"COUNSELOR, PROCEED WITH CAUTION": THE USE OF INTEGRATED EVIDENCE PRESENTATION SYSTEMS AND COMPUTER-GENERATED EVIDENCE IN THE COURTROOM

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[Ladies and Gentlemen of the jury,] [t]here is nothing wrong with your television. Do not attempt to adjust the picture. We are now controlling the transmission. We control the

h o r i z o n t a l

and

the

vertical.

We can deluge you with a thousand channels or expand one single image to crystal clarity and beyond. We can shape your vision to anything our imagination can conceive.[1]

* Production Editor, *Cardozo Law Review*. J.D. Candidate (June, 2002). This Note is dedicated to the memory of Dr. Jerome Levy, former principal of the author's high school, and to the memory of the victims of the tragedies of September 11, 2001. The author wishes to thank his parents, Dr. Neal and Mrs. Bonnie Weinreb, for their love, support, and guidance. The author also wishes to thank Professor Peter Tillers, Professor Arnold Enker, and Professor Lynn Wishart of the Benjamin N. Cardozo School of Law for their support and guidance. In addition, the author would especially like to thank Professor Fred Galves of the University of the Pacific/McGeorge School of Law and the Harvard Journal of Law and Technology ("Harvard JOLT") for donating the CD-ROM that accompanied Professor Galves' article, *Where the Not-So-Wild Things Are: Computers in the Courtroom, The Federal Rules of Evidence, and the Need for Institutional Reform and More Judicial Acceptance*, cited *infra* note 5. The animation sequence involving the heart valve (reproduced *infra* in this Note) and other images are adapted from animations that appear on this CD-ROM, and these animations, as well as other materials appearing upon the CD-ROM, are copyrighted by the Harvard JOLT and Engineering Animation, Inc. ("EAI"), a professional computer animation firm. Finally, the author would like to thank DOAR COMM., INC. for extending to him *gratis* a video depicting DOAR's evidence presentation system, DEPS™, in action. For more information about DEPS™ and other services offered by DOAR, see generally the DOAR website *at* http://www.doar.com.

[1] The Inner Mind, *Outer Limits Openings*, *at* http://www.innermind.com /outerlimits/info/olopen.htm (last modified Dec. 13, 1998) (copy on file with the *Cardozo Law Review* office) (quoting the opening narration of *The Outer Limits*, a science fiction television series).

INTRODUCTION

In the twenty-first century, the computer has become a virtual member of our society.[2] Its ubiquitous presence has touched practically every aspect of our lives and even our deaths.[3] Therefore, it is not surprising that computers and computer technology have also made their presence felt in the legal world.[4] More specifically, computer technology has become a permanent fixture in the trial lawyer's domain,[5] constituting one of a litigator's most powerful weapons.[6] However, the use of computers and computer technology in trial has not been without controversy.[7]

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[2] *See* Robert B. Bennett, Jr. et al., *Seeing is Believing; or is it? An Empirical Study of Computer Simulations as Evidence*, 34 WAKE FOREST L. REV. 257, 258 (1999) ("Our society is fascinated, even obsessed, with modern technology, particularly computers which project an aura of objectivity."); Mario Borelli, Note, *The Computer as Advocate: An Approach to Computer Generated Displays in the Courtroom*, 71 IND. L.J. 439, 439 (1996) ("In the 1990s, our culture has become computer crazed. We constantly hear such terms as 'information superhighway,' the 'net,' and 'multimedia.'").

[3] *See* Kevin Lee Thomason, *Using Computer Generated Evidence*, *at* http://www.legalimaging.com/evidence.html (1996) (last visited July 19, 2001) ("Whether we work as a fry cook at McDonald's, or as a corporate CEO, computers now take our orders, schedule our appointments, create our reports, monitor our progress, and print our paychecks. And when we die, the local newspaper uses computerized typesetting equipment to print our obituaries.").

[4] *See id*. ("Computers are now used to check conflicts, keep track of client billings, print pleadings and contracts. Massive computer databases are used to keep track of the incredibly profuse document productions that accompany today's complex litigation. . . ."); CRAIG JOYCE ET AL., COPYRIGHT LAW 1-2 (5th ed. 2000) ("Today, we are increasingly linked by digital networks, which defy physical distance to carry texts, images and sounds with startling ease and rapidity.").

[5] *See* Fred Galves, *Where the Not-So-Wild Things Are: Computers in the Courtroom, the Federal Rules of Evidence, and the Need for Institutional Reform and More Judicial Acceptance*, 13 HARV. J.L. & TECH. 161, 166-67 (2000) ("Indeed, any perspective that may have initially prevailed of computerization in the courtroom as a threatening newcomer . . . is fading into the view that the incorporation of [computer-generated exhibits] in the courtroom is positive, inevitable, and in many ways quite natural."); Borelli, *supra* note 2, at 456 ("The computer has arrived in litigation.").

[6] *See* Michael Hoenig, *Gatekeeping Reliability of Computer Simulations*, N.Y. L.J., July 10, 2000, at 3 ("Computer assisted courtroom animation has become a powerful tool for the visual recreation of accidents, mechanical failures and other occurrences.").

[7] *See* Galves, *supra* note 5, at 165-66 (quoting Timothy W. Cerniglia, *Computer Generated Exhibits—Demonstrative, Substantive or Pedagogical—Their Place in Evidence*, 18 AM. J. TRIAL ADVOC. 1, 1 (1994)) ("[A]s late as 1994, an experienced trial attorney, Timothy W. Cerniglia, in describing the admissibility problems of evidence associated with [computer-generated exhibits], asserted that 'for legal scholars and commentators, this computer technology present[s] a tangled evidentiary knot of Gordian proportions.'"); Borelli, *supra* note 2, at 440 ("There are many ways of thinking about how to deal with computers in the courtroom, and no clear standards have been set."). Furthermore, courts have taken divergent views in determining whether to include computers and computer technology in trials. *Compare* Star v. Campos, 655 P.2d 794, 797 (Ariz. Ct. App. 1982) ("[T]he court may take judicial notice of the ability of a properly programmed computer to perform mathematical computation and of the general acceptance of the underlying principle of the method."), *and* People v. McHugh, 476 N.Y.S.2d 721, 722-23 (N.Y. Sup. Ct. 1984) ("A computer is not a gimmick and the court should not be shy about its use

Judges, lawyers, and jurors would probably agree that any legal "argument is supposed to be confined to facts introduced in evidence, facts of common knowledge, and logical inferences based on the evidence."[8] "Evidence normally consists of witness testimony and actions, documents, charts, photographs or other images, and physical objects."[9] However, once computer technology is used either for the presentation of evidence or as actual evidence in visual format, it leaves an impression upon a person's mind that cannot easily be erased.[10] Moreover, that impression is likely to be perceived as one of truth. Both judges and jurors "more easily give credibility to televised information. If Peter Jennings says it happened, it happened."[11]

Congress, the federal judicial system, and state judicial systems have provided safeguards in the past to check the potential abuse of the persuasive power of technology.[12] However, in the face of recent technological advances, these safeguards may

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when proper. Computers are simply mechanical tools—receiving information and acting on instructions at lightning speed. When the results are useful, they should be accepted, when confusing, they should be rejected."), *with* Perma Research & Dev. v. Singer Co., 542 F.2d 111, 121 (2d Cir. 1976) (van Graafeiland, J., dissenting) ("I am not prepared to accept the product of a computer as the equivalent of Holy Writ."), *and* Exxon Corp. v. Halcon Shipping Co., Ltd., No. CIV.A.91-920, 1995 WL 20667, at *23 (D. N.J. Jan. 18, 1995) ("This [computer simulation] is the type of exhibit that *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 113 S. Ct. 2786 (1993), had in mind when it designated the judge as the gatekeeper to eliminate junk science from the judicial arena.").

[8] J. Alexander Tanford, *An Introduction to Trial Law*, 51 MO. L. REV. 623, 688 (1986).

[9] Fredric I. Lederer, *The Road to the Virtual Courtroom? A Consideration of Today's—and Tomorrow's—High-Technology Courtrooms*, 50 S.C. L. REV. 799, 812 (1999).

[10] *See* Karen D. Butera, *Seeing is Believing: A Practitioner's Guide to the Admissibility of Demonstrative Computer Evidence*, 46 CLEV. ST. L. REV. 511, 512 n.7 (1998) (quoting Adam T. Berkoff, *Computer Simulations in Litigation: Are Television Generation Jurors Being Misled?*, 77 MARQ. L. REV. 829, 829 (1994)); Jennifer L. Mnookin, *The Image of Truth: Photographic Evidence and the Power of Analogy*, 10 YALE J.L. & HUMAN. 1, 2 (1998) ("Seeing a photograph almost functions as a substitute for seeing the real thing.").

[11] James E. Carbine & Lynn McLain, *Proposed Model Rules Governing the Admissibility of Computer-Generated Evidence*, 15 SANTA CLARA COMPUTER & HIGH TECH. L.J. 1, 5 (1999); *see also* Richard C. Jennings, *Evidence Survey*, 72 DENV. U. L. REV. 703, 715 (1995) (observing that video animation may have a "dramatic power" over the trier of fact). *But see* Donald C. Dilworth, *Is Technology Changing Civil Justice?*, TRIAL, Mar. 1, 1998, *available at* 1998 WL 30769918 (quoting Professor Lederer) ("[J]urors are not overly affected by presentation technology. So many people are used to seeing information on their television screens at home that they don't overreact to display technology in the courtroom."); James W. McElhaney, *Gizmos in the Courtroom*, 83 A.B.A. J. 74, 75 (1997) (quoting attorney David Malone) ("Just because it's on a television screen doesn't mean the jury thinks it happened that way."); Andrew C. Wilson et al., *Tracking Spills and Releases: High-Tech in the Courtroom*, 10 TUL. ENVTL. L.J. 371, 371-72 (1997) ("Constant exposure to movie and television animation has led the public and jurors to suspect "computer magic" in any extraordinary visual sequence.").

