

READABILITY OF THE LAW: FORMS OF LAW FOR BUILDING LEGAL EXPERT SYSTEMS

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INTRODUCTION

The major goal of our project¹ was to create a user interface for legal expert systems to work as: (1) an assistant for a lawyer creating a knowledge base; and (2) a consultant for a user of the expert system. The interface must be relatively easy for a lawyer to use to create a legal knowledge base and for

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On request, the authors will make available electronic copies of the experimental protocols and an electronic database with results from our experiment.

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a user (lawyer or layperson) to consult by entering facts or asking questions. The system will provide assessments of legal consequences or list facts required to achieve the desired legal results. For either the lawyer or the consultant user, the system will show its reasoning process on demand.

A key issue was how to write rules to be entered into and used by the system to explain its reasoning. As much as one might like to allow rules to be written in natural language as they are in traditional statutes or judicial opinions, building a natural language parser seemed (and still seems) a daunting task. The next best solution would be to restrict natural language as little as possible. Thus, the search was for a set of restrictions that the user would not see as overly constraining.

Based on prior work² we hypothesized that putting laws in standard normalized form³ (SN) would improve their readability and the ability of persons to use them. Hence, we assumed that SN would be an appropriate set of restrictions on natural language input.

SN requires that all laws be written as series of premises followed by conclusions. Legal conditions are linked to legal results by the conditional or biconditional logical operators, IF . . . THEN or IF AND ONLY IF . . . THEN. Conditions are linked by conjunction and disjunction operators, AND or OR. Results are linked by the conjunction operator, AND. Operators are always fully capitalized and placed at the beginning or end of proposition clauses. Each condition and result is a grammatically complete sentence. A simple example is:

²Grayfred B. Gray, *Statutes Enacted in Normalized Form: The Legislative Experience in Tennessee*, in COMPUTING POWER AND LEGAL REASONING 467 (Charles A. Walter ed., 1985); Grayfred B. Gray, *Preparing Enacted Normalized Statutes for an Expert System*, 4 CC AI 389 (1987) (Belg.) [hereinafter *Preparing Enacted Normalized Statutes*]; Grayfred B. Gray, *Reducing Unintended Ambiguity in Statutes: An Introduction to Normalization of Statutory Drafting*, 54 TENN. L. REV. 433, 435 (1987) [hereinafter *Reducing Unintended Ambiguity*]; Grayfred B. Gray, *An Experiment with Normalized Statutes in an Emycin Expert System*, in COMPUTING POWER AND LEGAL LANGUAGE 225 (Charles A. Walter ed., 1988); Layman E. Allen & C. Rudy Engholm, *The Need for Clear Structure in 'Plain Language' Legal Drafting*, in U. MICH. J.L. REF. 455 (1980); Layman E. Allen & Charles S. Saxon, *Exploring Computer-Aided Generation of Questions for Normalizing Legal Rules*, in COMPUTING POWER AND LEGAL LANGUAGE 243 (Charles A. Walter ed., 1988).

³Standard normalized form, as it has been used in Tennessee statutes, is exemplified in *Reducing Unintended Ambiguity*, *supra* note 2, at 436, 440, 442-43, 448, 450-51. We call this form "standard normalized" to distinguish it from the other forms of law used in the experiment that this article reports. Our use of the term "standard normalized form" is not meant to suggest that normalization as exemplified in this article is more commonly accepted or proper than normalization as found in other articles. See, e.g., James A. Sprowl, *Automating the Legal Reasoning Process: A Computer That Uses Regulations and Statutes to Draft Legal Documents*, 1979 AM. B. FOUND. RES. J. 1, 36-45; Allen & Engholm, *supra* note 2, at 493-505. SN uses essentially the elementary between-sentence structural terms and outline format described in Allen & Engholm, *id.*

Normalization and its syntax operators are evolving. Normalized writing has been criticized as "shredded law" by RUDOLF I. FLESCH in HOW TO WRITE PLAIN ENGLISH 102-05 (1979) and for impairing readability and being "unnecessarily elaborate" for most rules by REED DICKERSON in THE FUNDAMENTALS OF LEGAL DRAFTING 122, 262, 262 n. 19, 268-69 (1986). On the other hand, some observations reported by VADA R. CHARROW in WHAT IS "PLAIN ENGLISH" ANYWAY? 2-10 (1979) support our assumption, e.g., jury instruction comprehensibility had either no correlation or negative correlation with sentence length.

- IF
(1) (A) A proper certificate is prepared, OR
(B) The patient proposes voluntary admission,
THEN
(2) an institution may consider the patient for care.

Note that the operators are capitalized and the text is indented so that clauses are separated.

Previous experiments using SN-like forms of law are not conclusive about the ability of naive users to understand law written in SN.⁴ We decided to undertake a readability experiment to determine the ability of naive users to understand law written in SN form.

EXPERIMENT

To evaluate a reader's ability to understand SN, it was necessary to contrast SN with other potential forms. We chose four other law forms: Standard Normal Reverse Order (SNRO), Non-Indented Normalized (NIN), Non-Indented Normalized with Lower Case operators (NINLC), and Ordinary Text (OT).

Personal communications⁵ from subjects in previous experiments and users of laws enacted in SN form suggested that readability would be increased if legal results preceded legal conditions. SNRO is a simple recasting of SN so that results are given before conditions. The example of SN given above would appear as follows in SNRO:

- (1) An institution may consider a patient for care
IF
(2) (A) A proper certificate is prepared, OR
(B) The patient proposes voluntary admission

Some have argued that the beneficial effects of SN may be due to the outline indentations rather than the restrictions of and emphasis on operators.⁶ To respond to such suggestions, we created a non-indented normalized form (NIN) and a non-indented normalized form with lower case operators (NINLC). The example of SN given above would appear as follows in NIN:

⁴See Allen & Engholm, *supra* note 2, at 469-70 and n.4; *Reducing Unintended Ambiguity*, *supra* note 2, at 447 and n.46.

⁵Gray, who was Director of the Office of Legal Counsel of the Tennessee Department of Mental Health and Mental Retardation, had conversations with staff at Arlington Developmental Center, Arlington, Tenn., who participated in earlier experiments, and with other lawyers in the department who worked with statutes enacted in normalized form.

⁶*Reducing Unintended Ambiguity*, *supra* note 2, at 452 and n.55.

IF (1) (A) a proper certificate is prepared, OR (B) the patient proposes voluntary admission, THEN (2) an institution may consider the patient for care.

The example of SN given above would appear as follows in NINLC:

If (1) (A) a proper certificate is prepared, or (B) the patient proposes voluntary admission, then (2) an institution may consider the patient for care.

These four specialized forms were compared to ordinary text (OT) statements of law. The example of SN given above would appear as follows in OT:

If a proper certificate is prepared, or the patient proposes voluntary admission, then an institution may consider the patient for care.

Since our goal was to produce a legal expert system, and since SN laws can be inserted into such a system with little or no editing,⁷ it was our hope that SN laws would be most easily understood and used by subjects.

DESIGN

A paper-and-pencil test was constructed using five Tennessee mental health statutes.⁸ Each was modified to eliminate cross-references to laws outside those to be applied, to reduce legal jargon, and to make complete sentences of the condition and result propositions.⁹ The five laws varied in complexity, from one with a set of three conditions connected to each other by AND and OR and leading to a single legal result (law 1), to one with two subsections, nine conditions connected to each other by AND's and OR's leading to three different results (law 5). Table 1, the laws in outline form, shows that laws 2 and 5 are the most complex.

⁷See *Preparing Enacted Normalized Statutes*, *supra* note 2, at 389-408.

