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# WEDDING CARLSON AND SCHWARTZ: UNDERSTANDING SECURED CREDIT AS A FUZZY SYSTEM

*Edward S. Adams\**

*Steve H. Nickles\*\**

*Thomas Harju Ressler\*\*\**

*As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.*

—Albert Einstein<sup>1</sup>

## INTRODUCTION

USING economic analysis, legal academics have challenged themselves to posit a rational explanation for a debtor's willingness to issue secured debt. These academics have questioned why a debtor would grant a creditor a security interest in collateral, given that the debtor's unsecured creditors, recognizing that "the pool of assets available to satisfy their claims has shrunk," will increase the price of credit they provide by an amount that precisely corresponds to the secured creditor's reduction in price.<sup>2</sup> Economic theorists contend that, because the debtor's overall position is not obviously improved by the issuance of secured debt, the existence of secured debt is a puzzle.<sup>3</sup>

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\* Associate Professor of Law, University of Minnesota Law School.

\*\* Roger F. Noreen Chair in Law, University of Minnesota Law School.

\*\*\* Assistant Professor, University of St. Thomas.

<sup>1</sup> Albert Einstein, *Geometry and Experience*, in *Sidelights on Relativity* 25, 28 (photo. reprint 1983) (G.B. Jeffery & W. Perrett trans., 1923). Einstein used this axiomatic statement to answer the puzzle of how mathematics, a product of human thought independent of experience, is "so admirably appropriate to the objects of reality." *Id.*

<sup>2</sup> See Alan Schwartz, *Security Interests and Bankruptcy Priorities: A Review of Current Theories*, 10 *J. Legal Stud.* 1, 7-8 (1981).

<sup>3</sup> This puzzle of secured debt was first identified in a law review article by Professors Thomas Jackson and Anthony Kronman. See Thomas H. Jackson & Anthony T. Kronman, *Secured Financing and Priorities Among Creditors*, 88 *Yale L.J.* 1143 (1979). The puzzle assumed its current form in an article by Professor Alan Schwartz. See Schwartz, *supra* note 2, at 7-9. Since then, numerous commentators have addressed the puzzle. See, e.g., Barry E. Adler, *An Equity-Agency Solution to the Bankruptcy-Priority*

Professor David Gray Carlson attempts to "solve" the secured debt puzzle by denying that there really is a puzzle. Using price theory, Carlson contends that, because security interests lower the cost of debt service by "shifting power from the debtor to the creditor,"<sup>4</sup> they actually reduce risk and therefore the interest compensation the creditor requires. This reduction in risk, Carlson asserts, "is large enough to make available credit that otherwise would not be extended."<sup>5</sup> And, if no future unsecured creditors arise, "the risk dissipated by the security interest vanishes entirely."<sup>6</sup>

The fundamental problem with Carlson's article is its remarkable inconsistency with his prior work. For years he has argued that efficiency alone fails to explain everything (or much of anything) about secured credit. Carlson has seen more clearly than anyone else writing in commercial law that "there is no single correct explanation [of law]."<sup>7</sup> Rather, "[t]here are infinite correct explanations, each co-existing with the other at different levels of generality."<sup>8</sup> This Carlson, the true Carlson, is insightfully right. Through his full body of work, Carlson has tried admirably to broaden the debate and make it more inclusive, less rigid, and more democratic. In doing so, he has essentially argued for a mul-

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Puzzle, 22 *J. Legal Stud.* 73 (1993); James W. Bowers, *Whither What Hits the Fan?: Murphy's Law, Bankruptcy Theory, and the Elementary Economics of Loss Distribution*, 26 *Ga. L. Rev.* 27 (1991); F.H. Buckley, *The Bankruptcy Priority Puzzle*, 72 *Va. L. Rev.* 1393 (1986); Homer Kripke, *Law and Economics: Measuring the Economic Efficiency of Commercial Law in a Vacuum of Fact*, 133 *U. Pa. L. Rev.* 929 (1985); Thomas H. Jackson & Alan Schwartz, *Vacuum of Fact or Vacuous Theory: A Reply to Professor Kripke*, 133 *U. Pa. L. Rev.* 987 (1985); Saul Levmore, *Momitors and Freeriders in Commercial and Corporate Settings*, 92 *Yale L.J.* 49 (1982); Steve H. Nickles, *Radical Reductionism in Debtor-Creditor Law*, 39 *Cath. U. L. Rev.* 765 (1990); Randal C. Picker, *Security Interests, Misbehavior, and Common Pools*, 59 *U. Chi. L. Rev.* 645 (1992); Alan Schwartz, *A Theory of Loan Priorities*, 18 *J. Legal Stud.* 209 (1989); Alan Schwartz, *The Continuing Puzzle of Secured Debt*, 37 *Vand. L. Rev.* 1051 (1984); Robert E. Scott, *A Relational Theory of Secured Financing*, 86 *Colum. L. Rev.* 901 (1986); James J. White, *Efficiency Justifications for Personal Property Security*, 37 *Vand. L. Rev.* 473 (1984). For an excellent account of the history of commentary on the secured debt puzzle, see Paul M. Shupack, *Solving the Puzzle of Secured Transactions*, 41 *Rutgers L. Rev.* 1067 (1989).