[12] *See* Dean M. Harts, *Reel to Real: Should You Believe What You See?*, 66 DEF. COUNS. J. 514, 515 (1999) ("The purpose of the Federal Rules of Evidence, as well as state rules, includes assuring that all scientific, technical, or specialized knowledge evidence and testimony admitted is relevant and reliable.").

no longer be adequate. Attorneys have already begun experimenting with integrated evidence presentation systems ("IEPSs")—powerful tools that take advantage of computing power to effectively convey focused information to juries.[13] They have also started to use computer-generated evidence ("CGE")—computer animations or simulations that are tremendously persuasive and significantly aid jurors in comprehending difficult issues.[14] There is no question that technology will continue to advance and that IEPSs and, more importantly, CGE will become more widely used.[15] There is, however, a question as to whether the federal and state legal systems can safeguard justice when IEPSs and CGE make their entrance into the courtroom.[16]

This Note answers this question by identifying and proposing solutions to the major problems in the usage of IEPSs and CGE in the courtroom. Part I provides background information on IEPSs and CGE, explains their functions and capabilities in litigation, and highlights problems associated with IEPSs. Part II reviews existing federal and state admissibility standards for CGE. Part III addresses problems that potentially exist under these standards when CGE is used in the courtroom. Finally, Part IV proposes some general solutions to IEPS and CGE problems and then proceeds to propose a comprehensive, two-part solution to the problem of jury prejudice when CGE is used in the courtroom. The first part of this solution illustrates a novel CGE presentation technique that is achieved through use of IEPSs. The solution's second part takes Yale Professor Edward Tufte's six key principles of visual evidence reasoning and recommends that courts apply them in CGE cases. This Note concludes that while not every problem associated with IEPSs and CGE may be solvable, courts should nonetheless support the use of IEPSs and CGE and recognize that IEPSs and Professor Tufte's principles have the power to effectively control CGE's strong persuasive power.

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[13] *See* discussion *infra* Part I.A.

[14] *See* discussion *infra* Part I.B; Kristin L. Fulcher, Comment, *The Jury as Witness: Forensic Computer Animation Transports Jurors to the Scene of a Crime or Automobile Accident*, 22 U. DAYTON L. REV. 55, 56 (1996) ("Increasingly, attorneys are using computer reconstructions in criminal cases or automobile accidents as a method of commanding the jury's attention and persuading it to find in favor of the proponent of the computer-generated evidence.").

[15] Every area connected with computer technology, from video games to the Internet, has seen advances over the last decade. *See* Mark C. Joye, *Computer Animations*, TRIAL, Nov. 1, 1998, *available at* 1998 WL 30770072 ("[T]he use in court of computer-generated animations—particularly in products liability cases—continues to increase.")'.

[16] *See* L. Neal Ellis, Jr. et al., *Recent Developments in Trial Techniques*, 35 TORT & INS. L.J. 677, 695 (2000) ("[C]ourts have been increasingly confronted with the difficult task of determining the admissibility of [computer-generated] evidence."); s*ee also* Thomason, *supra* note 3 ("[T]here is little agreement among the courts regarding the admissibility of computer animations.").

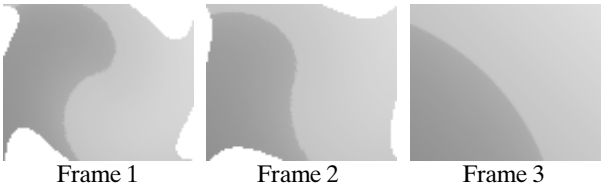
I. BACKGROUND: IEPSS AND CGE

A. *The Uses and Advantages of IEPSs*

If a picture is worth a thousand words, a computer-generated animation is worth a thousand pictures,[17] and the incorporation of

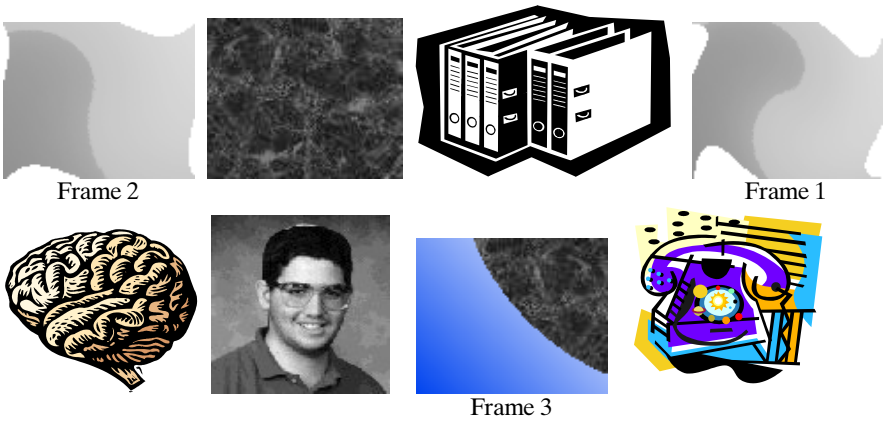
[17] *See* Galves, *supra* note 5, at 190 ("If a 'picture is worth a thousand words,' then a computer-generated animation says a thousand words, sings a thousand songs, and paints with a thousand colors all at once.").

Like motion pictures and other visual animations, computer animations are composed of still images replacing one after another in a rapid sequence. *See id.* at 180-81 ("Animations are simply computer-generated drawings assembled frame by frame which, when viewed sequentially, produce the image of motion. The still frames are viewed in rapid succession, usually at a speed of 24 or 30 frames per second."). A phenomenon known as stroboscopic movement tricks us into thinking that we have observed motion when we have not. *See* DAVID G. MYERS, PSYCHOLOGY 190 (5th ed. 1998). For example, scan this simple three-frame distortion animation:



Frame 1 Frame 2 Frame 3

The darker quarter-circle finally seems to "unbend" or "separate" itself from the lighter "contrast" area in Frame 3. However, this is only the illusion of stroboscopic movement. Observe what happens when the image sequence is "interrupted" by dissimilar images, text, extra white space, image reversals and a different final frame:



Frame 2 Frame 1

Frame 3

Despite the interference, it is still possible to see some "movement" between Frame 2 and Frame 1. Our minds simply remove the clutter standing in the way of the "movement" of the two images. *See id.* at 186 (explaining the cues of similarity and closure). However, it is difficult to discern movement between Frames 1 and 3, especially in light of the interference and the color changes. Note, however, that Frame 3 here is only Frame 3 of the animation above colorized, inverted, and reversed (or "mirrored"). A side-by-side comparison will show how the two images are really more similar than different:

such an animation into an entire system specifically designed to persuade others is, to say the least, beyond any estimation of worth.[18] This system may be called an integrated evidence presentation system ("IEPS")[19]—one or more computing devices specifically designed to organize and present evidence of all types and forms in order to maximize persuasive impact. In a twenty-first century trial, the litigator will still stand as the general-master strategist, one who analyzes every possibility, strength, and weakness to achieve legal triumph. The IEPS will serve as his or her faithful adjutant, marshalling the general's soldiers—individual pieces of evidence—in a manner that captivates the jury's total and undivided attention. The trial of the future will thus involve, more than ever before, the synthesis of human and machine to serve justice.

Courts have already witnessed such a synthesis. For example, since 1991,

> [s]pecialist litigation consultants have formulated courtroom graphics communications systems designed to help trial attorneys store, organize and present demonstrative exhibits using a single medium, the laserdisc. Since demonstrative

Nevertheless, only one of these images promotes the illusion of animation. The colorized image destroys it since one can only take advantage of stroboscopic movement if images *slightly* vary from each other. *See id.* at 190. The general science behind stroboscopic movement and other illusions and visual cues such as visual cliffs, convergence, relative size, relative brightness (note that in both of the above images—but especially in the colored one—the quarter-circle (or is it a quarter-sphere?) seems to be "closer"), interposition, similarity, continuity, etc. is voluminous and beyond the scope of this Note. For more information, see generally *id.* at 184-94.

Although animations are really only composed of frames, animations have been distinguished as being distinct from the frames upon which they are based. *See* Atari Games Corp. v. Oman, 888 F.2d 878, 883 (D.C. Cir. 1989) (noting a legal distinction between a video game animation and its individual frames or parts).

[18] *See* Galves, *supra* note 5, at 186 ("[A]n actual picture, especially with motion, is far better than the attempt to create that very same image in the minds of jurors through the indirect and ephemeral medium of mere words."); James T. Clancy, Jr., Note, *Computer Generated Accident Reenactments: The Case for Their Admissibility and Use*, 15 REV. LITIG. 203, 205 (1996) ("Anyone who desires to make an effective presentation knows that people gain information primarily through sight.").

[19] "Integrated Evidence Presentation System" is the author's original term adopted from the name of a real evidence presentation system called DEPS™ ("Digital Evidence Presentation System") that was produced by DOAR Communications, Inc. in 1998, and the term "multimedia presentation system," found in Kevin M. Hout & Richard de Bodo, *Multimedia Technologies Aid Litigators*, NAT'L L.J., Feb. 19, 1996, at B9. Pursuant to the author's definition of "integrated evidence presentation system," DEPS™ is a fully-functional integrated evidence presentation system and is even acknowledged by DOAR as such. *See* DOAR COMM., INC., INNOVATIVE COURT TECHNOLOGIES (1999).

> exhibits come in many forms (e.g., charts, graphs, documents, photographs, transcribed and video depositions, videotape and computer animation), they ordinarily would require different media to display. Laserdisc technology using computer, laser and video animation applications, however, can now blend the trial lawyer's needs into the use of one medium, the laserdisc.[20]

In addition to its potential for consolidation of exhibits into one medium, the laserdisc is also superb for its document storage potential. "[S]everal hundred key documents can be presented from laserdisc using a bar code or touch screen retrieval system."[21]

Starting in 1996, computers and scanners began to play a bigger role in determining the essence of IEPS than the laserdisc,[22] and the document-storage functions of laserdisc were inherited by more advanced technologies: CD-ROM[23] and DVD.[24] Today, "most technology-augmented evidence and information presentations originate with document cameras,[25] computers, and

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[20] Michael Hoenig, *Computer Simulations and Other Weapons*, N.Y. L.J., Mar. 8, 1993, at 3 (footnotes omitted). Mr. Hoenig's article also explains further technical workings of this form of IEPS.

