, as set forth by the above function. Play takes place on a much larger grid, but each agent focuses on her tic-tac-toe board—in simulation language, the Moore neighborhood on which the agent is centered.

In the first round, I assign strategies at random from a range of a minimum value of 0 to a maximum value of 200. The values given to agents are uniformly distributed throughout this range. This means that any number of strategies are at work at any time. Players select a new strategy in each round by looking at their neighbors in her Moore neighborhood. The agent chooses the strategy that resulted in the highest payoff observed in the immediately preceding round. So the agent looks around at her neighbors, observes what worked best, and adopts that strategy. This process repeats in each round.

The larger board on which play takes place is a mechanical detail, but important conceptually. As to details, it is a 101 x 101 grid, and thus has 10,201 spots with no real edges—it is a torus. Conceptually, the board can be thought of as representing a society. It can also be thought of as a firm, with the individual agents working within the same firm.

Two other variables are of interest. To make clear the role that movement plays in transmitting information, an explicit movement rate is established. The movement rate determines the percentage of agents allowed to move each round. Otherwise, the agent remains fixed in place. The second variable of interest is a rate of spontaneous mutation. In each round, a designated percentage of agents simply redraws from the original distribution of strategies.

A. *Simulation No. 1*

To get our feet wet, consider an example: set the target value equal to 85, the spontaneous mutation rate equal to 0, and the movement rate equal to 100% (meaning that each agent moves in each round). The choice of 85 is purely arbitrary. Populate the grid with 5100 agents, so we have an equal number of agents and open spots in the grid. To see this simulation, play Simulation No. 1.[10] The movies use a ten-color scheme to convey information about the various strategies. Agents in the lowest

10. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/MM1AMOOV.AVI (last visited Nov. 5, 2001).

decile will be coded as black; those in the next brown; followed by: violet, blue, red, green, sky, cyan, pink, and finally, magenta. We will also track the lowest and highest strategies played and the average strategy played in each round.

In the simulation, colors are assigned by strategy in the following way:

TABLE 1

Color	*Strategy Range*
Black	(0.1999, 20.2788)
Brown	(20.2788, 40.3577)
Violet	(40.3577, 60.4366)
Blue	(60.4366, 80.5156)
Red	(80.5156, 100.5945)
Green	(100.5945, 120.6734)
Sky	(120.6734, 140.7523)
Cyan	(140.7523, 160.8312)
Pink	(160.8312, 180.9102)
Magenta	(180.9102, 200.9891)

The target value of 85 lies squarely within the red range.

The initial board in the movie reflects that strategies are assigned at random over the full range of [0–200]. And if you look at Chart 1A,[11] you will see that each strategy decile starts out at the same 10% level. As rounds are played and agents make decisions based on observation and updating, the society evolves rapidly. Three rounds in, three strategy deciles predominate—red, the decile containing the target; blue, the decile just below the target; and green, the decile just above the target. Chart 1A confirms that, as does visual inspection of the movie. And by three rounds in, four deciles—the top two and the bottom two—have almost vanished.

By nine rounds in, more than 98% of the players are in the target red decile, which can again be confirmed by continuing to play the movie frame by frame and by examining Chart 1A. By the fifteenth round, all players are in the target red decile. The movie stays all red for all rounds after that, but that just reflects the crudeness of the color-coding scheme. Remember that the red decile ranges from 80.5 to 100.6, so many agents could be missing the target of 85. As Chart 1B[12] makes clear, at the fifteenth round, there is a sizable gap between the low red strategy, 82.4, and the high red strategy, 93.2. But at round 30, fifteen rounds later, the low is 84.8 and the high 85.2.

11. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart1A.pdf (last visited Nov. 5, 2001).

12. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart1B.pdf (last visited Nov. 5, 2001).

This is a good result. We get rapid convergence to the target. The population—the organization—rapidly searches for, learns, and communicates the superior strategy. Under these circumstances, very simple decision rules for individuals lead to quite sophisticated decision making for the organization. Put differently, the individuals may not be very smart, but the organization is.

B. Simulations Nos. 2 and 3

In part because of the rapid movement of the agents, the successful target strategy diffuses quickly throughout the organization. Suppose we eliminate movement. How would this change the result? Play Simulation No. 2[13] and look at Charts 2A[14] and 2B.[15] By the eighth round, the movie has locked; no changes are visible, though changes may occur within deciles. As the charts confirm, there is very little change after that. Why?