<sup>4</sup> David G. Carlson, *On the Efficiency of Secured Lending*, 80 *Va. L. Rev.* 2179, 2182 (1994).

<sup>5</sup> *Id.*

<sup>6</sup> *Id.*

<sup>7</sup> David G. Carlson, *Rationality, Accident, and Priority Under Article 9 of the Uniform Commercial Code*, 71 *Minu. L. Rev.* 207, 234 (1986).

<sup>8</sup> *Id.*

tivalent analysis of law, which is the central idea of this Commentary.

In his present article, however, Carlson's solution to the secured debt puzzle joins most other justifications and criticisms of Article 9 in purporting to be a *certain* and precise explanation of secured lending and the existing Article 9 priority scheme. The Article 9 debate has been defined in bivalent—yes/no, black/white, true/false—terms. Proponents of secured debt have justified its existence on various efficiency grounds.<sup>9</sup> In contrast, opponents maintain that the present secured debt priority scheme may be unfair to nonconsensual (i.e., tort) claimants and unsecured creditors.<sup>10</sup> This bivalent tug-of-war between efficiency and fairness has dominated the Article 9 literature. To date, however, neither side has made significant progress in bolstering or undermining the legitimacy of secured debt. Both sides have labored like Sisyphus to push their views to the pinnacle of Article 9 theory, but neither has much to show for their efforts.

This Commentary urges that we take the debate in an entirely different direction. It rejects the very premise of bivalence in the Article 9 setting in favor of a principle of fuzzy logic.<sup>11</sup> According to this principle, everything is a matter of degree; fuzziness is multivalence. It suggests an infinite number of perspectives for viewing a problem, not just two extremes: "analog instead of binary, infinite shades of gray between black and white."<sup>12</sup> Part I of this Commentary explores the general parameters of fuzzy logic, discussing the operation of fuzzy principles, fuzzy rules, fuzzy sets, and fuzzy systems. Embracing and applying these fuzzy concepts, Part II

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<sup>9</sup> See, e.g., Jackson & Kronman, *supra* note 3, at 1152-53 (justifying secured debt as providing savings in monitoring costs); Levmore, *supra* note 3, at 51-53 (explaining secured debt as a device to assure that necessary monitoring occurs); Scott, *supra* note 3, at 931-33 (justifying secured debt as both an incentive and form of compensation for the valuable monitoring role played by the secured creditor); White, *supra* note 3, at 491-502 (explaining secured debt as a response to different levels of creditor risk aversion). In this literature, "efficiency" generally refers to the Kaldor-Hicks concept of efficiency: if the gains to society from a particular rule exceed the losses imposed on society, the rule is efficient. See Richard A. Posner, *Economic Analysis of Law* 13-16 (4th ed. 1992).

<sup>10</sup> See, e.g., Lynn M. LoPucki, *The Unsecured Creditor's Bargain*, 80 Va. L. Rev. 1887 (1994).

<sup>11</sup> For an accessible account of fuzzy logic, see Bart Kosko, *Fuzzy Thinking* (1993). Kosko's book largely informs Part I of this Commentary.

<sup>12</sup> *Id.* at 19.

seeks to reformulate the bivalent secured debt debate as a multivalent one. Part II suggests that an explanation and justification of secured debt can be found somewhere between the two extremes of efficiency and fairness by working from principles that derive their strength from their very looseness, or *uncertainty*.

Fuzziness has been contemporarily popularized by the work of Lotfi Zadeh.<sup>13</sup> Legal scholars such as Jack Williams and Charles Yablon have already used fuzzy logic to analyze pieces of debtor-creditor and corporate law.<sup>14</sup> We admire the work of these scholars and build on it to argue for using fuzzy analysis more broadly, even systematically, to understand and interpret the whole of secured transactions law.