[21] Hout & de Bodo, *supra* note 19, at B9.

[22] *See id.* ("The most current systems for presenting large populations of documents are multimedia presentation systems, which display scanned images of documents on a computer monitor."). Note also that a computer can be used to supplement a laserdisc system. *See* McElhaney, *supra* note 11, at 74 ("The computer also is the heart of retrieval systems that use laserdiscs to store thousands of documents and exhibits that can be brought up in court instantly.").

[23] CD-ROM stands for Compact Disc Read Only Memory. CD-ROMs act as storage devices and are capable of storing the text of thousands of documents. *See* Galves, *supra* note 5, at 196-97.

[24] *See id.* at 197 (noting that CD-ROMs "can move from displaying a document to playing a videotaped deposition to running a [computer-generated exhibit]. The newest storage device is DVD (Digital Video Disc or Digital Versatile Disc). DVDs offer the best quality in displaying video, data, and sound and can hold the contents of seven CD-ROMs.").

[25] The DOAR Communicator () is an example of such a device. *See* DOAR COMM., INC., DOAR Inc.—Communicator, *at* http://www.doar.com/products/communicator.htm (last visited Jan. 2, 2001). Professor Lederer also gives a concise technical explanation of the workings and capabilities of document cameras:

> The most commonplace, and simple, way of presenting material in court via technology is to use a document camera. Often known under the name of the two most common vendors, Elmo and DOAR (Communicator), a document camera is simply a vertically mounted TV camera aimed down at a flat surface. The lawyer puts a photo, document, or object on the surface, and the camera instantly displays the image on the television(s) or monitor(s) to which it is attached. The camera has two buttons permitting easy and fast close-ups.
>
> A document camera is normally connected to one or more televisions by a simple cable. However, some vendors offer an RF (radio frequency) add-on that permits the camera to transmit its information to a TV connected receiver

computer white boards."[26] The modern high-tech courtroom of today and tomorrow is in essence

> characterized by one core capability, a multi-faceted, technology-based evidence presentation system. Ordinarily, such a system will consist of at least a television-based document camera and a display system able to display not only what is placed under the camera, but also, *and critically*, computer output. The computer input may stem from one or more installed desktop units, from a notebook computer supplied by counsel and connected temporarily to the display system, or a combination of these. The display system may consist of televisions, computer monitors, or large front or rear projection systems. Usually a combination of these systems is used.[27]

And what a powerful combination it is! By allowing an attorney the ability to store and present all of his or her documents and other evidence in one central location, an IEPS decreases the

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> without wires. This capability can be critical in convincing a judge to permit counsel to bring the equipment into the courtroom. When a person using the basic document camera wishes to point to an area or point under the camera, he or she can do so with a pointer, pen or pencil, or a finger. An electronic pointer can be added, however. A device such as a DOAR Illustrator or a "Beckler" permits the use of a light pen on a pad or on an attached computer monitor image.

Lederer, *supra* note 9, at 813. Document cameras also go by the name "visual presenters." *See* Hout & de Bodo, *supra* note 19, at B9.

[26] Lederer, *supra* note 9, at 814. Professor Lederer also explains the use of computer whiteboards and their key advantages:

> [A] high technology whiteboard transmits writing to monitors fed from [a] connected computer, in the same color as that used on the board. The writing on the board can be preserved both by saving the image to disk on the attached computer and by printing it on a connected printer. One of the great advantages of the board is that once an image is saved to the computer, it can be restored immediately even if the image has been erased in whole or part. Whiteboards can be especially effective for witness drawings or counsel's opening statement and closing argument.

Id. at 813 n.41.

The Rear Projection SMART Board 3000i ( ) is an example of a high-tech whiteboard that is touch-sensitive. *See* SMART TECHNOLOGIES, INC., *SMART Technologies Inc., Integrated Rear Projection SMART Board*, *at* http://www.smarttech.com /rpsb3000i/index.html (last visited Feb. 1, 2001).

[27] Lederer, *supra* note 9, at 827 (emphasis added).

time needed to retrieve documents[28] and video footage[29] in court. No longer is there a need to leaf through papers or volumes of depositions. Text documents are simply cataloged before trial and ready for instant presentation to the jury by the IEPS' main computer. Moreover, an IEPS enables an attorney to focus a jury's attention upon a single issue in a trial through its ability to compile or collate information from a variety of evidence forms.[30] In addition, an IEPS that includes white boards allows an attorney not just to present but to *interact* with trial evidence immediately. An area of focus in a document can be highlighted or enlarged through close-up zooming.[31] Furthermore, when an attorney selects portions of documents for viewing, he, by definition, *excludes* what he or she considers irrelevant. The result is that the jury members are presented with only the main statements or images that an attorney wants them to recall.[32]

An IEPS also presents secondary advantages. So long as its use is limited, an IEPS is a cost-effective technology.[33] Clients may in fact *request* that their attorneys use IEPSs to defray litigation

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[28] *See* Hout & de Bodo, *supra* note 19, at B9 ("The advantages of these systems are the ability to store huge numbers of documents for quick retrieval and interactive highlighting in the courtroom."). See Carlo D'Angelo, *The Snoop Doggy Dogg Trial: A Look at How Computer Animation Will Impact Litigation in the Next Century*, 32 U.S.F. L. REV. 561, 566 (1998) for a real-life example of how an IEPS, powered by software called Gravity/Verdict, can influence the outcome of a trial.

[29] *See* Hout & de Bodo, *supra* note 19, at B13 ("Using MPEG compression algorithms, more than one hour of low-resolution video can be put onto one small CD-ROM. Using an 18-CD jukebox, counsel can have random access to 18 hours of video-taped deposition material at a time.").

[30] *See id.* (noting how video material can be linked electronically to deposition transcripts stored in a computer, so that when an attorney performs a search of the deposition transcript, corresponding video is also shown). Furthermore, by using

> computer-based, multimedia presentation systems, counsel can also make the graphics or animations interactive. After viewing a computer animation, for example, counsel might go back to a key frame of the animation and click on the screen where a certain device appears. The computer then searches and finds a sequence of animation to further explain that device. The same techniques used by video game creators and educational software developers can be used to make interactive demonstrative exhibits for the courtroom.

Id.

[31] *See id.*

[32] *See id.*; Bennett, Jr. et al., *supra* note 2, at 261 ("The presenters [of CGE] can eliminate extraneous background or details that may be unrelated to what happened.").

[33] *See* Hout & de Bodo, *supra* note 19, at B9, B13 ("The cost per page to scan and organize . . . documents for courtroom retrieval is generally less than $1 per page. This per page cost is considerably lower than the cost to put document highlights onto video laserdisc."). The costs for transferring video to CD-ROM are also not excessive. "Another advantage of CD-ROM for videotaped-deposition storage is cost—less than $300 to digitize and compress 60 minutes of video onto each CD-ROM. One hundred hours could be put onto 100 discs for under $30,000, without any pre-planning or editing of the materials." *Id.* at B13; *see also* Ellis, Jr. et al., *supra* note 16, at 694 ("[T]he cost of procuring such technological aids is decreasing for litigants."). *But see* discussion *infra* Part I.C.

expenses.[34] Moreover, the judicial system appears willing to accommodate those who wish to use IEPSs.[35] Finally, unlike CGE, an IEPS in and of itself is not evidence. It is only a tool or mechanism for presenting evidence, much like a blackboard or microphone is only a device for information conveyance.[36] Therefore, problematic evidentiary questions do not usually arise in connection with IEPSs, and courts have embraced them wholeheartedly.[37]

B. *CGE: Its Definition and Uses*

The term "CGE" includes two general types of evidence: demonstrative evidence and substantive evidence.[38] More specifically, since CGE's inception in the 1970s,[39] the term has

[34] *See* Galves, *supra* note 5, at 172 (footnote omitted) ("To the extent that trial automation through computer technology saves money, legal clients will demand that attorneys remain technologically competitive with other societal and business institutions to avoid legal bills associated with manual retrieval and storage of documents.").

[35] "New courthouses are [now] outfitted with facilities for built-in computer and demonstrative evidence/presentation equipment." Ellis, Jr. et al., *supra* note 16, at 694 (footnote omitted); *see also* Fulcher, *supra* note 14, at 73, ("Increasingly, courts are recognizing that [computer-generated] reconstructions can help to provide for more efficiency at trial.").

[36] *See* Galves, *supra* note 5, at 180 (footnote omitted) (noting that just as the microphone "made it easier for attorneys and witnesses to tell their stories in large courtrooms with no evidentiary admissibility concerns, the invention of computers to display images to make it easier for attorneys and witnesses to show and tell their stories at trial should similarly pose no evidentiary admissibility concerns").

[37] *See Judicial Conference Nixes Cameras in Courtrooms*, 67 DEF. COUNS. J. 429, 429 (2000) (quoting Chief Judge Becker) ("The federal courts have shown strong leadership in the continuing effort to modernize the litigation process. This has been particularly true of the federal judiciary's willingness to embrace new technologies, such as electronic case filing and access, videoconferencing, and electronic evidence presentation systems."). Professor Lederer notes that "the current trend is toward integrated, high-technology courtrooms," and that as of April 1998, eight state and thirty-two federal courtrooms had become high-technology courtrooms." Lederer, *supra* note 9, at 801. Professor Lederer also mentions that "[m]ore [high-tech courtrooms] have come on line since then." *Id.*

[38] *See* Harts, *supra* note 12, at 514 (quoting BLACK'S LEGAL DICTIONARY, which defines demonstrative evidence as that "addressed directly to the senses without intervention of testimony" and substantive evidence as evidence "adduced for the purpose of proving a fact in issue, as opposed to evidence given for the purpose of discrediting a witness (i.e., showing that he is unworthy of belief), or of corroborating his testimony").