⁸TENN. CODE ANN. § 33-3-108 (Supp. 1987) (enacted in normalized form) (referred to in text as law 1), § 33-6-101 (Supp. 1987) (enacted in traditional paragraph unnormalized form) (referred to in text as law 2), § 33-6-103(k) (Supp. 1987) (enacted in normalized form) (referred to in text as law 3), § 33-6-104(a), (b) (Supp. 1987) (enacted in normalized form) (referred to in text as law 4), and § 33-7-301(a) (Repl. 1984) (enacted in traditional, unnormalized form) (referred to in text as law 5).

See Appendix A for the full SN text of each law.

Text changes are illustrated in Appendix B as is the SN conversion of a statute that was adopted in traditional, unnormalized form.

⁹For example, phrases such as "under this title," "as defined in section 33-1-101," and "under section 33-6-103" were omitted from all versions. Legalistic words and phrases were simplified, for example, "petition, application or certificate" became "certificate," "shall not be considered under this title" became "is not valid," and "defendant" became "person."

Table 1
Outline of Syntactic Complexity of Laws (SN Form)

Law 1:

IF
(1) _____, AND
(2) (A) _____, OR
(B) _____,
THEN
(3) _____.

Law 2:

IF
(1) _____, AND
(2) _____, AND
(3) (A) _____, OR
(B) (i) _____, AND
(ii) _____,
THEN
(4) _____, AND
(5) _____.

Law 3:

IF
(1) _____, AND
(2) (A) _____, OR
(B) _____, AND
(3) _____,
THEN
(4) _____.

Law 4:

Subsection (a)

IF AND ONLY IF
(1) (A) _____, OR
(B) _____, OR
(C) _____, OR
(D) _____, AND
(2) _____,
THEN
(3) _____ (GO TO subsection b)

Subsection (b)

IF AND ONLY IF
(1) _____, AND
(2) _____, AND
(3) _____, AND
(4) _____,
THEN
(5) _____.

Table 1 (continued)

Law 5:

Subsection (a)

IF

(1) _____, AND

(2) (A) _____, OR

(B) _____, AND

(3) (A) _____, OR

(B) _____, AND

(4) _____,

THEN

(5) _____.

Subsection (b)

IF

(1)(Refer to subsection a),

THEN

(2) IF

(A) _____,

THEN

(B) _____, AND

(3) IF

(A) _____,

THEN

(B) _____.

An effort was made to lead the subjects through a series of problems that increased in difficulty of interpretation independent of clausal complexity. The sample problem and problems 1 and 2 were the easiest in the experiment, and problems 9 and 10 were designed to be the most difficult. Average confidence levels which could cover the range from "Completely confident" to "Not at all confident" are patterned in a way that indicates this design object was met. Confidence levels, table 2, begin at 3.2 and fall to 2.6 by problem 3, where they level off.

Table 2
Average Confidence Levels and Percent Correct Answers

Problem	1	2	3	4	5	6	7	8	9	10
Confidence	3.2	3.0	2.6	2.9	2.7	2.9	2.7	2.8	2.6	2.7
Percent Right	52.4	26.0	49.1	61.5	45.3	45.1	36.4	46.2	54.6	49.8

We were aware that changing the wording of laws might affect their readability. Our tests of all changes in wording showed that we were able to create different forms of the law with minimal differences in readability. None of the index scores varied by more than five percent for any one law. Other

indexes of complexity were virtually constant across all forms of a given law.¹⁰ Given the results of these analyses, we are confident that differences in ability to make legal decisions would be a function of law form rather than differences in readability.

The five laws dealt with different aspects of mental health law. Knowing one law did not make the other laws easier to understand.

Subjects were presented two problems based on each law—ten problems in all. Each problem included an issue to be resolved, a statement of the facts of the case, and a statement of the law. Each subject used all five laws, but each law was in a different form (SN, SNRO, NIN, NINLC, OT). Though subjects saw the laws and the problems in the same order, the form of the laws was varied from test to test so that different subjects saw the law forms in different orders. For example, for some the order was SN, SNRO, NIN, NINLC, OT, and for others it was OT, NINLC, NIN, SNRO, SN. There were ten different orders, each of which was used by 10% of the subjects. The reason for varying the order of presentation of the forms was to reduce correlation between form of the law and other variables, e.g., years of schooling, that might also account for correct answers. The design was eminently successful since not one of the other potential explanatory variables was related to form of the laws.¹¹ The ability of all potentially explanatory variables to explain correct answers is independent of the effect of form of the law.

Each problem required the subject to choose the correct answer from four choices and requested the subject to use a five-point scale to express confidence in the chosen answer.¹² The full test included a sample problem with an ordinary text law—for training—and a set of demographic items following the last problem.

Subjects were given the test in groups and told that our general purpose was to test the readability of different forms of law and that the tests were coded in ten colors to distinguish variants of the test. We also requested that once a question had been completed that they not go back and change any of their answers. They were instructed to do the example problem and wait. When most of the group had finished the example, the experimenter gave the correct answer and answered any questions that arose. Subjects then completed the test at their own pace. Most completed the test in 45–60 minutes.

¹⁰A full report of these analyses can be obtained from the authors.

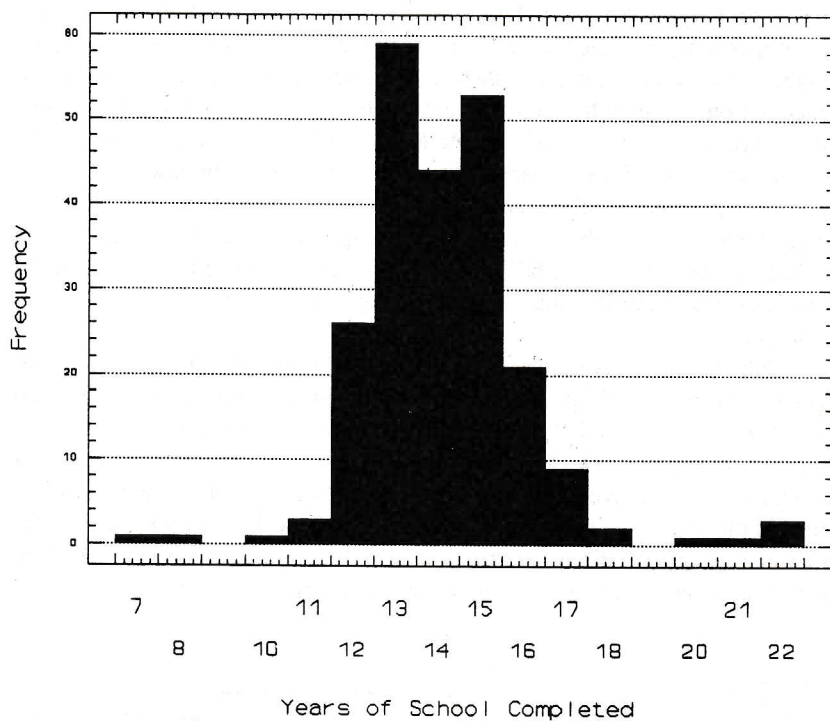
¹¹This design is called a Latin Square. Across the experiment subjects are exposed to the experimental stimulus—here the different law forms—in different sequences. The design eliminates order of presentation as a confounding effect. This result is shown graphically in Appendix C for Years of School Completed and Law Form. Similar graphs or tabular equivalents are available from the authors for other variables.

¹²In the research instrument, confidence levels were coded from 1 to 5 with 1 being the highest level (Completely confident) and 5 being the lowest (Not at all confident). For analysis and discussion within this article, the numbers assigned were manipulated mathematically to make larger numbers equal to higher confidence levels.