### I. FUZZY CONCEPTS

Academics, like most everyone else, usually speak, write, and think in bivalent terms. An especially rigorous type of this bivalent logic is used extensively in numerous aspects of everyday life, including mathematics and computer science, where it is particularly useful to work with strings of zeroes and ones and to eliminate fractions. But, in employing this type of logic, one “trades accuracy for simplicity.”<sup>15</sup> The alternative descriptions “my lawn is green” and “my lawn is yellow” are bivalent statements. They describe one’s view of the lawn. Yet, rarely is either precisely accurate—grass is seldom completely green or completely yellow.

Fuzziness, or multivalence, may be useful everywhere between these two extremes. A fuzzy interpretation of the statement “the lawn is green” takes the statement to be a partial truth.<sup>16</sup> Fuzziness attempts to capture a more nuanced and precise picture of the world, not merely a bivalent description of it. Fuzziness does not, however, reject absolutes—multivalence reduces to bivalence in extreme cases. Occasionally, a lawn really is purely green or purely

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<sup>13</sup> See L.A. Zadeh, *Fuzzy Sets*, 8 *Info. & Control* 338 (1965).

<sup>14</sup> See Jack F. Williams, *The Fallacies of Contemporary Fraudulent Transfer Models as Applied to Intercorporate Guaranties: Fraudulent Transfer Law as a Fuzzy System*, 15 *Cardozo L. Rev.* 1403, 1448-70 (1994); Charles M. Yablon, *On the Allocation of Burdens of Proof in Corporate Law: An Essay on Fairness and Fuzzy Sets*, 13 *Cardozo L. Rev.* 497, 504-18 (1991).

<sup>15</sup> Kosko, *supra* note 11, at 21.

<sup>16</sup> See *id.* at 26.

yellow. Yet fuzziness recognizes that this description is accurate only in rare situations. More often, a lawn is more accurately described as both green and yellow or, in fuzzy terms, as both green and not green. Multivalent logic trades the “rounded-off simplicity of bivalence” for “the expressive power and accuracy of fuzziness.”<sup>17</sup> Fuzziness recognizes that every statement, every word, is a matter of degree.<sup>18</sup>

Suppose, for example, that one imagines being on vacation. The word “vacation” has a different meaning for each of us because we have all read, taken, or dreamed about different vacations. The words we use are public, but we think in sets (denoted by these words) that are private and subjective.<sup>19</sup> The word “vacation” stands for a set of vacations, a group of activities we can each point to and call “vacation.”<sup>20</sup> But which events are *really* “vacations” and which are not? Is a two-week stay in Hawaii a vacation? What about a weekend away from your children? How about leaving work early one Friday afternoon? It should be apparent that “vacation” is a matter of degree. Each of these events is to some degree both a vacation and not a vacation. The boundary between vacation and non-vacation is a blurry one. The word “vacation” stands for a fuzzy set of events that may constitute a vacation.<sup>21</sup> Bart Kosko summarizes, “We think in fuzzy sets and we each define our fuzzy boundaries in different ways and with different examples.”<sup>22</sup> The very looseness of the fuzzy set enhances its expressiveness.

“Fuzzy logic,” a term used to describe technology employed in devices from video cameras to washing machines,<sup>23</sup> is nothing more than reasoning with fuzzy sets. In practice, it most often means creating devices that reason with fuzzy rules—if-then statements

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<sup>17</sup> Id. at 29.

<sup>18</sup> Id. at 122.

<sup>19</sup> See id.

<sup>20</sup> See id. for a similar example.

<sup>21</sup> See id.

<sup>22</sup> Id. at 123.

<sup>23</sup> See, e.g., Michael Schrage, Looking Ahead to the Smart House, *Boston Globe*, Nov. 28, 1993, at 84 (reporting that fuzzy logic is used in the computer system of a proposed “smart home”); Michael White, A Woolly Head for Logic, *The Times Magazine* (London), Jan. 22, 1994, at 26, 26 (discussing the uses of fuzzy logic in consumer appliances like camcorders, microwave ovens, and dishwashers).

like, "If the clothes are *Very Dirty* (fuzzy set X), then make the wash cycle *Longer* (fuzzy set Y)." In mathematical terms, fuzzy if-then rules express the relation between fuzzy sets. Each rule, in turn, defines a "fuzzy patch," the product of fuzzy sets X and Y.<sup>24</sup> "The wider the fuzzy sets [X and Y], the wider and more uncertain the fuzzy patch."<sup>25</sup> Moreover, the fuzzier the fuzzy set, the more the set resembles its own opposite, and the greater its fuzzy entropy. A set with 0% fuzziness is a black and white set; a set that equals its own opposite is a 100% fuzzy set.<sup>26</sup>

The operation of fuzzy sets is nicely illustrated in the context of America's favorite pastime. Suppose, for example, we are attempting to determine the batting average of a hitter described by baseball pundits as "good." We might sketch a graph, where the x axis represents the range of batting averages, and the y axis represents whether a particular hitter is good. Illustration 1 graphs in this manner the traditional, bivalent view of a good hitter.