[39] The history of the use of CGE is relatively brief:

> As early as the 1970s, legal practitioners and scholars anticipated the application of computer technology to trial litigation. Such technology evolved slowly, however, due to the limited capabilities and impracticality of early computers. Simple graphic animation could only be generated by multi-million dollar computer systems that, because of their enormous size, would barely fit into most courtrooms. With the advent of smaller, more efficient hardware, came increased potential for courtroom presentation. It was not until the 1980s, however—when "general purpose" animation software began to hit the marketplace—that computers started to surface in courtrooms. Since then, lawyers gradually have begun to incorporate computer animation into both civil

been used to denote computer animations and simulations.[40] A comprehensive definition of CGE is not only limited to computer animations and simulations but also includes computer-generated data, such as business records.[41] However, since the standards involved in the admission of computer-generated business records are not heavily disputed,[42] and the other "static" forms of CGE do not arouse or have not aroused much controversy,[43] this Note will only address admissibility concerns related to "dynamic" forms of CGE: computer animations and simulations. Thus, for the purposes of this Note, computer-generated evidence ("CGE") is defined as "(1) a computer-generated aural, visual, or other sensory depiction of an event or thing and (2) a conclusion in aural, visual, or other sensory form formulated by a computer program or model."[44] Of all the evidence forms that IEPSs can exhibit,[45] CGE is the most powerful because of its ability to impact persuasively.[46] As a result, courts often question the admissibility of CGE when it is presented at trial.[47]

A computer animation is computer-generated demonstrative

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and criminal trials.

D'Angelo, *supra* note 28, at 562 (footnotes omitted); *see also* Butera, *supra* note 10, at 515-16 (relating a general history of the development of the computer).

[40] *See* Carbine & McLain, *supra* note 11, at 8 ("[T]wo forms of computer-generated evidence pose significant concerns: (1) computer simulations and (2) computer animations.").

[41] *See id.* at 12-19.

[42] *See* Bray v. Bi-State Dev. Corp., 949 S.W.2d 93, 99 (Mo. Ct. App. 1997) ("Few jurisdictions have attempted to enunciate a formula or fixed set of guidelines to govern the establishment of a foundation for computer-generated evidence *other than business records.*") (emphasis added); Carbine & McLain, *supra* note 11, at 8 (noting that business records and similar forms of evidence "have not caused the courts any lingering concern"); Borelli, *supra* note 2, at 440 (noting that the standards involved in the admission of computer business records are "well-settled").

[43] *See* Galves, *supra* note 5, at 177-80, 208 (noting that "glorified chalkboard" exhibits and static computer-generated exhibits whose images are capable of manipulation are not causes for admissibility concerns).

[44] Carbine & McLain, *supra* note 11, at 46 (quoting MD. R. CIV. P. 2-504.3(a)). Maryland is the first state to have adopted model rules for computer-generated evidence. *See* Harts, *supra* note 12, at 523. No other state has followed Maryland's example. *See* Ellis, Jr. et al., *supra* note 16, at 696. A close reading of the Maryland court's definition allows for the inclusion of virtual reality evidence within the definition of CGE ("other sensory depiction" and "other sensory form"). MD. R. CIV. P. 2-504.3(a)(1)-(2). This type of evidence is beyond the scope of this Note. See generally Gregory P. Joseph, *Virtual Reality Evidence*, 2 B.U. J. SCI. & TECH. L. 12 (1996) for more information on the topic of the evidentiary use of virtual reality.

[45] These forms include, but are not limited to, documents, photographs, charts, diagrams, audio, and video recordings. *See supra* note 30 and accompanying text.

[46] *See* D'Angelo, *supra* note 28, at 585 ("Given its highly persuasive tendencies, computer animation is likely to become the single most powerful evidentiary tool utilized by trial lawyers in the next century."); Joye, *supra* note 15 ("In the childhood game 'paper, scissors, rock,' the paper beats the rock, and the scissors beat the paper. In the high-stakes game of persuasion in a products liability trial, pictures beat words, and moving pictures beat static pictures.").

[47] *See* discussion *infra* Part III.

evidence—a computer illustration of witness testimony or opinion.[48] To put this into more of a concrete framework, assume that Dr. *E*, an expert witness for the defendant, is asked by the defendant's counsel to describe a surgical procedure. Dr. *E* gives a verbal description of the procedure and simultaneously uses computer-produced visual imagery to graphically "parallel" his description. Here, defendant's counsel has made use of computer animation. The animation is helpful as an illustration of testimony but not necessarily outcome determinative.[49] Moreover, "the reliability of the animation as evidence still depends completely on the [expert] witness's testimony and credibility."[50]

A computer simulation, on the other hand, involves a computer becoming a witness. The computer not only illustrates the testimony but actually presents it.[51] Sets of variables are fed into the computer, which then processes and synthesizes this information to yield output in the form of a visual presentation that conforms to the laws of physics and science.[52] For example, assume that another Dr. *E*, testifying in a murder case where the

[48] *See* Carbine & McLain, *supra* note 11, at 8-9 ("A computer-generated animation . . . is based on the opinion evidence of an expert witness or on the non-expert testimony of a lay witness. A witness on the stand would generate the conclusion, and then use the animation to illustrate that conclusion."); Galves, *supra* note 5, at 181 (footnote omitted) (noting that computer animations are "a series of pictures 'drawn' by a computer operator" that depict witness testimony. "[T]he [animation] input data is nothing more than a witness who (1) has personal knowledge of the scene depicted in the animation and (2) witnessed the event depicted in the animation as it actually transpired."); Hoenig, *supra* note 6, at 3 (noting the difference between computer animations and computer simulations).

[49] However, as use of computer animation becomes more widespread and cost-effective in the future, clients may demand their use in their quest for legal victory. *See* Galves, *supra* note 5, at 172 ("Clients will also expect the cost savings associated with short computer animations which quickly explain fact-patterns that would take much longer to explain verbally with expert witnesses.").

[50] *Id.* at 182.

[51] *See* Carbine & McLain, *supra* note 11, at 8 (footnotes omitted) ("Computer simulations showing 'computer opinions,' where the computer has been programmed with certain information and then compiles a simulation of how an event occurred . . . or would or could occur . . . may be offered as (a) substantive evidence or (b) the basis for . . . a testifying expert's opinion."). Computer simulations are also known as computer reconstructions. *See* Hoenig, *supra* note 6, at 3. *But see* Fulcher, *supra* note 14, at 62 ("This Comment argues that reconstructions are based on the technical ability of the expert and therefore should be admitted as *demonstrative* evidence to illustrate his opinion.") (emphasis added). Professor Galves has made further refinements to the definition of computer simulation, distinguishing it from computer re-creations and computer animations by adding a temporal element. In other words, a computer re-creation is a computer simulation as the author has defined it that looks backward in time to digitally re-create an event, whereas a computer simulation looks forward in time to digitally predict an event. *See* Galves, *supra* note 5, at 183-85. For the purposes of this Note, there is no distinction between computer simulations and re-creations or reconstructions; they are one and the same. There is only a distinction between computer animations and simulations.

[52] *See* Thomason, *supra* note 3 ("[A] computer simulation is an actual re-enactment of an event (albeit inside a computer). . . . [T]he output that one sees on the computer screen is merely a representation of calculations that have taken place inside the computer.").

defendant has claimed self-defense, states that gunpowder burns were found on the victim in a specific pattern. If the prosecutor inputs this pattern, along with the speed that the bullet was traveling (based upon another bullet being fired from the same gun), the actual size of the bullet, and information as to which of the victim's organs were damaged by the bullet (from the medical examiner's report) into a computer to arrive at the killing bullet's trajectory, the prosecutor has made use of a computer simulation. Unlike the case of computer animations, computer simulations can be outcome determinative. Here, if the computer arrives at a conclusion that the victim was shot from behind, the defendant's claim of self-defense loses much credibility. In contrast, if the computer arrives at a conclusion that the victim was shot from the front, the defendant's self-defense claim gains credibility.[53]

CGE has already been used in a variety of cases.[54] For example, CGE has aided both prosecution and defense in criminal trials. In 1993, "a rough, three-minute computer animation was used by the prosecution to illustrate its theory of a murder case. It helped to convict theater operator Jim Mitchell of killing his brother."[55] In 1996, a computer simulation was key in persuading a

[53] While the case above is purely hypothetical, it is very much based in reality. See D'Angelo, *supra* note 28, at 564-67, for a description of how a computer simulation was instrumental in gaining an acquittal for rapper Snoop Doggy Dogg on murder charges. "The defense commissioned computer animators to produce a video-reconstruction of the shooting that was consistent with both eye-witness statements and the evidence collected from the crime scene." *Id.* at 565 (footnote omitted).

[54] For examples of cases in which CGE has been employed successfully, see Robinson v. Mo. Pac. R.R. Co., 16 F.3d 1083, 1087 (10th Cir. 1994) (upholding admission of accident simulation which illustrated expert's theory); Seattle Master Builders Ass'n v. Pac. Northwest Elec. Power & Conservation Planning Council, 786 F.2d 1359, 1370 (9th Cir. 1986) (allowing the use of computer simulations to ascertain energy conservation value); Perma Research & Dev. v. Singer Co., 542 F.2d 111, 115 (2d Cir. 1976) (allowing computer simulation results to form the basis of expert testimony that pertained to the likelihood of perfection of an automobile anti-skid device); Livingston v. Isuzu Motors, Ltd., 910 F. Supp. 1473, 1495 (D. Mont. 1995) (holding that computer expert's Advanced Dynamic Vehicle Simulation (ADVS) was properly admissible as scientific evidence); Cleveland v. Bryant, 512 S.E.2d 360, 362 (Ga. Ct. App. 1999) (upholding admission of computer-generated accident reconstruction); Commercial Union Ins. Co. v. Boston Edison Co., 591 N.E.2d 165, 168 (Mass. 1992) (upholding the admission of a computer-generated model that estimated energy consumption); Kudlacek v. Fiat S.p.A., 509 N.W.2d 603, 617 (Neb. 1994) (upholding the admission of expert testimony regarding the path of a car on a road depicted by a computer simulation); People v. McHugh, 476 N.Y.S.2d 721, 722-23 (N.Y. Sup. Ct. 1984) (upholding admission of computer simulation of car crash in a second degree manslaughter prosecution); State v. Clark, 655 N.E.2d 795, 814 (Ohio Ct. App. 1995), *aff'd*, 662 N.E.2d 362 (Ohio 1996) (upholding admission of expert's testimony detailing a crime scene reconstruction created through the use of AutoCAD software); Deffinbaugh v. Ohio Turnpike Comm'n, 588 N.E.2d 189, 194 (Ohio Ct. App. 1990) (upholding the admission of two computer-generated simulations at trial); *see also* Butera, *supra* note 10, 518-20 (noting a variety of civil and criminal cases in which CGE has been used); Fulcher, *supra* note 14, at 62 ("One popular use of computer-generated evidence is to reconstruct automobile accidents.").