CHARACTERISTICS OF THE SAMPLE

Of the 260 distributed tests, 236 were usable. The 24 unusable tests came from administrations in community groups, in which subjects were more than sixty years old, many of whom had literacy problems. College students are the largest single group within the sample of 236 subjects. Figure 1 is the distribution of last year of school completed; figure 2 is the distribution of age in years. The sample is 60% female and 82% white; 81% were enrolled in college when they completed the test; 39% of the subjects reported family incomes greater than \$50,000 per year. Median number of years of school completed for the sample is above the population median. In summary, subjects are well-educated members of the middle to upper classes and predominantly white and young.

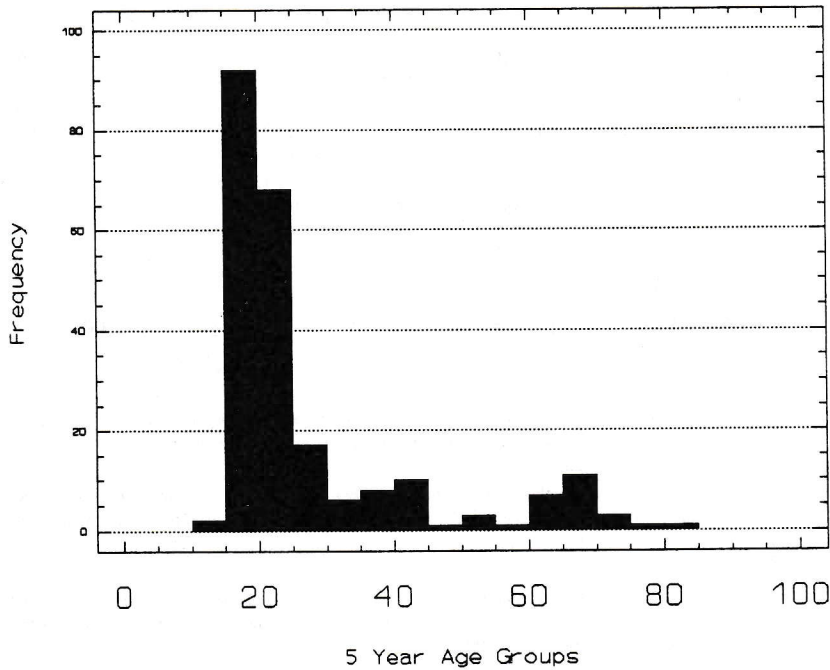
Figure 1
Education



EFFECT OF THE LAW FORMS

The main goal of the experiment was to determine whether the form of the law influenced the ability of individuals to make appropriate legal inferences.

Figure 2
AGE



While the results conform to our expectations, they are not as strong as we would have liked. Answers to two problems, 3 (using law 2) and 9 (using law 5), vary according to form of the law with more correct answers given when SN is used than for any other form.

Table 3 shows that subjects given SN form for problem 3 did substantially better than those given OT (69% correct compared to 27% correct). In addition, those with SN did substantially better than most others, except NIN.

Table 4 shows that in problem 9, subjects given SN form also did better than all others. The pattern is the same as in problem 3, except that it is less pronounced. In this case, subjects do reasonably well even when the operators are not emphasized (NINLC) so long as the law follows SN format. Once again the Chi-Square value is such that the result is not a chance fluctuation.

Tables for the other individual problems are given in Appendix D. With the exception of problems 3 and 9, none of the results is significant. The form of the law that was presented to the subject is not correlated with the probability of a correct answer for any problems except 3 and 9. If one combines results over all problems, the differences between law forms are slight and not signifi-

Table 3
Answers to Problem 3 by Law Form

Problem 3	Law Form					TOTAL
	SN	SNRO	NIN	NINLC	OT	
WRONG	14	27	17	29	32	119
%	31.11	55.10	35.42	60.42	72.73	50.85
RIGHT	31	22	31	19	12	115
%	68.89	44.90	64.58	39.58	27.27	49.15
TOTAL	45	49	48	48	44	234
FREQUENCY MISSING = 2						
CHI-SQUARE ^a = 22.128		D.F. ^b = 4		P VALUE ^c < 0.0001		
CRAMER'S V ^d = 0.308		CHI-SQUARE _(4, .05) ^e = 9.488				

^a Chi-Square measures the discrepancy between expected and actual results. The larger the values of Chi-Square, the greater the discrepancy. Chi-Square ranges between zero and two times the number of cases. See HUBERT M. BLALOCK, JR., *SOCIAL STATISTICS* 279-92 (1979).

^b D.F. = degrees of freedom. In a table such as this with 2 rows and 5 columns, one might enter 4 numbers at random. The value of the remaining numbers will be determined by the constraints of row, column, and grand totals. The numbers one might enter at random are degrees of freedom, i.e., one is free to set those numbers to any value.

^c P Values are the probability of getting values of Chi-Square as large or larger than the one reported. P Values equal to or less than 0.05 are generally interpreted to mean the results are significantly different from chance. All P Values are reported to the nearest thousandth.

^d Cramer's V standardizes Chi-Square. The range of Cramer's V is zero to one—the closer to one, the stronger the association between the variables in the table. For an extended discussion, see HUBERT M. BLALOCK, JR., *SOCIAL STATISTICS* 279-92, 305 (1979).

^e The value of Chi-Square, 9.488, is as large or larger than all but 5% (.05) of the values of Chi-Square with 4 degrees of freedom.

Table 4
Answers to Problem 9 by Law Form

Problem 9	Law Form					TOTAL
	SN	SNRO	NIN	NINLC	OT	
WRONG	15	28	15	19	27	104
%	32.61	62.22	35.71	40.43	55.10	45.41
RIGHT	31	17	27	28	22	125
%	67.39	37.78	64.29	59.57	44.90	54.59
TOTAL	46	45	42	47	49	229
FREQUENCY MISSING = 7						
CHI-SQUARE = 12.092		D.F. = 4		P VALUE = 0.017		
CRAMER'S V = 0.230						

cant, but SN at 51.1% correct differs from the other forms which vary from 44.4%, NINLC, to 46.6%, SNRO, correct.¹³ If one compares SN to all other forms combined, as in table 5, the difference is statistically significant. When the law is given in SN form, subjects get a significantly higher proportion of correct answers. We appear to be on firm ground: either form of the law makes no difference in the outcome, or SN form is better.

Table 5
SN Compared to All Other Law Forms

All Problems	Law Forms		TOTAL
	SN	All Others	
WRONG	226	1016	1242
%	48.9	54.5	53.4
RIGHT	236	848	1084
%	51.1	45.5	46.6
TOTAL	462	1864	2326
CHI-SQUARE = 4.43 D.F. = 1 P VALUE = 0.035			
CRAMER'S V = 0.045			

CONTROL VARIABLES

Several demographic variables might be expected to account for our findings. To determine the power of other variables, we first looked at zero order correlations between these variables and correct answers to all of the problems. The results are summarized in table 6. Variables are listed in order of strength of association; for any problem the first variable listed has the strongest association, the last variable the weakest. All variables listed have statistically significant associations with answers to the problems. Note that answers to problems 1, 4, and 7 are not correlated with law form or any other explanatory variable. The variable, "years of school completed," our measure of education, has the strongest correlation with correct answers for all problems except 3 and 9, where law form is most powerful. Having taken calculus courses is also a powerful predictor of correct answers. "Number of courses," another variable with strong associations with correct answers, measures formal educational exposure to six subject areas: calculus, computer science, law, linguistics, logic, and public speaking. Our hypothesis is that years of schooling and exposure to specific courses are surrogate measures of intellectual ability. We do not have data to verify this.

¹³Table 9, Appendix D, shows the combined results for all problems for each law form.