ILLUSTRATION 1

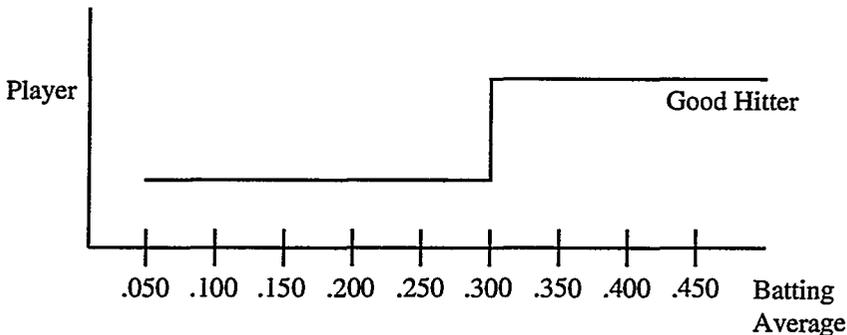


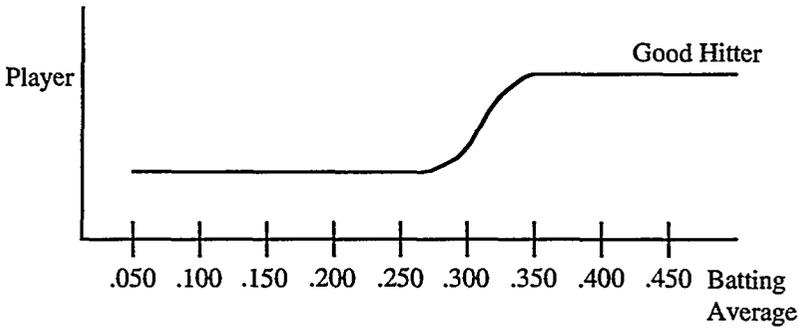
Illustration 2 illustrates the fuzzy view of this same classification problem.

<sup>24</sup> Kosko, *supra* note 11, at 292.

<sup>25</sup> *Id.*

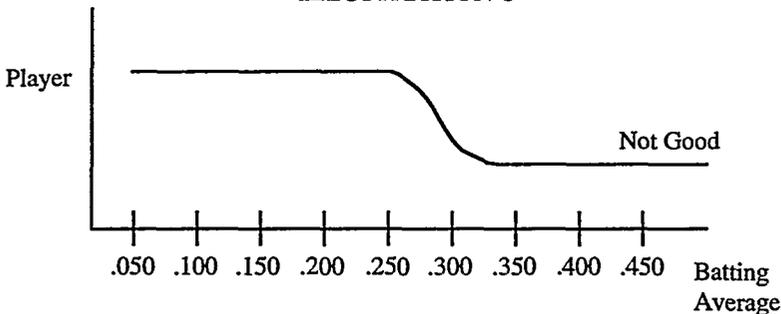
<sup>26</sup> *Id.* at 291.

ILLUSTRATION 2



In Illustration 2, the concept “good” is denoted by a curve of “fit values”—a number between the “bit values” of zero and one—that, for each average, provides the degree of membership in the set of good hitters. Good hitting is a smooth function of average. Every hitter is a good or not-good hitter to some degree. As such, the graph of “not good” looks like the mirror image of the “good” curve, as seen in Illustration 3.

ILLUSTRATION 3



If Illustrations 2 and 3 are placed on top of each other, they intersect at the point where “good” equals “not good,” where fuzziness is most explicit.<sup>27</sup>

The power of fuzzy sets is evidenced by a comparison with bivalent sets. Bivalent sets are drawn with hard, sharp lines between being a good and a not-good hitter. In bivalent terms, some hitters are good and others are not good, and no one hitter is (at the same