[55] Borelli, *supra* note 2, at 439 (footnote omitted).

jury to acquit rapper Snoop Doggy Dogg.[56] Also, both defendants and plaintiffs have used CGE in products liability actions.[57] In *Lally v. Volkswagen Aktiengesellschaft*,[58] the Appeals Court of Massachusetts, affirming judgment in favor of defendant car company, upheld the trial judge's ruling "that a film [depicting a computer animation] likely 'assist[ed] the jury in understanding the very technical nature of [the] testimony [of defendant's expert].'"[59] In another products liability case, *Jimenez v. Chrysler,*[60] the jury awarded punitive damages against defendant automotive company after witnessing a computer animation depicting a design flaw.[61] In this case, the unsuccessful defendant automotive company also used CGE.[62]

Finally, litigants have used CGE in medical malpractice and wrongful death cases. In *McCool v. Gehret*,[63] the plaintiff won her medical malpractice case after "animators designed an exhibit that explained in visual detail the procedure the defendant performed on the plaintiff."[64] In *Salvatore v. Value Jet*,[65] a case involving a plane crash, defendant airline company was persuaded to settle the case after "animators allowed . . jurors to feel the terror of the three and a half minutes it took [defendant's] plane to fall from the sky by animating the flight path of the plane and synchronizing it with the cockpit voice recording."[66] The case demonstrates that

[56] "By combining masterful trial work with sophisticated computer technology, the Snoop defense team effectively presented its case to the jury. As a result, the jury acquitted both defendants on the charges of first- and second-degree murder, and it deadlocked on the lesser offense of voluntary manslaughter." D'Angelo, *supra* note 28, at 567 (footnote omitted).

[57] *See* Joye, *supra* note 15.

[58] 698 N.E.2d 28 (Mass. App. Ct. 1998).

[59] *Id.* at 40; *see also* Galves, *supra* note 5, at 168-69 (noting that computer-generated exhibits "are not solely being introduced to add 'sparkle' to cases or 'entertain' . . . or even 'dazzle' easily-bored jurors, as much as they are simply necessary to explain the complexities of case so that the jury can understand the factual issues involved . . . .").

[60] 74 F. Supp. 2d 548, 558, 586 (D.S.C. 1999) (referring to an earlier unreported proceeding, No. 2:96-1269-11 (D.S.C. 1997), in which CGE was used, *see* Joye, *supra* note 15, at n.1, and upholding the jury's determination that Chrysler's conduct was 'reckless, willful or wanton,' and exhibited a 'conscious failure to exercise reasonable care'").

[61] *See* Joye, *supra* note 15.

[62] *See id.* ("[T]he plaintiff and defendant used computer-generated animations extensively.").

[63] This case, after remand, is unreported. Its outcome may be found at ANIMATORS AT LAW, INC., *McCool Case Study*, Animators at Law Website, *at* http://www.animators.com/mccoolcasestudy.html (1995) (last visited Jan. 2, 2001) [hereinafter *McCool Case Study*]. See McCool v. Gehret, 657 A.2d 269, 285 (Del. 1995) for the case that originally reversed a judgment in favor of the defendant physician.

[64] *McCool Case Study*, *supra* note 63.

[65] This case is also unreported due to a settlement. *See* ANIMATORS AT LAW, INC., *Value Jet Case Study*, *at* http://www.animators.com/valujetcasestudy.html (2000) (last visited Jan. 2, 2001) [hereinafter *Value Jet Case Study*]; Christa Zevitas, *Lawyer Helps Litigators Match Computer Graphics to Trial Strategy*, LAWYERS WKLY., Nov. 1, 1999, *available at* http://www.animators.com/lawweek3.html (last visited Jan. 2, 2001).

[66] *Value Jet Case Study*, *supra* note 65.

CGE's power not only extends to the courtroom but also to the negotiating table as well.[67]

C. *The Problems Presented by IEPSs*

Although IEPSs are advantageous and useful, they also present various non-evidentiary problems for attorneys and the judicial system. While an IEPS can be a low-cost technology,[68] in extremely high-profile or complex cases, IEPS costs may be exorbitant and cost prohibitive.[69] Even if such cases are won, the costs incurred in the process of litigation may make the victory a Pyrrhic one. "In 1995, for example, the California Court of Appeals, [in *Science Applications Int'l Corp. v. Superior Court*,[70]] vacated a jury's award of costs to a prevailing party because it deemed 'high-powered computer support' did not fall within the definition of litigation expense."[71] Another problem that arises with an IEPS is that, like any other mechanical device, an IEPS requires regular maintenance, and mechanical failure is always a potential problem.[72] In addition, even if an IEPS is well-maintained, it still has the potential to backfire in another way,

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[67] *See* Galves, *supra* note 5, at 207 (noting that computer-generated exhibits, "especially at an early stage in the litigation process, help to crystallize critical facts and issues for the attorneys and litigants and therefore can serve as a legitimate means of facilitating settlement."); Barry Sullivan, Comment, *Computer-Generated Re-Enactments as Evidence in Accident Cases*, 3 HIGH TECH. L.J. 193, 239 (1989) (noting that future lawyers will increase their use of CGE when they realize its power to force settlements and attain legal victory).

[68] *See supra* note 33 and accompanying text.

[69] *See* McElhaney, *supra* note 11, at 74 ("High tech can certainly help make interesting presentations. But it isn't cheap. In a large case with lots of documents, exhibits, and computerized re-enactments, it is easy to spend $50,000 or $100,000 just on demonstrative evidence.").

[70] 46 Cal. Rptr. 2d 332 (Dist. Ct. App. 1995).

[71] Lederer, *supra* note 9, at 831-32 (quoting Science Applications Int'l, 46 Cal. Rptr. 2d at 333).

> Specifically, the court allowed recovery of expenses for 'graphic exhibit boards' ($57,969) and an evidence video ($101,908), but disallowed recovery for document control and a case management database ($200,000), the production of laser disks for evidence storage ($47,481), the rental of graphics communications system equipment for trial use ($9,916), fees for an on-site computer technician during trial ($11,983), and fees for editing video depositions for better jury presentation ($35,652).

Id. at 832 n.97 (quoting *Science Applications Int'l,* 46 Cal. Rptr. 2d at 336-37) (emphasis added).

[72] Professor Lederer remarks:

> Some form of maintenance clearly is necessary. Normal maintenance will likely consist of adjusting monitors, correcting altered switch settings, or finding where someone has unplugged equipment. If a monitor fails, someone must be able to replace it with a spare. More sophisticated maintenance, perhaps including an outside maintenance contract, is necessary for less likely but more serious failures. . . .

Id. at 831 & n.95; *see also id.* at 831 n.95 ("[N]etworks can be perennial problems.").

namely at trial, where there must be a balanced synthesis of litigator and machine. If the IEPS takes over as "lead counsel" on a case, effectively making the attorney's argument for him or her, a judge or jury may find the trial to be too mechanical.[73] As a result, an *adverse* verdict may result from the use of IEPSs.

Finally, probably the most significant problem with the use of IEPSs is that of prejudicial effect. The ability of an IEPS to filter and synthesize information from a variety of evidentiary materials into one compact informational presentation is a key advantage in litigation.[74] This advantage can become a cause for concern when one litigant has the option of using an IEPS and the other does not.[75] Such disparity in litigation potential may arise where acquiring an IEPS is too expensive for one party, an attorney does not have the skills or training to use the system,[76] and/or an attorney feels that use of an IEPS would not be appropriate in the case.[77]

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[73] It may be that

> the ultimate threat to the judicial system from technology-augmented litigation is loss of humanity. Traditional litigation places the lawyer at the focus of the fact-finder's attention. Papers are shown to human witnesses in the courtroom, charts are placed easels, and lawyers add emotion to logic in closing arguments. Even the tribulations of the participants, hours wasted by waiting witnesses and inactive jurors, are classic human complaints. . . . Should technology use increase past a certain, unknown point in any given case, jurors, observers, and perhaps legal professionals may become uncomfortable.

Id. at 835, 836. Professor Galves cites the famous case of O.J. Simpson as an example of a trial where Professor Lederer's technology threshold was passed:

> Consider Johnnie Cochran's trial strategy in the O.J. Simpson case. Although he was equipped with state of the art technology (donated free of charge by the In Vzn Trial Link system), his most effective advocacy was not through [computer-generated exhibits] but with verbiage, such as "if the glove don't fit, you must acquit" and "genocidal racist Mark Fuhrman." Such rhetoric, of course, was effective in persuading the jury to render a not-guilty verdict in a trial in which it often appeared as though the technology just got in the way.

Galves, *supra* note 5, at 186 n.69 (citation omitted).

[74] *See supra* notes 28-32 and accompanying text.

[75] *See* Lederer, *supra* note 9, at 834 (noting that a major public policy problem arises "when a trial includes a pro se litigant who either has no ability to use technology or lacks the access to it").

[76] For example, attorneys may not find IEPSs useful to them if they are resistant to them or are unable to use them in the first place. Consider Professor Galves:

> [T]here is still some lingering resistance to the full incorporation of computerization into the practice of law, especially in the courtroom. Some of this resistance to innovation can be attributed to the normal and perhaps unavoidable implementation time lags associated with change, fear of new technology, and a social and psychological fear of change in general. Moreover, attorneys have been practicing with paper and photo enlargements in court for years—without computer images—and therefore many lawyers adhere to the old adage that "if it ain't broke, don't fix it[.]"