Table 6
Significant Zero Order Correlations Between
Correct Answer and Other Variables

Problem	Variable(s)
1	----
2	education, calculus course
3	law form, education, calculus course, number of courses
4	----
5	education, calculus course, number of courses
6	sex
7	----
8	education, calculus course
9	law form, education, age, calculus course, number of courses
10	education, calculus course, computer science course, number of courses

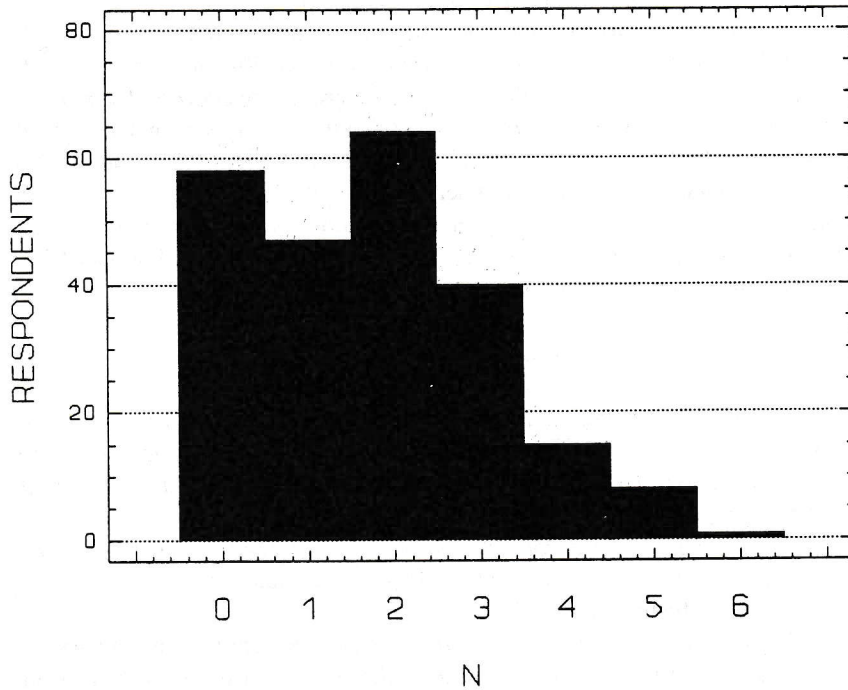
Variables tested include: age, attitude summary, calculus course, computer science course, education, feeling summary, income, number of courses, law form, sex

In addition to the standard demographic items, subjects were asked whether they had taken courses in law, linguistics, logic, computer science, calculus, and public speaking. In the analysis, an index of formal exposure to these subject areas was formed by counting one for each course taken. Figure 3 shows the distribution of this index. Very few subjects have been exposed to more than three areas. Subjects were most likely to have been exposed to: calculus, 45%; computer science, 43%; and public speaking, 37%.

Our assumption was that those familiar with computers would be more likely to have correct answers since the SN form was very close to computer logic. Subjects were asked their feelings "when you hear of a way people do things differently because of computers," and their attitudes "toward having to do things in a way you are not used to." A feeling index was developed with positive feelings (pleasure, excitement, curiosity, glee, amusement) coded 1, and negative feelings (anxiety, fear, frustration, anger, indifference, nervous) coded 0; and an attitude index, with positive attitudes (open, curious, challenged) and negative attitudes (reluctant, skeptical, indifferent, irritation, caution). Subjects could choose only one feeling and one attitude; thus, the indexes were confined to values 1 and 0. Neither index was correlated with law form.

Since our main concern was with form of the law, we have concentrated attention on problems 3 and 9—the only ones in which form of the law is a significant predictor. It is important to determine whether form of the law continues to be a significant explanatory factor in the presence of other vari-

Figure 3
Number of Courses Taken



ables. To test this, we performed logit¹⁴ regressions with the answer to the problem (3 or 9) as the dependent variable, law form as a categorized independent variable, and a variety of controls with relevant interaction terms (terms designed to see whether the effect of one variable was contingent on specific values of any of the others). In both cases, the findings indicated that form of the law had significant independent affect on the probability that the answer would be correct. Years of school completed, family income, gender, and age did not reduce the relationship between law form and problems 3 or 9 (relevant analyses are available from the authors).

In order to test whether our results were due to particular patterns of

¹⁴Logit regressions replace the probability of a particular answer (in this case "correct") with the logit of the probability defined as:

$$\log \left\{ \frac{\text{Probability}}{1-\text{Probability}} \right\}$$

For a fuller discussion see JOHN FOX, *LINEAR STATISTICAL MODELS AND RELATED METHODS* 302 (1984).

courses taken, we determined the relationship of the summary index, computer science, and calculus with law form. None of these variables was correlated with the form of the law that a subject was given.

The last step was to determine whether any of the control variables affected the relationship between law form and the probability of a correct answer in problems 3 and 9. The results of these tests are in Appendix E. Even in the presence of other variables, law form continues to be an important determinant of the probability of a correct answer to problems 3 and 9. "Having taken a calculus course" was the only other variable to have affected whether an answer was correct when the answers to problems 3 and 9 were regressed on law form, the summary index, calculus, and other relevant variables (see table 6) and interaction terms in logit regressions.

OTHER VARIABLES

Other variables were examined which are not directly linked to the primary hypothesis that SN form helps persons understand and use law more correctly. Among these variables were age, education, gender, and subject feelings and attitudes.

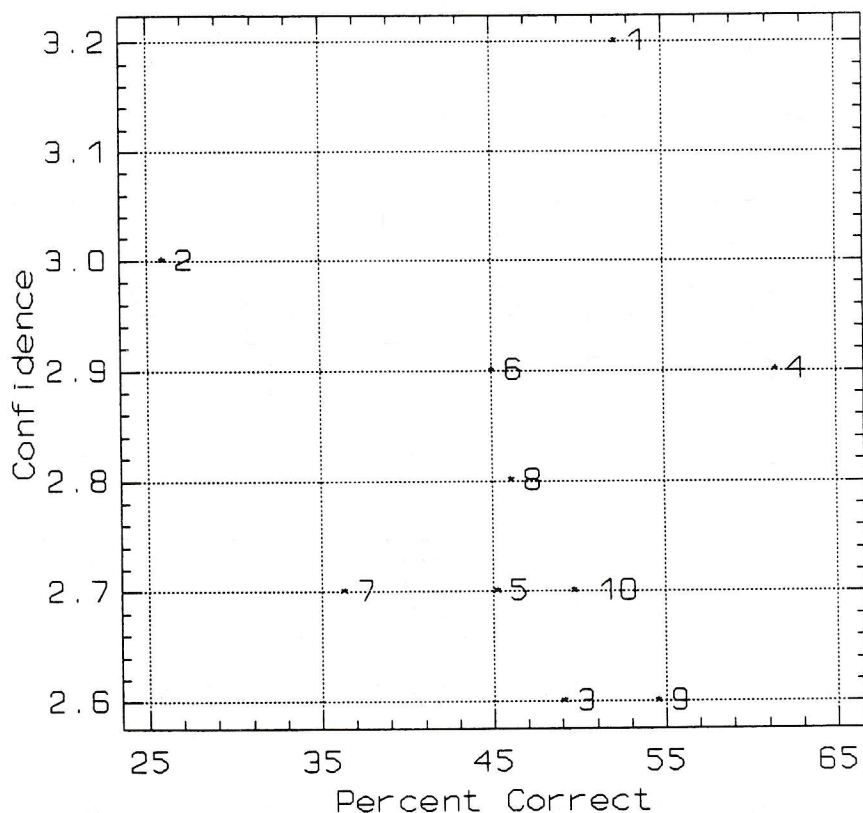
The *probability of a correct answer* was computed for all subjects by totaling their correct answers to each of the 10 problems and dividing by the number of problems attempted.