Recall that the grid is only 50% full, and the agents are just tossed onto the grid at random. Strategies can spread only by agents observing the strategy and adopting it. Agents lose the ability to observe other agents when there is no movement. They only observe the agents immediately around them, and that will frequently result, as it does in Simulation No. 2, in a checkerboard, where local groups of agents play the same strategies, but many deciles survive. By the final round in Simulation No. 2, 58% of the agents are in the target decile, but 24% are in the adjacent blue decile, and roughly 13.5% are in the adjacent green decile. That accounts for 95% of the agents, but 5% are still in other deciles.

Movement clearly makes a big difference. To see this, set the movement rate at 5% (meaning that in each round, each agent has a 1 in 20 chance of changing locations), play Simulation No. 3[16] and look at Charts 3A[17] and 3B.[18] By the tenth round, only three deciles have an appreciable number of agents: blue at 20.6%; target red at 73.5%; and green at 5.2%. By the twentieth round, blue is at 10.5%, red at 88.5%, and green is gone. By the fiftieth round, blue is at 0.4% and red at 99.6%. Movement—which is one way in which agents communicate—clearly matters for the success of organized decision making. Movement

13. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/MM2AMOOV.AVI (last visited Nov. 5, 2001).

14. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart2A.pdf (last visited Nov. 5, 2001).

15. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart2B.pdf (last visited Nov. 5, 2001).

16. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/MM3AMOOV.AVI (last visited Nov. 5, 2001).

17. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart3A.pdf (last visited Nov. 5, 2001).

18. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart3B.pdf (last visited Nov. 5, 2001).

enhances exposure to other strategies, and a little bit of movement goes a long way.

C. *Simulation No. 4*

Movement is not the only thing that matters. Suppose that the target value used by the coordination function changes after a certain number of rounds. How well will our agents adapt to that change? This is important, as we would like a system that is robust to exogenous changes in the underlying values. Suppose, for example, that the target value changes from 85 (and red) to 125 (and sky) after fifty rounds of calculations. Start by reconsidering Simulation No. 1 and Charts 1A and 1B.[19] This model converged to the target value after approximately fifteen rounds. This society will be poorly equipped to deal with an exogenous shift to a new target of 125 in the thirty-fifth round. The society will have eliminated all of the off-the-beaten-path strategies and be unable to shift to the new target. Monolithic societies are fragile and lack the robustness to adapt to new conditions and frequently fail.

As should be clear, without mutation, strategies slowly leave the system and are lost forever. This is a system without memory. The agents have available to them in each round only the strategies that they currently observe. Strategies no longer played by any player are lost to the collective memory. How do we solve this? In the framework of the model, introduce spontaneous mutation. Play Simulation No. 4[20] and look at Charts 4A[21] and 4B.[22] In this simulation, 5% of the agents "die" in each round and are replaced with new agents. The new agents redraw from the original distribution of strategies, so the full range of choices, captured as [0–200], are always available, with some probability to the society.

By the fifth round, only two deciles are present in any meaningful way, blue at 12.7% and red at 84.8%. By the tenth round, red is at 99.2%, and by the fiftieth round, red is at 99.7%. Given the 5% mutation rate, the system never converges to 100%. In each round, 5% of the agents switch strategies, but those strategies routinely fail to take root given that no neighbors are playing the same strategy and that the mutation is far from the target.

In the fiftieth round, the underlying conditions switch and the target moves from 85 to 125. Ten rounds later, red is at 91%, green, the next step up, at 4.7%, and sky, the new target, at 3.6%. Then by the seventi-

19. *See supra* note 12–14.

20. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/MM4AMOOV.AVI (last visited Nov. 5, 2001).

21. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart4A.pdf (last visited Nov. 5, 2001).

22. Randal C. Picker, *SimLaw 2011*, *at* http://www.law.uchicago.edu/Picker/IllinoisPaper/Chart4B.pdf (last visited Nov. 5, 2001).

eth round, the change is stunning: red is at 2.6%, on its way to vanishing; green is at 18.6%; and sky at 78.3%. Ten rounds later, sky's victory is complete at 99.3%. Mutation reintroduces the strategies to the system, and that makes it possible for this society to turn on a dime and adapt to the new target quickly.