Galves, *supra* note 5, at 169-70 (footnotes omitted).

[77] Consider Professor Lederer:

> Technology-augmented litigation has been embraced by many trial lawyers largely because the lawyers believe it enhances their ability to persuade juries. Although we should prize and encourage anything that enhances fact finding

II. CURRENT EVIDENTIARY STANDARDS FOR CGE

While IEPSs have some limited problems, these pale in comparison to the evidentiary problems presented by CGE. However, before discussing these evidentiary problems, a review of the current federal and state admissibility standards for CGE is necessary.

A. *Current Federal Admissibility Standards*

While the Federal Rules of Evidence ("FRE") do not specifically address issues involving the use of CGE,[78] their general provisions concerning the admissibility and relevancy of regular evidence deal with the subject tangentially. Proponents of CGE can easily overcome the legal obstacles erected by these provisions:

> Under the Federal Rules of Evidence, the proponent of computer-generated evidence faces evidentiary roadblocks in a number of rules: Rule 901, requiring authentication and a proper foundation; Rule 402, requiring relevance; Rule 403, requiring that evidence not be unduly prejudicial; Rule 611, giving the trial court control over the presentation of evidence; and Rule[s] 801 [and 802], precluding hearsay.[79]

However, even before one considers these rules, it should be noted that failure to disclose to the court and opposing counsel intention to use CGE early on in a case is grounds for automatic exclusion.[80] If the CGE to be presented is a computer simulation, rather than a computer animation, additional evidentiary requirements must be satisfied.[81] However, even in the case of computer simulations, fulfillment of evidentiary requirements for CGE is not particularly difficult.

> accuracy, we should be deeply concerned about any technique that increases the risk of a verdict justified more on emotion than fact. Presently, there is reason to believe that technology creates special risks of such an unacceptable result.

Lederer, *supra* note 9, at 830.

[78] *See* Galves, *supra* note 5, at 263 ("[T]here is no direct reference to computerized evidence in general in the rules, nor an over-arching definition applicable to all of the rules.").

[79] Ellis, Jr. et al., *supra* note 16, at 695 (footnote omitted); *see also* Hoenig, *supra* note 6, at 6 (citing Robinson v. Mo. Pac. R.R. Co., 16 F.3d 1083, 1088-89 & n.7 (10th Cir. 1994)).

[80] *See* Galves, *supra* note 5, at 199 & n.116 (citing Shu-Tao Lin v. McDonnell Douglas Corp., 574 F. Supp. 1407, 1412 (S.D.N.Y. 1983), *aff'd and rev'd in part*, 742 F.2d 45 (2d Cir. 1984) (CGE excluded on grounds of untimely disclosure)); Baugh v. Gulf Air Transp., 526 So. 2d 1239, 1240-42 (La. Ct. App. 1988) (same); Miss. Pub. Serv. Comm'n v. Miss. Valley Gas, 358 So. 2d 418, 423 (Miss. 1978) (providing examples of cases in which CGE was excluded on grounds of untimely disclosure).

[81] *See generally infra* notes 113-124 and accompanying text.

Authentication standards, provided for in Rule 901,[82] are always an issue when an attorney wishes to present demonstrative evidence. In such cases, authentication of CGE is accomplished when attorneys lay an appropriate foundation before a judge.[83] The steps to produce such a foundation and authenticate an exhibit under Rule 901(a) include (1) having a court official mark the exhibit for identification; (2) authenticating the exhibit through witness testimony unless the exhibit is self-authenticating; (3) offering the exhibit into evidence; (4) authorizing opposing counsel to examine the exhibit; (5) permitting opposing counsel the opportunity for objection; (6) giving the exhibit to the court for examination at its request; (7) obtaining a ruling upon the exhibit by the court; and (8) requesting the court's consent to have the exhibit, if admitted, shown to the jury.[84] Furthermore, the FRE provide that for authentication of a process or system,[85] an offering party must produce "evidence describing [the] process or system used to produce [the] result [e.g., a computer animation] and showing that the process or system produces an accurate result."[86] Therefore, CGE authentication typically includes a showing that:

> (1) the computer equipment is accepted in the field as standard and competent and was in good working order, (2) qualified computer operators were employed, (3) proper procedures were followed in connection with the input and output of information, (4) a reliable software program was utilized, (5) the equipment was programmed and operated correctly, and (6) the exhibit [to be admitted] is properly identified as the output in question.[87]

In many cases, authentication of CGE is not especially complicated. So long as one chooses competent witnesses who can testify to their qualifications, capabilities of their computers, and regular use of standard construction programs like Auto-CAD,[88] federal authentication requirements do not present much of a challenge.[89]

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[82] In general, "[t]he requirement of authentication or identification as a condition precedent to admissibility is satisfied by evidence sufficient to support a finding that the matter in question is what its proponent claims." FED. R. EVID. 901(a). For illustrations of this general standard see FED. R. EVID. 901(b).

[83] *See* D'Angelo, *supra* note 28, at 567.

[84] *See* CHRISTOPHER B. MUELLER & LAIRD C. KIRKPATRICK, EVIDENCE § 9.1, at 1123 (1995).

[85] This includes CGE. *See* D'Angelo, *supra* note 28, at 568; Galves, *supra* note 5, at 230 ("According to the literal language of the rule, [computer-generated exhibits] appear to fit in this illustration.").

[86] FED. R. EVID. 901(b)(9).

[87] MUELLER & KIRKPATRICK, *supra* note 84, § 9.17, at 1153 (footnote omitted).

[88] *See* D'Angelo, *supra* note 28, at 573.

[89] *See id.*; *see also* Galves, *supra* note 5, at 227 (noting that "animations used for demonstrative purposes should be and often are the easiest to authenticate because they are merely illustrative of a witness's related testimony.").

Once an exhibit is appropriately authenticated, a trial judge scrutinizes the exhibit under Rules 402,[90] 403,[91] and 611[92] to determine admissibility.[93] Taken together, it would appear that these rules act as safeguards to prevent abuse of the power of CGE by granting a trial judge broad discretion over admissibility; but appearances can be deceiving. First, under Rule 402, one who seeks to admit CGE only needs to establish that it has probative value and does not need to demonstrate how the CGE will prove a fact in dispute.[94] Second, under Rule 403, before a trial judge will exclude CGE, the party opposing its admission "must prove that the danger of confusion will substantially outweigh the exhibit's probative value."[95] Absent such proof, it is unlikely that a court will refuse admission of relevant and authentic CGE under its Rule 611 power.[96]

Rule 611 also provides for judicial discouragement of leading questions (and therefore narrative testimony) on direct examination.[97] Opponents of CGE may argue that presentation of CGE at trial will take the form of narrative testimony rather than

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[90] Providing that "evidence which is not relevant is not admissible." FED. R. EVID. 402.

[91] Providing that "[a]lthough relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence." FED. R. EVID. 403. There are no set formulas concerning application of Rule 403 or state rules similar to it. *Compare* Commonwealth v. Scaramuzzino, 317 A.2d 225, 227 (Pa. 1974) (holding that admission of fourteen color slides showing graphic and bloody scenes was error), *with* United States v. McRae, 593 F.2d 700, 707 (5th Cir. 1979) (overruling a Rule 403 objection to photos of the deceased and an accompanying death scene). *See also* Galves, *supra* note 5, at 215 (footnote omitted) (noting that Rule 403's purpose is "to exclude evidence that is relevant but which also contains an inherent danger of distracting the members of a jury with unfair considerations that may cloud what otherwise would be a rational decision based only on the relevant facts of the case").

[92] Providing that "[t]he court shall exercise reasonable control over the mode of . . . presenting evidence so as to (1) make the . . . presentation effective for the ascertainment of the truth and (2) avoid needless consumption of time . . . ." FED. R. EVID. 611(a).

[93] *See generally* Galves, *supra* note 5, at 210-26, 233-38.

[94] *See* D'Angelo, *supra* note 28, at 569. In other words, "it must [only] be established that the exhibit 'helps persuade the trier [of fact] of the existence (or non-existence) of some fact that is germane to the dispute between the parties.'" Galves, *supra* note 5, at 211 (quoting GRAHAM C. LILLY, INTRODUCTION TO THE LAW OF EVIDENCE 24 (3d ed. 1996)).

[95] D'Angelo, *supra* note 28, at 570 (footnote omitted); *see also* Galves, *supra* note 5, at 222 & n.188 (noting that Rule 403 favors admission—not exclusion—of evidence and citing United States v. Dennis, 625 F.2d 782, 797 (8th Cir. 1980)) ("In weighing the probative value of evidence against the dangers and considerations enumerated in Rule 403, the general rule is that the balance should be struck in favor of admission.").

[96] *See* D'Angelo, *supra* note 28, at 570 (noting that CGE that is both authentic and relevant is likely to withstand an objection of possible confusion on the part of the jury).

[97] "Leading questions should not be used on the direct examination of a witness except as may be necessary to develop the witness' testimony. Ordinarily leading questions should be permitted on cross-examination." FED. R. EVID. 611(c).

a witness' answers to individual questions.[98] This objection, however, is not really evidentiary but procedural in nature.[99] So long as an attorney does not violate proper procedure by making the mistake of playing an animation or simulation without any corresponding testimony associated with it,[100] Rule 611(c) objections can usually be avoided.[101]

In addition to Rules 901, 402, 403, and 611, Rules 801 and 802, which preclude hearsay from admission,[102] can also be considered by a judge in ascertaining whether to admit a computer-generated exhibit.[103] A party seeking to exclude a computer-generated exhibit will usually advance a hearsay objection that a "declarant, probably some type of computer expert, has entered data into the computer and, through the computer, has created an assertion about the truth of a matter at issue."[104] Arguably, the declarant expert's testimony at trial is then hearsay[105] because the computer-generated exhibit that he references in his testimony constitutes an out-of-court statement.[106] However, this objection can be easily overcome through use of Rule 807, which provides:

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[98] *See* Galves, *supra* note 5, at 234.