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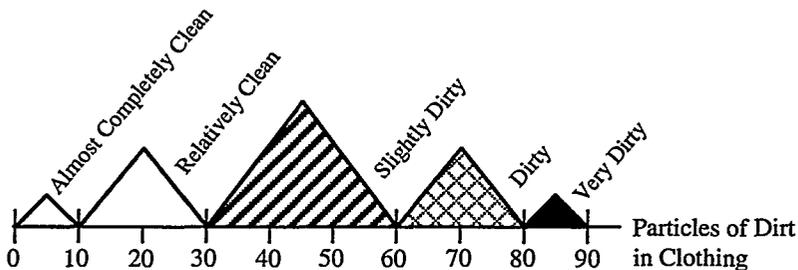
<sup>27</sup> For a similar model, see *id.* at 146-55.

time) both. In Illustration 1, we segregate good and not good hitters at a single point—hitters with an average of .300 or higher were considered good, and those with an average below .300 were considered not good. Yet this view does not comport well with reality. Whether a hitter is good, “like most properties of the world, is a matter of degree.”<sup>28</sup> Whereas curves and fuzzy sets show this smooth change, from good to not good, straight lines do not show it, nor can they. Fuzzy sets tie words to curves, recognizing that all hitters are good or not good to some degree. The hitter who has a batting average of .280 is good and not good, and probably more good than not.

Combining fuzzy rules allows us to create a fuzzy system that automatically converts inputs into outputs. Building such a fuzzy system requires three steps: (1) selecting the inputs and outputs of the system, (2) picking the fuzzy sets, and (3) choosing the fuzzy rules.<sup>29</sup> Assume, for example, that we want to build a washing machine that “knows” to wash dirtier clothes more intensely than relatively clean clothes. Suppose our input is the degree of dirtiness and our output is the intensity of the wash.

First, we select the fuzzy subsets of the inputs and outputs. For the fuzzy input sets we might pick *Very Dirty*, *Dirty*, *Slightly Dirty*, *Relatively Clean*, and *Almost Completely Clean*. We might draw these as triangles, as illustrated in Illustration 4.

ILLUSTRATION 4

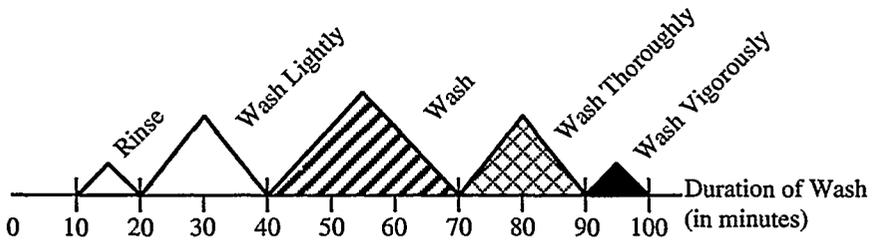


<sup>28</sup> Id. at 147.

<sup>29</sup> Id. at 161, 163.

Next, we draw the five fuzzy output sets *Wash Vigorously*, *Wash Thoroughly*, *Wash*, *Rinse and Wash Lightly*, and *Rinse*, which are denoted by triangles in Illustration 5.

ILLUSTRATION 5



Finally, we choose the fuzzy rules. This step associates the inputs and outputs—i.e., the degree of dirtiness with the intensity of the wash. Because we want the intensity of the wash to correspond to the dirtiness of the clothing, we might posit the following rules:

Rule 1: If the clothes are *Almost Completely Clean*, then they are only *Rinsed*.

Rule 2: If the clothes are *Relatively Clean*, then they are *Rinsed and Washed Lightly*.

Rule 3: If the clothes are *Slightly Dirty*, then they are *Washed*.

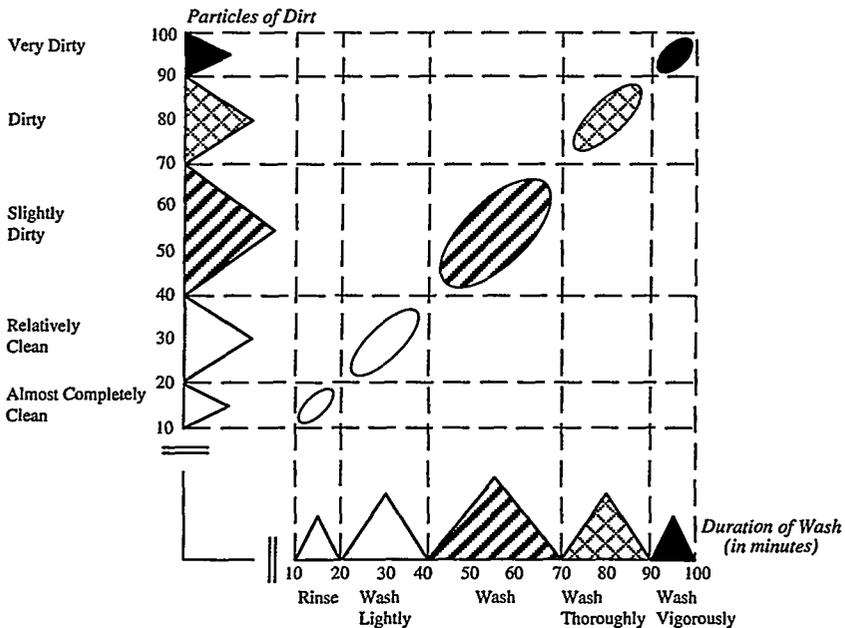
Rule 4: If the clothes are *Dirty*, then they are *Washed Thoroughly*.