Figure 4 displays the relationship between confidence and correct answer. The relationship is not significant and is the reverse of expectations: lower confidence levels are associated with higher levels of percentage of correct answers. If one looks at individual problems, it appears that problems 1 and 4 have much higher confidence levels relative to the others. If these problems are omitted, there is a significant reverse association between percentage of correct answers and level of confidence for the remaining problems. An interpretation is that as the experiment progressed, subjects perceived that the problems were more difficult; at the same time their percentage of correct answers increased.

The box plots¹⁵ in figure 5 show the relationship between years of school and probability of correct answers. There is a small relationship between years of schooling and probability of correct answers. Our most highly educated subjects are in the highest quintile. There is a fairly steady progression of medians from the lowest to the highest quintile, but the trend line is not steep.

¹⁵Box plots are ways to picture distributions. See WILLIAM S. CLEVELAND, *THE ELEMENTS OF GRAPHING DATA* 129-34, 163-66 (1985). The box extends from the first to the third quartile; the center line in the box is the median. Thus, each compartment in the box covers 25% of the data. The lines from the box extend, at most, one and one-half times the distance between quartiles. Observations that are further away from the median are marked as separate points to emphasize their distance from the rest of the observations.

Figure 4
Plot of Average Confidence by
Percent Correct, Problems 1-10



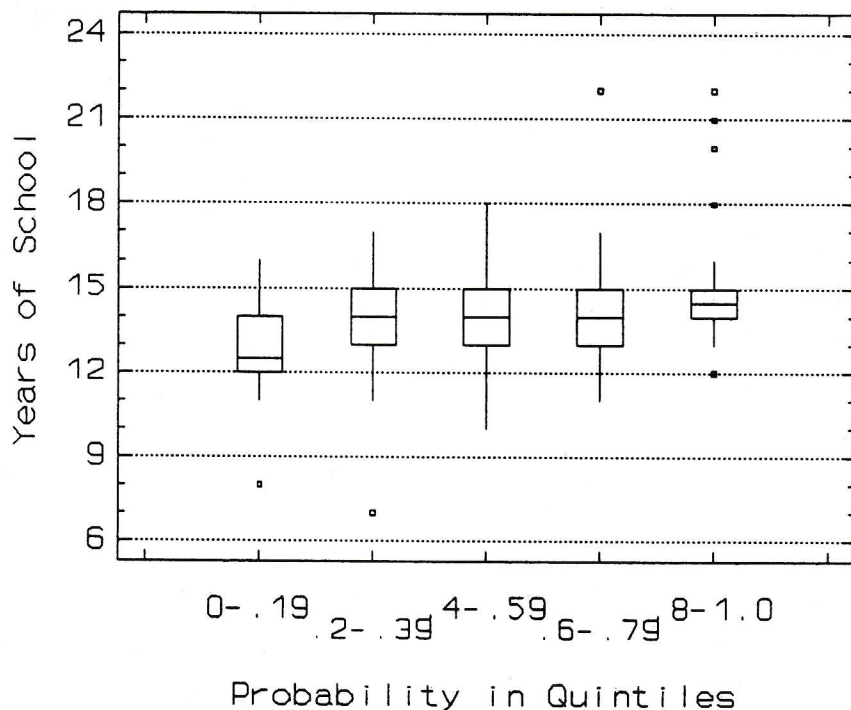
The age and education distributions show different relationships with the probability of a correct answer. Age has a curvilinear relationship with older subjects scoring worse and better than younger ones (figure 6). The trend is rather pronounced.

The age distribution shows that we have a block of subjects of college age and a block of older subjects. In general, the older subjects have poorer education, which is the main reason that they do not do as well. Correct answers are linked to education, and through education to age.

Probability of a correct answer is not a function of gender. Males and females have the same median probability of a correct answer and the same first and third quartiles.

Probability of a correct answer is only weakly related to the number of courses taken. Though persons who have taken more courses do better than

Figure 5
Range of Years of School Completed
by Probability of Correct Answer



those who have taken fewer, the relationship is not linear (two courses does less well than one, and four or more, less well than three) and not very strong.

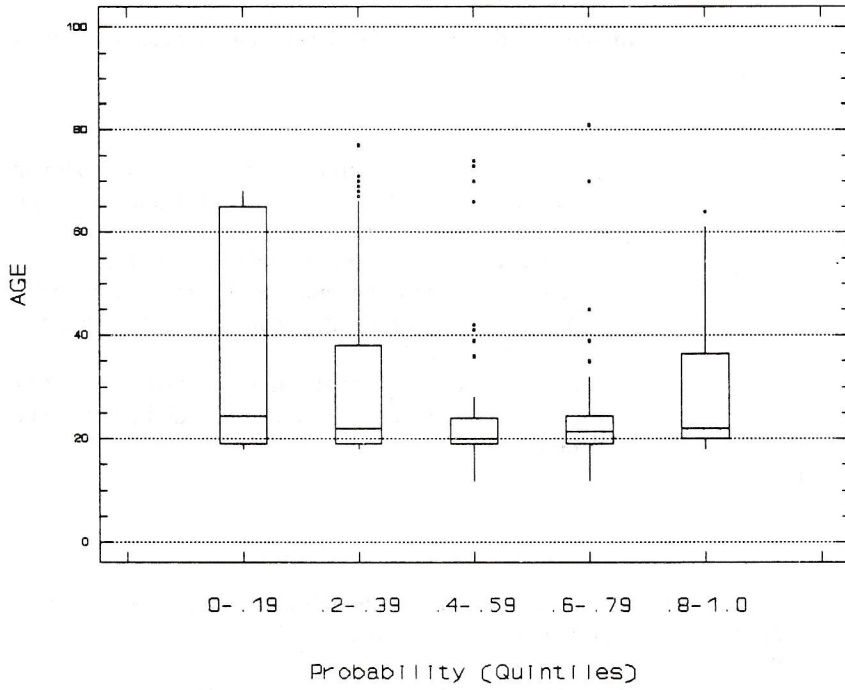
There were not enough African-American subjects to perform a meaningful analysis showing difference between racial groups. That task was deferred for another experiment.

Probability of a correct answer is not related to either the summary of feelings or the summary of attitudes.

CONCLUSION

The experiment demonstrates that standard normalized form (SN) is at least as readable as all other forms of law considered. With complex laws, subjects applying laws in SN were significantly more accurate than those using any other form. It appears clear that an expert system which explains its results in SN will be understandable to users. The experiment shows that a user interface which accepts rules in SN permits the lawyer who builds an expert

Figure 6
Probability of Correct Answer by Age



system to use a form of expression the lawyer is likely to be able to apply and understand readily.

APPENDIX A

The Five Laws in Standard Normalized Form

Law 1 (Derived from Tenn. Code Ann. § 33-3-108 (1984) (enacted in normalized form))

IF

- (1) A certificate of need for commitment to care and treatment as a patient or resident is made by a physician, psychologist, or other professional, AND
- (2) (A) It is made by such a professional who is the spouse, parent, grandparent, brother, sister, child, aunt, uncle, nephew, or niece of the individual who is the subject of the certificate, OR
- (B) It is made by a professional who has an ownership interest in a private facility in which the individual is to be detained,

THEN

- (3) It is not valid.

Law 2 (Derived from Tenn. Code Ann. § 33-6-101(a)(2) (Supp. 1987) (enacted in traditional paragraph unnormalized form))

IF

- (1) An application for admission is received by the superintendent, AND
- (2) An examination by an admitting physician determines the need for hospitalization, AND
- (3) (A) The admission is applied for in an emergency, OR
- (B) (i) The admission is not applied for in an emergency, AND
- (ii) Suitable accommodations are available for the proposed patient,

THEN

- (4) The superintendent of a public hospital shall admit the person, AND
- (5) The superintendent of a private hospital or treatment resource may admit the person.