III. LAW AND ORGANIZED DECISION MAKING BY INDIVIDUALS

The lessons of the agent-based simulation framework are relatively crisp:

- Simple individual decision rules are completely consistent with sophisticated decisions in the aggregate.
- Isolation or incomplete networks breed bad decisions.
- Dense networks lead to good diffusion of information and good decisions.
- Even minimal movement substantially improves communications and ultimate decisions.

That said, I do not want to be understood to say that organizing decision making will mute all of the genuine problems of isolated-individual bounded rationality. Organizations may organize poorly, and thus, we may be able to sustain bad decision processes. Thaler's work on bounded rationality in financial markets suggests that these problems are still substantial.[23] It is not clear whether these problems are intrinsic, meaning that rationality is simply too bounded to allow us to design around, or simply reflect early and inadequate efforts to address the issues of bounded rationality. Additionally, individuals left to their own devices may not organize decisions well. Herd behavior,[24] information cascades, and fads[25] are examples of referential decision making, and this may or may not enhance social welfare. Groups can also polarize in tightly wedded situations, such as juries and cults.[26]

What does all of this mean for individuals? Outside of organizations, individuals can organize decisions by looking to information sources for help. These information sources may be from organizations devoted to creating this information, such as Consumer Reports, J.D. Power and Associates, and the like. Individuals also may look to their local reference groups—neighbors, coworkers, fellow congregants—for information as well.

Individuals will structure reference groups on their own. This is most obviously true for teenagers who may look to others in assessing

23. *See* RICHARD H. THALER, QUASI RATIONAL ECONOMICS 239–350 (1991).
24. *See* Abhijit V. Banerjee, *A Simple Model of Herd Behavior*, 107 Q.J. ECON. 797, 797–801 (1992).
25. *See* Sushil Bikchandani et al., *A Theory of Fads, Custom, and Cultural Change as Informational Cascades*, 100 J. POL. ECON. 992, 992–95, 1014–17 (1992).
26. *See* Cass Sunstein, *Deliberative Trouble? Why Groups Go to Extremes*, 110 YALE L.J. 71 (2000).

what behavior is or is not appropriate. The very idea of "Keeping up with the Joneses" captures the idea of consumption decisions driven by reference groups.[27] Inner city youths may join gangs because they have been deprived of any other reference point for decision making. As these examples suggest, we should care quite a bit about how these reference groups are organized.

Changing these patterns might require dramatic governmental steps that would be flatly inconsistent with our notions of freedom of association. In the framework of my model, it is as if we would plop an individual down in the middle of a new cluster of individuals, so that she can observe their choices and outcomes. Obviously, to some extent, we do regulate freedom of association; antidiscrimination laws are one way in which we do this. The agent-based models in this essay suggest that the increased heterogeneity of exposure that results may improve matters for everybody. To some extent, the government can also influence associational outcomes, as it does by subsidizing public schools and limiting school vouchers. Again, this may increase exposure to different individuals—but only partially if we really live in a Tiebout world, where public schools sort into likes with likes—and again the examples suggest that will lead to better overall decision making.

In a much narrower sense, we could switch from considering legal policies that regulate or influence associations and turn instead to exposure and a revised form of information disclosure. We could embed individuals into virtual reference groups. Through these, we would not have information disclosures driven by simplification—the Plain English movement—but rather disclosures of the decisions that others made under similar circumstances and the results of those decisions. In a phrase, these would be *experience disclosures*.

As any web surfer will tell you, this is happening every day on the web. Smart websites are creating customer experience databases and making these available to their customers. *Amazon.com* asks readers to read books and submit reviews and ratings via e-mail. You can read the reviews, and the ratings are aggregated into a single rating. These websites not only provide access to the product and a way to order it, but compile information from their customers. Online user groups played this role before the advent of the web, and the Better Business Bureau has collected complaints from customers for years.