Rule 5: If the clothes are *Very Dirty*, then they are *Washed Vigorously*.

By tying together these fuzzy sets through fuzzy rules, we create fuzzy patches. These patches are derived from the intersection of the triangles of our fuzzy sets, as shown in Illustration 6.<sup>30</sup>

<sup>30</sup> Kosko develops a similar model. See id. at 161-67.

ILLUSTRATION 6



The type of rule we develop determines the size of the patch. Sloppy rules create large patches. Fine, more precise rules produce smaller patches. As the widths of our triangles decrease, the fuzzy sets decrease in their fuzziness. Regardless of the precision of the rule, however, “[e]ach input to the fuzzy system [activates] all the rules to some degree as in a massive associative memory.”<sup>31</sup> The more the input resembles the if-part of a fuzzy rule, the more the then-part is activated. The fuzzy system then calculates all these then-part fuzzy sets and takes their average, or centroid, value—the output of the fuzzy system.<sup>32</sup>

Such fuzzy systems make possible products that functionally “think for themselves,” by calculating the proper response to complex situations. For instance, the Japanese have used fuzzy logic to control subways and to stabilize helicopters, as well as to improve numerous consumer products.<sup>33</sup> The obvious question for our pur-

<sup>31</sup> *Id.* at 293.

<sup>32</sup> *Id.*

<sup>33</sup> See *id.* at 38-39.

poses, however, is what all this has to do with law and, more specifically, secured debt. The following Part addresses this question.

## II. FUZZIFYING THE SECURED DEBT DEBATE

An underlying tension between fairness and efficiency is at the core of the secured debt debate. To the extent a debtor improves her position by issuing secured debt, she may do so at the expense of unsecured creditors who are either ignorant of or unable to protect themselves against the superior position of secured creditors.<sup>34</sup> Many scholars contend that efficiency concerns justify the present priority scheme, notwithstanding its effect on unsecured creditors.<sup>35</sup> Others assert that a grant of security is fundamentally unfair, “exploit[ing] not only creditors who are forced into unsecured status but also creditors who accept unsecured status on the basis of an underestimation of the risk.”<sup>36</sup>

What unites the respective proponents of efficiency and fairness is their failure to appreciate that law is a paradigmatic example of a fuzzy system. This fuzziness is manifested by the exceptions and ambiguities built into every legal rule and principle. For instance, Article 9 lays out the seemingly bright-line rule that, between two competing creditors with an interest in the same collateral, the first secured creditor to file or perfect prevails.<sup>37</sup> This rule is fuzzified, however, by numerous statutory exceptions that codify overriding policies<sup>38</sup> and by judicial decisions that recognize overriding principles.<sup>39</sup> Further fuzziness manifests itself in cases of lender liability,

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<sup>34</sup> See Schwartz, *supra* note 2, at 30-36. For a detailed discussion of the distributional explanations for secured debt, see James H. Scott, Jr., *Bankruptcy, Secured Debt, and Optimal Capital Structure*, 32 *J. Fin.* 1 (1977); James H. Scott, Jr., *Bankruptcy, Secured Debt, and Optimal Capital Structure: Reply*, 34 *J. Fin.* 253 (1979).

<sup>35</sup> See *supra* note 9 and accompanying text.

<sup>36</sup> LoPucki, *supra* note 10, at 1916.

<sup>37</sup> See U.C.C. § 9-312(5)(c) (1990).

<sup>38</sup> See, e.g., *id.* § 9-401(2) (establishing that misfiled financing statement are effective against person with knowledge of the contents of the financing statement); *id.* § 9-312(3), (4) (establishing purchase-money priority for conflicting security interest when holder is second-in-time). “Purchase-money” is itself a fuzzy concept because it is *pro tanto*. See *id.* § 9-107. It would be even fuzzier—and a better principle—if purchase-money status were acquired to the extent that any new value added in any way by the second secured party had the same effect as the financing of the debtor’s purchase of collateral.