Law 3 (Derived from Tenn. Code Ann. § 33-6-103(k) (Supp. 1987) (enacted in normalized form))

IF

- (1) The superintendent of a licensed private or local public hospital or treatment resource determines that the person is medically eligible for admission, AND

- (2) (A) A parent, guardian, spouse, or an adult relative of the person, or any other person has made arrangements to pay the cost of care and treatment in a hospital, or treatment resource, OR
- (B) Such a facility chooses to accept the person despite the fact that no such third person has made arrangements to pay the cost, AND
- (3) Placement in the facility is more appropriate to the needs of the person than placement in a state facility,

THEN

- (4) The facility may admit and detain the person for emergency diagnosis, evaluation and treatment.

Law 4 (Derived from Tenn. Code Ann. § 33-6-104(a), (b) (Supp. 1987) (enacted in normalized form))

Subsection (a)

IF AND ONLY IF

- (1) (A) A person has threatened or attempted suicide or to inflict serious bodily harm on himself, OR
- (B) The person has threatened or attempted homicide or other violent behavior, OR
- (C) The person has placed others in reasonable fear of violent behavior and serious physical harm to them, OR
- (D) The person is unable to avoid severe impairment or injury from risks, AND
- (2) There is a substantial likelihood that such harm will occur,

THEN

- (3) The person poses a "substantial likelihood of serious harm" for purposes of subsection (b).

Subsection (b)

IF AND ONLY IF

- (1) A person is mentally ill, AND
- (2) The person poses a substantial likelihood of serious harm because of the mental illness, AND
- (3) The person needs care, training, or treatment because of the mental illness, AND
- (4) All available less drastic alternatives to placement in a hospital or treatment resource are unsuitable to meet the needs of the person,

THEN

- (5) The person may be judicially committed to involuntary care and treatment in a hospital or treatment resource.

Law 5 (Derived from Tenn. Code Ann. § 33-7-301(a) (1984) (enacted in traditional paragraph, unnormalized form))

Subsection (a)

IF

- (1) The defendant is charged with a criminal offense, AND
- (2) (A) The defendant is believed to be incompetent to stand trial, OR
- (B) There is a question as to his mental capacity at the time of the commission of the crime, AND
- (3) (A) The criminal, circuit, or general sessions court judge requests an evaluation order, OR
- (B) The district attorney general or the defendant's attorney requests an evaluation order, AND
- (4) A hearing shows the request should be granted,

THEN

- (5) The defendant is eligible for an evaluation.

Subsection (b)

IF

- (1) The defendant is eligible for an evaluation under subsection (a),

THEN

- (2) IF
- (A) The evaluation can be made by the community mental health center or licensed private practitioner designated by the commissioner to serve the court,

THEN

- (B) The court may order the defendant to be evaluated on an outpatient basis by the center or licensed private practitioner, AND

- (3) IF
- (A) The evaluation cannot be made by the community mental health center or licensed private practitioner designated by the commissioner to serve the court,

THEN

- (B) The court may order the defendant to be evaluated on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.

APPENDIX B

Illustration of Text Changes Made to Focus on Syntax

This appendix illustrates the changes which were made to focus the test of readability on syntax and away from other features of legal writing that can trouble readers. It also illustrates how one law in the experiment that had been originally enacted in an un-normalized form was converted, including further changes in language, to normalized form for the other four forms used in the experiment.

Law 5 is shown below beginning with its original statutory text. Changes that were made in the language to eliminate troublesome features of legal writing are indicated by underlining (material to be inserted) and bracketing (material to be deleted) in the Marked Version. The Marked Version, stripped of underlining and deletions, became the OT version that was used in the experiment and was converted by normalization to SN. Normalization was accomplished by converting the OT version first to the Marked and Revised for Normalization version. New changes in language were required for normalization, and they are indicated in the same way.

Original Statutory Text

When a person charged with a criminal offense is believed to be incompetent to stand trial, or there is a question as to his mental capacity at the time of the commission of the crime, the criminal, circuit, or general sessions court judges may, upon their own motion or upon petition by the district attorney general or by the attorney for the defendant and after hearing, order the defendant to be evaluated on an outpatient basis by the community mental health center or licensed private practitioner designated by the commissioner to serve the court or, if the evaluation cannot be made by the center or licensed private practitioner, on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.

Tenn. Code Ann. § 33-7-301(a) (Repl. 1984).

Marked Version

(Underlined language is new, bracketed language to be deleted.)

When the defendant [a person] charged with a criminal offense is believed to be incompetent to stand trial, or there is a question as to his mental capacity at the time of the commission of the crime, the criminal, circuit, or general sessions court judges may, upon their own request [motion] or upon request [petition] by the district attorney general or by the defendant's attorney for [the defendant] an evaluation order and after a hearing shows the request should

be granted, order the defendant to be evaluated on an outpatient basis by the community mental health center or licensed private practitioner designated by the commissioner to serve the court or, if the evaluation cannot be made by the center or licensed private practitioner, on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.

OT Version

When the defendant charged with a criminal offense is believed to be incompetent to stand trial, or there is a question as to his mental capacity at the time of the commission of the crime, the criminal, circuit, or general sessions court judges may, upon their own request or upon request by the district attorney general or by the defendant's attorney for an evaluation order and after a hearing shows the request should be granted, order the defendant to be evaluated on an outpatient basis by the community mental health center or licensed private practitioner designated by the commissioner to serve the court or, if the evaluation cannot be made by the center or licensed private practitioner, on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.

Marked and Revised for Normalization Version

(Underlined language is new, bracketed language to be deleted.)

Subsection (a)

IF [When]

- (1) The defendant is charged with a criminal offense, AND
- (2) (A) The defendant is believed to be incompetent to stand trial, OR
(B) There is a question as to his mental capacity at the time of the commission of the crime, AND
- (3) (A) The criminal, circuit, or general sessions court judge[s] may, upon their own request or] requests an evaluation order, OR
(B) [upon request by] The district attorney general or [by] the defendant's attorney requests [for] an evaluation order, AND
- (4) [after] A hearing shows the request should be granted,

THEN

- (5) The defendant is eligible for an evaluation. [order the defendant to be evaluated on an outpatient basis by the community mental health center or licensed private practitioner designated by the commissioner to serve the court or, if the evaluation cannot be made by the center or licensed

private practitioner, on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.]

Subsection (b)

IF

- (1) The defendant is eligible for an evaluation under subsection (a),

THEN

(2) IF

- (A) The evaluation can be made by the community mental health center or licensed private practitioner designated by the commissioner to serve the court,

THEN

- (B) The court may order the defendant to be evaluated on an outpatient basis by the center or licensed private practitioner [designated by the commissioner to serve the court or], AND

(3) IF

- (A) The evaluation cannot be made by the community mental health center or licensed private practitioner designated by the commissioner to serve the court,

THEN

- (B) The court may order the defendant to be evaluated on an outpatient basis by the state hospital or the state-supported hospital designated by the commissioner to serve the court.

Full SN Version Is in Appendix A as Law 5

APPENDIX C

Years of School and Law Form

Years of schooling are evenly divided among the law forms for each of the problems. For all practical purposes, the quartiles are the same; therefore, the inter-quartile range, which is a good estimator of the standard deviation, is the same. The medians are the same, with a few exceptions. Figures 7 to 11 contain multiple box plots. These are visual displays showing that years of schooling are distributed similarly for all law forms. Since years of schooling are similarly distributed across law forms, they are independent of law forms and will not bias the relationship between law forms and correct solution of the problems.