[99] *See id.* ("[S]uch an objection really goes to an attorney's improper actions, not to the intrinsic nature of a [computer-generated exhibit] as opposed to any other type of exhibit.").

[100] *See id.* at 234, 235 ("[F]ailing to ask the sponsoring witness pointed questions and failing to have them respond is a violation of the rules of evidence. . . . [However,] CGE played after or along with the witness's testimony is proper.").

[101] Voice-over narrations and sound effects can potentially cause Rule 611 objections as well. *See id.* at 236-38; Gregory P. Joseph, *A Simplified Approach to Computer Generated Evidence and Animations*, 156 F.R.D. 327, 335 (1994) ("Rule 611(a) vests the trial judge with discretion to decide whether to permit prerecorded narration or to require live testimony or narration from the witness on the stand.").

[102] "'Hearsay' is a statement, other than one made by the declarant while testifying at the trial or hearing, offered in evidence to prove the truth of the matter asserted." FED. R. EVID. 801(c). "Hearsay is not admissible except as provided by these rules or by other rules prescribed by the Supreme Court pursuant to statutory authority or by Act of Congress." FED. R. EVID. 802.

[103] *See* D'Angelo, *supra* note 28, at 570 (noting that "[i]n addition to the above requirements for admission, a computer animation exhibit must also pass the requirements of the hearsay rule, Rule 801").

[104] Carole E. Powell, Note, *Computer Generated Visual Evidence: Does* Daubert *Make a Difference?*, 12 GA. ST. U. L. REV. 577, 586 (1996).

[105] *See* Harts, *supra* note 12, at 516 (footnote omitted) ("Since one creates computer-generated evidence first with input data and then through the use of computer software manipulates this data, the data, the software and any extrinsic statements of the computer programmer are subject to hearsay objections.").

[106] *See* D'Angelo, *supra* note 28, at 570-71. It should be noted that this argument only applies to substantive CGE (i.e., computer simulations or, at the very least, hybrid animation/simulations as the author has defined them in this Note). *See* Galves, *supra* note 5, at 243 (noting that exclusion of a *demonstrative* computer-generated exhibit "because the computer programmer is not in court to be cross-examined would be like excluding a demonstrative list of elements displayed on a posterboard because the wordprocessor programmer and the copier machine inventor who made the posterboard blow up possible are not there to be cross-examined").

> A statement not specifically covered by Rule 803 or 804[107] but having equivalent circumstantial guarantees of trustworthiness, is not excluded by the hearsay rule, if the court determines that (A) the statement is offered as evidence of a material fact; (B) the statement is more probative on the point for which it is offered than any other evidence which the proponent can procure through reasonable efforts; and (C) the general purposes of these rules and the interests of justice will best be served by admission of the statement into evidence.[108]

In determining the trustworthiness of a computer-generated exhibit, a trial court will probably look favorably upon the fact that the declarant expert is available to testify and is subject to cross-examination.[109] To satisfy Rule 807's second requirement that the declarant's statement be offered as evidence of a material fact, one only needs to reestablish the exhibit's relevancy to a material trial issue.[110] To fulfill the third requirement of ultimate probative value of the evidence, one can argue that it would be more time-consuming and less effective—or even impossible—to present the exhibit without a computer.[111] Finally, a fairness argument will fulfill the fourth requirement—that justice will be best served through the exhibit's admission.[112]

If an exhibit is a computer simulation, additional evidentiary considerations beyond the Federal Rules arise. Since they are usually used as scientific evidence, computer simulations are held to a higher degree of scrutiny than demonstrative computer animations.[113] For these simulations, one must establish (1) the validity of the data that forms the basis for the simulation; (2) the scientific reliability, according to the guidelines of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,[114] of the computer hardware and software used to produce the simulation; and (3) the security

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[107] Rules 803 and 804 provide for a variety of hearsay exceptions. *See* FED. R. EVID. 803-04. If data used in creating a simulation or animation/simulation comes under one of these exceptions, Rule 807 need not be used. *See* Galves, *supra* note 5, at 244 (noting that one way to circumvent CGE hearsay problems is to "find an exception to the hearsay rule which may be applicable—especially important with respect to trying to admit . . . underlying input data"). Moreover, in the case of expert testimony, Rule 703 may also be used to avoid hearsay objections. *See* FED. R. EVID. 703; Galves, *supra* note 5, at 247-48.

[108] FED. R. EVID. 807. The rule also provides for pre-trial notice of admission of the hearsay CGE. However, since this portion of the rule rarely raises controversy, the author has omitted it from the rule's quotation. *See* D'Angelo, *supra* note 28, at 571-72.

[109] *See* D'Angelo, *supra* note 28, at 571. Note, however, that "[i]f [a] computer display does not actually represent the view of any one witness, but a composite view of multiple witnesses, then it will be difficult, at best, to get the computer display into evidence." Borelli, *supra* note 2, at 446.

[110] *See* D'Angelo, *supra* note 28, at 571.

[111] *See id.*

[112] *See id.*; Galves, *supra* note 5, at 249-52.

[113] *See* MUELLER & KIRKPATRICK, *supra* note 84, § 9.17, at 1153 ("When the output reflects data specially created or manipulated for purposes of litigation, courts may require a more stringent foundation than for output merely producing routine records.").

[114] 509 U.S. 579 (1993).

of the computer system and its output.[115] Moreover, the conditions portrayed in the simulation "must be substantially similar to those in the event at issue"[116] because a relatively small change in only one of the data variables used as a basis for simulation generation can have significant consequences.[117]

In 1993, *Daubert* overruled *Frye v. United States*[118] and set forth the proposition that FRE 702[119] should be the standard for admissibility of expert testimony and scientific evidence.[120] Recently, the Supreme Court extended *Daubert*'s holding to include technical evidence as being subject to Rule 702 admissibility analysis.[121] Under *Daubert*, in order to satisfy Rule 702, "the trial judge needs to determine two things: (1) whether the proposed testimony is based on 'scientific knowledge,' and (2) whether it would help the trier of fact understand or determine a fact at issue."[122] While the Court did offer guidelines to a judge as to making the first of these two assessments,[123] it did not sufficiently explain how the second requirement is not a simple reiteration of the relevancy requirements of the FRE.[124]

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[115] *See* Carbine & McLain, *supra* note 11, at 21.

[116] *Id.*; Galves, *supra* note 5, at 228 ("[T]he input information must be shown to be substantially similar to the complete, exact ingredients that created the event in the first place.").

[117] For example:

> In an airplane crash, for example, perhaps the speed at which the plane hit the ground can only be estimated to within 100 miles per hour of the actual velocity. The results from a [simulation] based on a speed of 450 mph will differ drastically from the results of a [simulation] using a speed of 550 mph or one using 350 mph. Contrast this with a demonstrative animation: if the point to be illustrated is how a plane, according to witness testimony, crashed nose-first, perhaps the estimation of the speed is of no consequence. However, if the output is a re-creation, possibly being 100 mph off the mark on velocity makes the re-creation too imprecise to be what it purports to be—that is, a re-creation of what must have happened. Similarly, if the output is a simulation, the output could not purport to be accurate if it is only one of many different simulated results that would occur within a wide range of differing crash speeds.

Galves, *supra* note 5, at 228-29.

[118] 293 F. 1013 (D.C. Cir. 1923).

[119] "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." FED. R. EVID. 702.

[120] *See* Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 589 (1993); Harts, *supra* note 12, at 515 (footnote omitted) ("Holding that the FRE superseded the *Frye* standard, the U.S. Supreme Court . . . rejected the 'general acceptance' standard as the sole test for admissibility of scientific evidence.").

[121] *See* Kumho Tire Co. v. Carmichael, 526 U.S. 137, 147 (1999) (holding that "as a matter of language, . . . [Rule 702] applies its reliability standard to all 'scientific,' 'technical,' or 'other specialized' matters within its scope").

[122] Borelli, *supra* note 2, at 443 (citing *Daubert*, 509 U.S. at 592).

[123] *See Daubert*, 509 U.S. at 592-95; Galves, *supra* note 5, at 260-61 (footnotes omitted) (discussing the four *Daubert* evidence requirements: ability of the evidence to be tested, peer review, known or potential rate of error, and particular degree of acceptance).

[124] *But see* Borelli, *supra* note 2, at 443 n.48.

B. *State Evidentiary Standards for CGE*

Since states adopt their own evidentiary standards, admissibility standards will differ amongst them.[125] The emerging general rule in state cases is that computer animations are admissible if they mirror the genuine facts of a case and support relevant testimony.[126] For computer simulations, many states, in contrast to the federal courts, continue to use the *Frye*[127] standard for admissibility.[128] Under *Frye*, scientific evidence must "have gained general acceptance in the particular field in which it belongs"[129] before it is admitted. Although *Frye* was decided in 1923, there [still] is no clear standard for determining the existence

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[125] *See* MUELLER & KIRKPATRICK, *supra* note 84, § 9.1, at 1123 (noting that the steps to authenticate and introduce computer-generated exhibits "vary among jurisdictions and judges and are very much a part of local custom and professional habit"); Butera, *supra* note 10, at 514 ("The foundational requirements for admissibility of evidence differ based upon jurisdictions.").