<sup>39</sup> See, e.g., *In re Howard’s Appliance Corp.*, 874 F.2d 88, 93-95 (2d Cir. 1989) (reordering normal priority scheme pursuant to constructive trust theory); *General Ins. Co.*

which undermine the rules of Article 9 by relying upon more broadly based principles of contract and tort law.<sup>40</sup> The line between a secured party's having priority and not having priority, then, will always be a curve, subject to being redrawn with each new case.<sup>41</sup>

Modeling the Article 9 scheme as a fuzzy system is useful because it forces us to think through the interrelations of competing interests and to seek points of intersection. This search for intersection helps us to refine the debate and to screen out needless noise; it defines areas of mutual agreement, thereby identifying the parameters of disagreement. In the context of Article 9, this type of group therapy between economist and non-economist ("symp")<sup>42</sup>—between proponent of efficiency and proponent of fairness—gives birth to mutual recognition that both sides are not as divided in their views as it might otherwise seem. In fact, conceptualizing the Article 9 debate as a fuzzy system simply confirms what we may already expect: economists and symps are not without significant common ground. Indeed, one would probably search in vain either for an economist who at some point would not trade efficiency for fairness or for a symp who at some point would not trade fairness for efficiency. The mechanism of creating a fuzzy system focuses each side on determining the boundaries of its fuzzy sets, as represented by terms such as "efficiency" and "fairness."

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v. Lowry, 412 F. Supp. 12, 14 (S.D. Ohio 1976) (reordering normal priority scheme pursuant to equitable lien theory), *aff'd*, 570 F.2d 120 (6th Cir. 1978); *Producers Cotton Oil Co. v. Amstar Corp.*, 242 Cal. Rptr. 914, 926-27 (Ct. App. 1988) (reordering normal priority scheme pursuant to unjust enrichment theory); *Affiliated Foods v. McGinley*, 426 N.W.2d 646, 648 (Iowa Ct. App. 1988) (reordering normal priority scheme pursuant to estoppel principles); *First Wyo. Bank v. Mudge*, 748 P.2d 713, 717 (Wyo. 1988) (reordering normal priority scheme pursuant to the theory of tortious interference with contractual relations). See generally Robert A. Hillman, Julian B. McDonnell & Steve H. Nickels, *Common Law and Equity Under the Uniform Commercial Code* ch. 24 (1985 & Supp. 1991) (ranking claims to collateral using supplements to the priority rules of Article 9).

<sup>40</sup> See, e.g., *K.M.C. Co. v. Irving Trust Co.*, 757 F.2d 752 (6th Cir. 1985); *State Nat'l Bank v. Farah Mfg. Co.*, 678 S.W.2d 661 (Tex. Ct. App. 1984). For a complete and useful analysis of this area, see Helen D. Chaitman, *The Law of Lender Liability* (1990); Mark E. Budnitz, *The Law of Lender Liability: 1994 Cumulative Supplement* (1994).

<sup>41</sup> See Kosko, *supra* note 11, at 263.

<sup>42</sup> Professors Harris and Mooney have characterized a "symp" as a member of a school of "sympathetic legal studies" that embraces concepts seemingly at odds with those of efficiency. See Steven L. Harris & Charles W. Mooney, Jr., *A Property-Based Theory of Security Interests: Taking Debtors' Choices Seriously*, 80 Va. L. Rev. 2021, 2045 (1994).

Suppose now that we undertake the construction of a fuzzy system that has as its output the degree of harm done to various creditors, to the debtor, and to others as the result of an Article 9 priority scheme similar to that currently in existence. Assume, moreover, that our input in this system is the level of global efficiency achieved by the scheme. The premise underlying this fuzzy system is that everyone (economist and symp alike) can tolerate a greater degree of harm to the involved parties when the corresponding efficiencies produced by this harm are greater. We might contend that this is so because the gains from efficiency in a very efficient system (i.e., lower credit costs for everyone) eclipse the harm borne by a few.

We might then posit the following fuzzy subsets of inputs and outputs. As our set of fuzzy inputs, we might use *Perfectly Efficient*, *Very Efficient*, *Efficient*, *Almost Efficient*, and *Inefficient*. For our set of outputs, we might choose *Great Harm*, *Moderate Harm*, *Some Harm*, *Little Harm*, and *No Harm*. Admittedly, determining the content of these sets will be a subjective enterprise with variable results. The model mandates that each economist and symp determine for herself the boundaries of the sets corresponding to these terms. This, however, is not a weakness in the model, but rather a strength—it ensures that all sides can be brought together in playing the same game, and it ultimately opens up and refines the debate.