Figure 7
Education by Form of Law
Problems 1 and 2

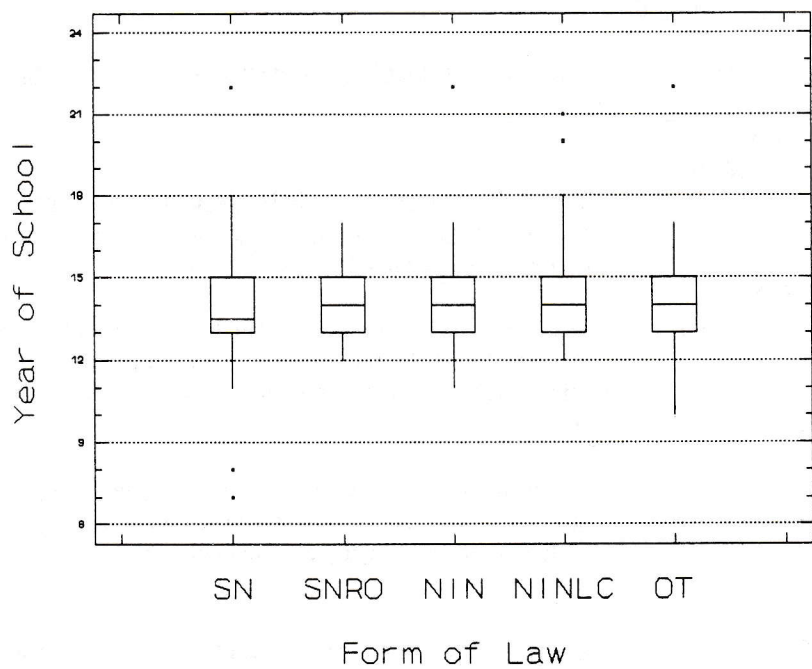


Figure 8
Education by Form of Law
Problems 3 and 4

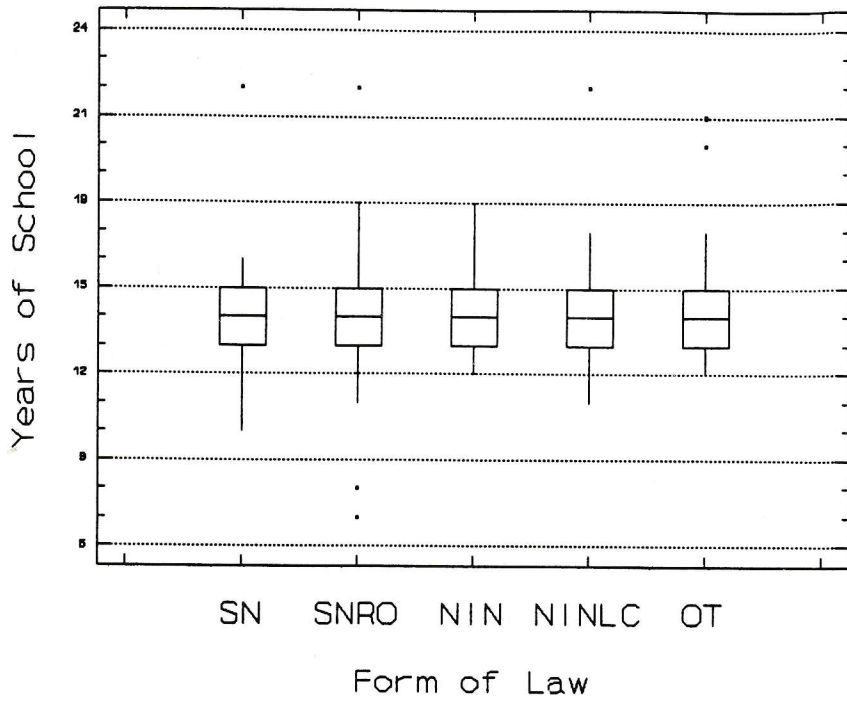


Figure 9
Education by Form of Law
Problems 5 and 6

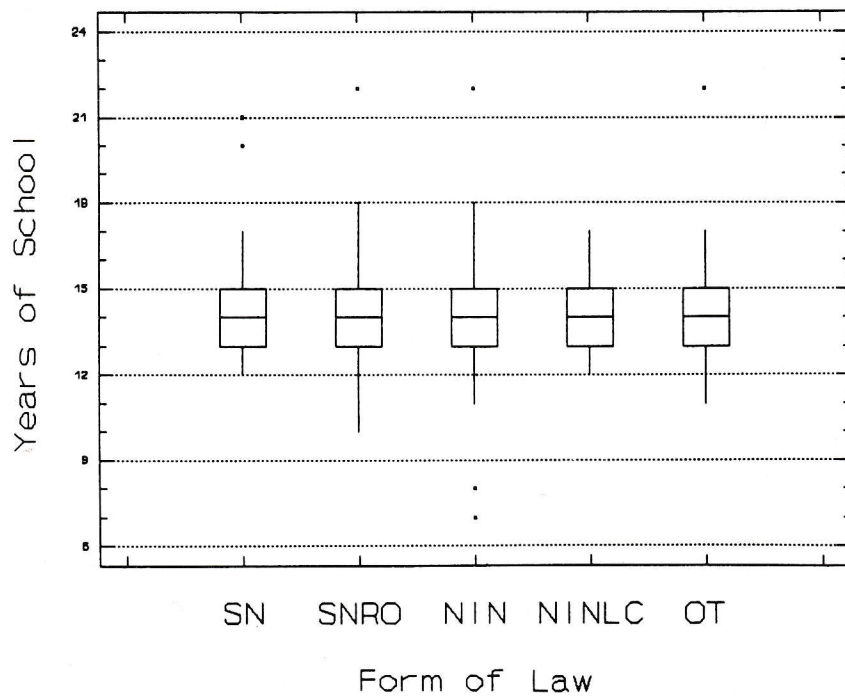


Figure 10
Education by Form of Law
Problems 7 and 8

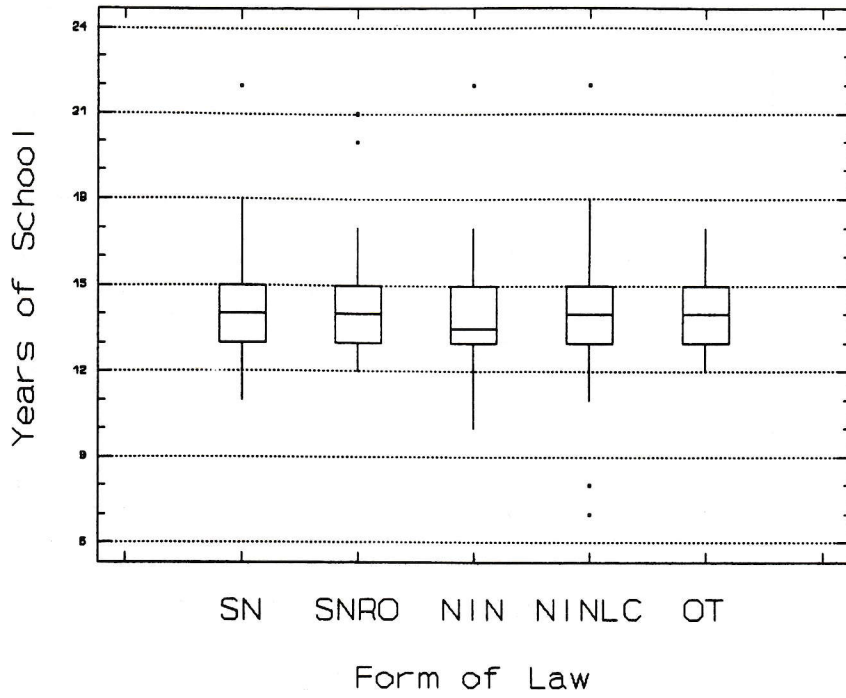
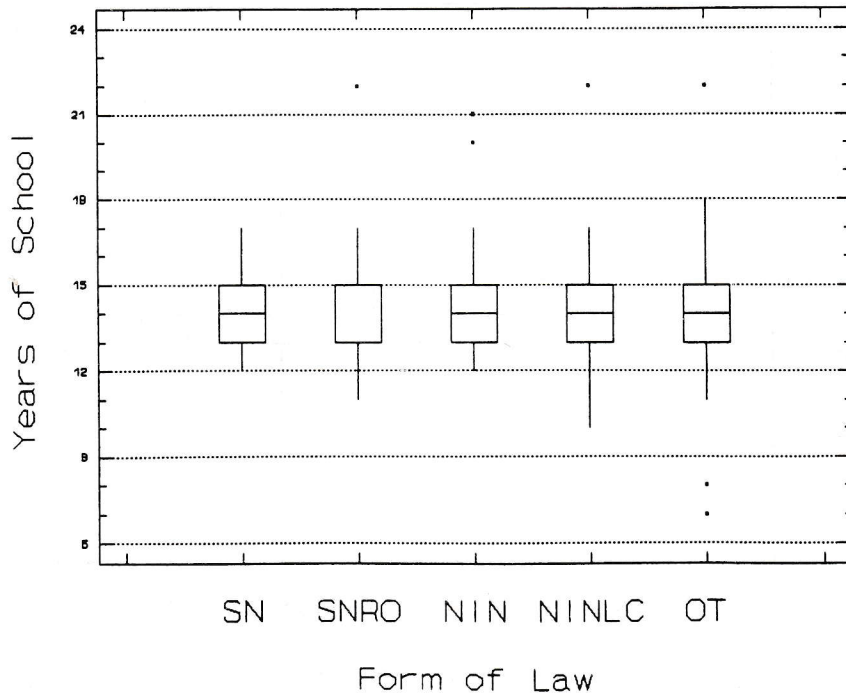