What does this mean at a practical level? Suppose that we printed pictures of smokers on the back of packs of cigarettes, along with a tag line. These pictures would be chosen at random from a database that would be compiled from a voluntary, random survey of smokers, and would change from pack to pack. Some of the smokers, presumably,

27. *See generally* ROBERT H. FRANK, LUXURY FEVER (1999) (analyzing research demonstrating that purchasing is driven by the need to match a chosen reference group); JULIET B. SCHOR, THE OVERSPENT AMERICAN (1998) (same).

would be quite happy with their choice and would express that in the tag line. Others would undoubtedly regret the choice, and would express that. Smokers would be exposed to the experiences of other smokers on a daily basis.[28]

To consider another decision of some significance, suppose that we required a woman seeking an abortion to watch six randomly selected five-minute videotapes of women describing their abortion experiences. Or consider information relating to fertility. The decisions of the American Infertility Association and the American Society of Reproductive Medicine to conduct a traditional information campaign about fertility problems has been controversial,[29] but the impetus for the campaign is clear: many couples have fertility problems, miscarriages are unfortunately common, and age matters.

Think of this as reference-group perturbation. The problem of knowing when you have identified an optimal amount of information to make a decision is quite hard. It is possible that as a society we could decide there are certain significant decisions where the focus is on whether the person has received a broad base of information. The strategy of reference-group perturbation should have consequences only for those who have weak priors, so that the new information moves them substantially. We are appropriately concerned if small amounts of information result in large discontinuities in decision making.

Why should there be a role for government in experience disclosure? Disclosure by the provider, of course, will be one sided: when you ask a potential building contractor for references, you know that you are not going to hear about the failed projects, only the ones that went smoothly. Cigarette billboards focus on young, vibrant smokers having fun, not a fifty-eight-year-old lung-cancer victim. We could rely on competing disclosure/advertising, but then we may get the battle of the extremes rather than an honestly random draw from the available information. We may have neutrals, who have no stake in the outcome, provide this information—think of Roger Ebert and computer reviews in PC magazines—but there needs to be a market for this, which may not exist. Would a fifteen-year-old kid who wants to start smoking because it would be cool, or make his parents mad, pay for information about smoking? More generally, does a person with a weak prior know that she has a weak prior, and that buying more information would make sense? The answers are unclear.

28. This is reminiscent of the campaign to put the pictures of missing kids on milk cartons, a campaign ultimately abandoned as it was thought that it made the risk of becoming a missing child too salient. *See* Bill Lagattuta, *48 Hours: Lost Lives; Pictures of Missing Children on Milk Cartons Discontinued Because It Struck Fear in Parents and Children* (CBS television broadcast, Feb. 15, 1996).

29. *See* Claudia Kalb et al., *Should You Have Your Baby Now?; A Group of Doctors Thinks Advances in Fertility Treatment Have Given Women Too Much Hope*, NEWSWEEK, Aug. 13, 2001, *available at* 2001 WL 19505131.

We might want to guard against this. How and in what contexts? Two strategies come to mind: filters/tests/licenses and duties to provide and disclose reference points. The first approach tests for decision-making ability directly. So, for example, we allow anyone to buy over-the-counter medication, but create a separate class of prescription medication and only permit licensed professionals—doctors—to allow use. This kind of licensing or capability testing is relatively expensive and is typically reserved for situations where there is a lot at stake. Information disclosure, including the kinds of reference disclosures suggested here, is usually less costly, though more uncertain.

IV. CONCLUSION

The purpose of this essay is just to give a flavor of how agent-based computer simulation might be used to help us understand law. In its most basic form, we will use agent simulation to look at small artificial societies to learn where they succeed and how they fail. In the examples here, we see that simple-minded agents can make smart decisions in the aggregate and, as a group, can learn and communicate quite successfully. The examples should suggest that, even if economic decision makers are not the perfect rational superminds typically found in most economic models, more limited individuals can still thrive in the right context. We can also test in this framework how sensitive outcomes are to small variations. In the examples, even small amounts of movement—a proxy for communication—can be important, as can a minimal amount of mutation.

With these examples in hand, it is possible to make some suggestions about law. The models suggest the importance of exposure to difference. We can certainly understand many antidiscrimination laws as having that consequence. We also know that broad social policies, such as those relating to public schools and vouchers, will impact daily exposure as well. Less intrusively, information disclosure can alter an individual's reference groups, and, again, the agent simulation examples show powerfully how outcomes can be altered.

As agent simulation spreads over the next decade, we can expect to see models attempt to incorporate more directly institutional and legal features. This will be hard—and there have been few successes to date—but the ability to test policies beforehand would be a huge accomplishment, and might be fun to boot. SimLaw anyone?