Finally, having developed the relevant sets, we can proceed to create our fuzzy rules. Because we want the degree of harm to correspond to the level of efficiency, we might posit the following:

Rule 1: If the system is *Inefficient*, then we tolerate *No Harm*.

Rule 2: If the system is *Almost Efficient*, then we tolerate *Little Harm*.

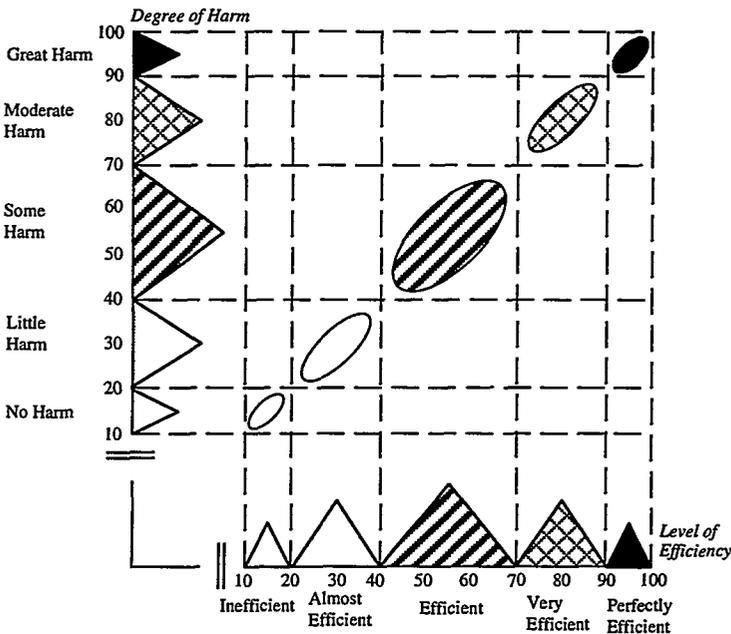
Rule 3: If the system is *Efficient*, then we tolerate *Some Harm*.

Rule 4: If the system is *Very Efficient*, then we tolerate *Moderate Harm*.

Rule 5: If the system is *Perfectly Efficient*, then we tolerate *Great Harm*.

Illustration 7 sketches the fuzzy system produced by these fuzzy rules.

## ILLUSTRATION 7



The fuzzy patches created by the system indicate areas of agreement between economist and symp. They are, of course, merely one possible set of fuzzy patches. The utility of this exercise lies more in its process than in its results. The exercise itself outlines areas of existing agreement and helps to build consensus where none existed previously. It also focuses the debate on the remaining areas of disagreement. Finally, it provides both sides with a shared methodology, hopefully enabling them to build a system that will be mutually acceptable.

## CONCLUSION

Fuzzy logic and fuzzy concepts are increasingly dominating both modern technology and the sciences, and they can no longer be ignored by academics in any field. Rejecting the search for certainty, fuzzy logic seeks consensus. It is both highly practical and keenly precise. For decades, scholars have relied upon archaic, bivalent tools; fuzzy logic offers more modern tools. As Lotfi Kadeh has noted in this regard:

Classical logic is like a person who comes to a party dressed in a black suit, a white, starched shirt, a black tie, shiny shoes, and so forth. And fuzzy logic is a little bit like a person dressed informally, in jeans, tee shirt, and sneakers. In the past, this informal dress wouldn't have been acceptable. Today, it's the other way around.<sup>43</sup>

Specifically, fuzzy logic offers a means to avoid a bivalence that David Carlson fears will sacrifice ethical principles in the name of legal predictability.<sup>44</sup> We agree with Carlson that "[t]he public interest in preserving the weak from the wicked is ineluctable. It is as welcome in commercial law as anywhere else. Nothing except the consensus of legal scholars stands in the way of judges who wish to do the right thing in Article 9 . . . ."<sup>45</sup> Perhaps a new consensus—one in which Carlson could be included—would be more likely if secured credit were understood as a fuzzy system. Scholars, judges, and lawyers could then spend their time developing fair, workable adjustments to Article 9 based on the reality of the endless cases arising in the middle, rather than working from unrealistic assumptions and fantasy cases at the narrow, bivalent extremes.

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<sup>43</sup> Coping with the Imprecision of the Real World: An Interview with Lotfi A. Zadeh, 27 *Comm. Ass'n Computing Machinery* 304, 310 (1984).

<sup>44</sup> See Carlson, *supra* note 7, at 253.

<sup>45</sup> *Id.*