Figure 11
Education by Form of Law
Problems 9 and 10



Appendix D

Tables for Answers to Problems by Law Form¹⁶

**Table D1
Problem 1 by Law Form**

Problem 1	Law Form					
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	24	18	27	23	19	111
%	52.17	38.30	56.25	51.11	40.43	47.64
RIGHT	22	29	21	22	28	122
%	47.83	61.70	43.75	48.89	59.57	52.36
TOTAL	46	47	48	45	47	233

FREQUENCY MISSING = 3

CHI-SQUARE = 4.648 D.F. = 4 P VALUE = 0.325
 CRAMER'S V = 0.141

**Table D2
Problem 2 by Law Form**

Problem 2	Law Form					
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	32	38	37	34	33	174
%	68.09	80.85	77.08	75.56	68.75	74.04
RIGHT	15	9	11	11	15	61
%	31.91	19.15	22.92	24.44	31.25	25.96
TOTAL	47	47	48	45	48	235

FREQUENCY MISSING = 1

CHI-SQUARE = 2.986 D.F. = 4 P VALUE = 0.560
 CRAMER'S V = 0.113

¹⁶For problems 3 and 9 by law form, refer to text and tables 3 and 4.

Table D3
Problem 4 by Law Form

Problem 4		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	19	14	23	19	15	90
%	40.43	28.57	47.92	40.43	34.88	38.46
RIGHT	28	35	25	28	28	144
%	59.57	71.43	52.08	59.57	65.12	61.54
TOTAL	47	49	48	47	43	234

FREQUENCY MISSING = 2

CHI-SQUARE = 4.224 D.F. = 4 P VALUE = 0.377
 CRAMER'S V = 0.134

Table D4
Problem 5 by Law Form

Problem 5		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	25	24	28	27	24	128
%	55.56	51.06	57.14	57.45	52.17	54.70
RIGHT	20	23	21	20	22	106
%	44.44	48.94	42.86	42.55	47.83	45.30
TOTAL	45	47	49	47	46	234

FREQUENCY MISSING = 2

CHI-SQUARE = 0.644 D.F. = 4 P VALUE = 0.958
 CRAMER'S V = 0.052

Table D5
Problem 6 by Law Form

Problem 6		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	27	24	31	24	22	128
%	60.00	51.06	63.27	52.17	47.83	54.94
RIGHT	18	23	18	22	24	105
%	40.00	48.94	36.73	47.83	52.17	45.06
TOTAL	45	47	49	46	46	233

FREQUENCY MISSING = 3

CHI-SQUARE = 3.205 D.F. = 4 P VALUE = 0.524
 CRAMER'S V = 0.117

Table D6
Problem 7 by Law Form

Problem 7		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	30	25	28	33	31	147
%	63.83	56.82	63.64	68.75	64.58	63.64
RIGHT	17	19	16	15	17	84
%	36.17	43.18	36.36	31.25	35.42	36.36
TOTAL	47	44	44	48	48	231

FREQUENCY MISSING = 5

CHI-SQUARE = 1.446 D.F. = 4 P VALUE = 0.836
CRAMER'S V = 0.079

Table D7
Problem 8 by Law Form

Problem 8		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	21	23	27	28	27	126
%	44.68	51.11	58.70	58.33	56.25	53.85
RIGHT	26	22	19	20	21	108
%	55.32	48.89	41.30	41.67	43.75	46.15
TOTAL	47	45	46	48	48	234

FREQUENCY MISSING = 2

CHI-SQUARE = 2.660 D.F. = 4 P VALUE = 0.616
CRAMER'S V = 0.107

Table D8
Problem 10 by Law Form

Problem 10		Law Form				
	SN	SNRO	NIN	NINLC	OT	TOTAL
WRONG	19	28	20	24	24	115
%	40.43	60.87	48.78	51.06	50.00	50.22
RIGHT	28	18	21	23	24	114
%	59.57	39.13	51.22	48.94	50.00	49.78
TOTAL	47	46	41	47	48	229

FREQUENCY MISSING = 7

CHI-SQUARE = 3.939 D.F. = 4 P VALUE = 0.414
CRAMER'S V = 0.131

Table D9
All Problems by Law Form

All Problems	Law Forms					TOTAL
	SN	SNRO	NIN	NINLC	OT	
WRONG	226	249	253	260	254	1242
%	48.9	53.4	54.6	55.6	54.4	53.4
RIGHT	236	217	210	208	213	1084
%	51.1	46.6	45.4	44.4	45.6	46.6
TOTAL	462	466	463	468	467	2326

CHI-SQUARE = 5.076 D.F. = 4 P VALUE = 0.280
 CRAMER'S V = 0.047

Appendix E

Final Regression for Problems 3 and 9

Table E1
Regression of Problem 3
on Law Form and Calculus
Analysis of Variance Table

Source	DF	Chi-Square	P Value
Constant	1	5.20	0.023
Law Form	4	21.77	0.000
Calculus	1	5.91	0.015
Likelihood Ratio	4	6.83	0.145

Individual Parameters

Effect	Estimate	S.E.	Standardized
Constant	-1.057	0.463	-2.283
Law Form	-0.794	0.289	-2.747
	0.110	0.269	0.409
	-0.717	0.281	-2.552
	0.362	0.272	1.331
Calculus	0.694	0.286	2.427

Table E2
Regression of Problem 9
on Law Form and Calculus
Analysis of Variance Table

Source	DF	Chi-Square	P Value
Constant	1	14.36	0.000
Law Form	4	11.34	0.023
Calculus	1	12.25	0.001
Likelihood Ratio	4	3.55	0.470

Individual Parameters

Effect	Estimate	S.E.	Standardized
Constant	-1.779	0.469	-3.793
Law Form	-0.626	0.294	-2.129
	0.746	0.284	2.627
	-0.301	0.294	-1.024
	-0.150	0.276	0.543
Calculus	1.003	0.287	3.495

Other regressions are available from the authors.