[126] *See* Ellis, Jr. et al., *supra* note 16, at 695 & n.141 (citing Cleveland v. Bryant, 512 S.E.2d 360, 362 (Ga. Ct. App. 1999) ("[A] computer-generated animation is admissible if it is a fair and accurate representation of the scene sought to be depicted.") and Clark v. Cantrell, 504 S.E.2d 605, 612 (S.C. Ct. App. 1998), *aff'd as modified*, 529 S.E.2d 528 (S.C. 2000) ("[A]nimated evidence [must] mirror the actual facts of the case and relevant testimony.")). *See also* Hutchinson v. American Family Mut. Ins. Co., 514 N.W.2d 882, 890 (Iowa 1994) (upholding trial court's refusal to admit an animation depicting how a closed-head injury occurs because it was not based upon the particular facts of plaintiff's case); Sommervold v. Grevlos, 518 N.W.2d 733, 738 (S.D. 1994) (citation omitted) ("[A]nimation must fairly and accurately reflect the oral testimony of the witness and be an aid to the jury in understanding the issues."); Carbine & McLain, *supra* note 11, at 20 n.78 (citing Bledsoe v. Salt River Valley Water Users' Ass'n, 880 P.2d 689, 692 (Ariz. Ct. App. 1994)) ("At a minimum, the proponent must show that the computer simulation fairly and accurately depicts what it represents, whether through the computer expert who prepared it or some other witness who is qualified to so testify, and the opposing party must be afforded an opportunity for cross-examination."). *But see* Galves, *supra* note 5, at 214 & n.159 (noting *Sommervold* and arguing that "courts should require the proponent of a re-creation or simulation CGE to make only a *basic showing* that it is *generally similar* to the conditions surrounding the original event, but not apply substantial similarity so stringently . . . .") (emphasis added). As of March 13, 2000, a compromise between the two views was struck by the Supreme Court of South Carolina in its modification of *Clark*:

> [An] animation must be a fair and accurate representation of the evidence to which it relates. *It need not be exact in every detail, but the important elements must be identical or very similar to the scene* as described in other testimony and evidence presented by the animation's proponent in order to constitute a fair and accurate representation. In an animation reconstructing a vehicle accident, for instance, the animation must be technically correct on details such as distance, terrain, relative speed, path of travel, and surroundings. The fact the animation is inconsistent with testimony or evidence presented by the opposing party should not necessarily lead to its exclusion, provided it fairly and accurately portrays the proponent's version of events.

Clark, 529 S.E.2d at 537 (emphasis added).

[127] Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).

[128] *See* Galves, *supra* note 5, at 256 (footnote omitted) ("Although *Daubert* is now the authoritative test in the federal system, many states continue to follow the *Frye* test."); Borelli, *supra* note 2, at 441 (footnote omitted) (noting that *Frye* "has been adopted by most courts in dealing with evidence derived from novel scientific techniques").

[129] *Frye*, 293 F. at 1014 (D.C. Cir. 1923).

of general acceptance.[130] The ruling on general acceptance is left to the trial court, and three methods of proving it that have been recognized are: (1) expert testimony, (2) scientific and legal writing, and (3) precedent.[131] Of these, expert testimony is the most popular method.[132] However, as time progresses and more cases of CGE admittance become commonplace, precedent may be relied upon more than expert testimony to admit CGE under the *Frye* standard.

Various state cases have addressed evidentiary issues posed by CGE simulations.[133] *Commercial Union Insurance Co. v. Boston Edison Co.*,[134] a case in which the Massachusetts Supreme Court addressed simulation foundation issues, is often used as a starting point for their simulation analysis.[135] According to the *Commercial Union* court, a litigant who wishes to introduce a simulation as evidence must prove that "(1) the computer is functioning properly; (2) the input and underlying equations are sufficiently complete and accurate (and disclosed to the opposing party, so that they may challenge them); and (3) the program is generally accepted by the appropriate community of scientists."[136] In 1997, the Missouri Court of Appeals, in *Bray v. Bi-State Development Corp.*,[137] explained these standards when it decided to uphold a trial court's decision to admit a computer-generated chart that displayed varying levels of luminosity in a parking garage.[138] Under *Bray*, the first requirement is presumed in favor of the simulation proponent unless opposing counsel specifically challenges the computer's functionality.[139] The second requirement is fulfilled by a litigant showing that any software used to produce

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[130] *See* Borelli, *supra* note 2, at 442.

[131] *See id.*

[132] *See id.*

[133] *See supra* note 54; Clark v. Cantrell, 504 S.E.2d 605, 612 n.7 (S.C. Ct. App. 1998), *aff'd as modified*, 529 S.E.2d 528 (S.C. 2000) (citing a variety of state cases and journal articles that have dealt with simulation evidentiary issues).

[134] 591 N.E.2d 165 (Mass. 1992).

[135] *See* Bledsoe v. Salt River Valley Water Users' Ass'n, 880 P.2d 689, 692 (Ariz. Ct. App. 1994); Lally v. Volkswagen Aktiengesellschaft, 698 N.E.2d 28, 40 (Mass. App. Ct. 1998); Kudlacek v. Fiat S.p.A., 509 N.W.2d 603, 617 (Neb. 1994); State v. Clark, 655 N.E.2d 795, 812 (Ohio Ct. App. 1995), *aff'd*, 662 N.E.2d 362 (Ohio 1996); Clark v. Cantrell, 504 S.E.2d 605, 612 (S.C. Ct. App. 1998), *aff'd as modified*, 529 S.E.2d 528 (S.C. 2000); State v. Farner, No. E1999-00491-CCA-R3-CD, 2000 Tenn. Crim. App. LEXIS 515, at *64 (Tenn. Crim. App. June 30, 2000).

[136] *Commercial Union*, 591 N.E.2d at 168 (citation omitted).

[137] 949 S.W.2d 93 (Mo. Ct. App. 1997).

[138] *See id.* at 100 ("The trial court did not err in admitting Exhibit I over the objection to foundation based on a challenge to the validity of the software. Point one is denied."). While this case did not deal specifically with CGE, the standards that the court discussed do concern computer animations directly. *See id.* at 98-99 (discussing the general acceptance standard in cases where computer-generated animations and simulations were used).

[139] *See id.* at 97.

the simulation is accepted by the relevant scientific community.[140] Finally, the last requirement is realized if the proponent's computer program itself fulfills the *Frye* standard of general acceptance.[141]

III. PROBLEMS ASSOCIATED WITH CGE UNDER THESE STANDARDS

As with IEPSs, problems arise with the use of CGE in the courtroom. These problems are primarily evidentiary in nature and are more serious than IEPS problems because the presence and quality of CGE can easily affect a trial verdict.[142] In contrast, the non-evidentiary problems with IEPSs are more technical[143] and thus easier to solve.[144]

The first of the evidentiary problems associated with CGE is cost. As with IEPSs, the use of CGE can be prohibitively expensive.[145] Moreover, if a judge interprets current evidentiary standards in a strict fashion so as to require experts to testify upon any and every CGE concern at trial,[146] court costs will rise and CGE will lose its efficiency advantage.[147] Finally, there is the possibility of an overall fairness problem with CGE if the cost of

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[140] *See id.* at 98.

[141] *See id.*

[142] As the Supreme Court has observed:

> Unlike an abstract premise, whose force depends on going precisely to a particular step in a course of reasoning, a piece of evidence may address any number of separate elements, striking hard just because it shows so much at once; the account of a shooting that establishes capacity and causation may tell just as much about the triggerman's motive and intent. Evidence thus has force beyond any linear scheme of reasoning, and as its pieces come together a narrative gains momentum, with power not only to support conclusions but to sustain the willingness of jurors to draw the inferences, whatever they may be, necessary to reach an honest verdict.

Old Chief v. United States, 519 U.S. 172, 187 (1997).

[143] Recall that IEPSs are not evidence themselves but only tools for the presentation of evidence. *See supra* note 36 and accompanying text.

[144] See discussion *infra* Part IV for solutions to some of the problems that IEPSs present.

[145] *See* D'Angelo, *supra* note 28, at 563 ("The production of computer animation is a costly and involved process."); *see also id.* at 563-64 (quoting Anne Marriott, *Alexandria Firm Courts Lawyers by Providing Animation Computers*, WASH. TIMES, Nov. 25, 1996, at D12, and her discussion of the technical aspects of computer animation construction); Galves, *supra* note 5, at 288 (footnote omitted) ("The range of [computer-generated exhibits] varies so dramatically that estimates are difficult to ascertain, but complex animations can range in cost from $50,000 to over $100,000.").

[146] In federal court, "[t]he court may appoint any expert witnesses agreed upon by the parties, and may appoint expert witnesses of its own selection." FED. R. EVID. 706(a).

[147] *See* Borelli, *supra* note 2, at 455 (noting that if the judicial system is "to add the costs of extra hearings and witnesses to the costs of using [CGE], then a problem that cheaper hardware and software was beginning to solve is exacerbated . . . after all, new technology tends to move downward in price, but the costs of court time never go down.").

CGE is prohibitive: certain litigants could gain access to it while others would be denied access.[148] In effect, justice would be purchased by the highest bidder.[149]

In addition to the cost of CGE, manipulation of the evidence which serves as the source for computer animations or simulations is a prominent concern of modern jurists.[150] Professor Lederer, for example, points out the potential for stealth alteration of electronic evidence.[151] Related to Professor Lederer's possibility of electronic fabrication is the possibility of presenting CGE in such a manner so as to cause juries to subconsciously favor one party's CGE.[152] For example, a particular use of color, like red or yellow, in presenting visual evidence can influence a jury.[153]

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[148] *See* Galves, *supra* note 5, at 288 ("[F]or clients with smaller litigation budgets who already find it difficult to pay high attorneys' fees and expert witnesses' fees, using [computer-generated exhibits] simply may not be a realistic option."); Frank Herrera, Jr. & Sonia M. Rodriguez, *Courtroom Technology: Tools for Persuasion*, TRIAL, May 1, 1999, *at* 1999 WL 17784140 (noting that "some may question whether the high cost of some courtroom technology makes the judicial system less accessible to certain segments of the population.").

[149] *See* D'Angelo, *supra* note 28, at 583-84 ("Litigants who bring contingency-based suits against insurance companies or large corporations may be unable to compete with the high-priced computer animated exhibits that their opponents are capable of utilizing.").

[150] *See* Clark v. Cantrell, 504 S.E.2d 605, 612 (S.C. Ct. App. 1998), *aff'd as modified*, 529 S.E.2d 528 (S.C. 2000) (citation omitted) ("[V]ideo animation requires heightened guarantees of trustworthiness because of its susceptibility to editorial distortion."). South Carolina's Supreme Court agreed with this observation:

> Likewise, our Court of Appeals [in *Clark*] correctly highlighted several concerns about computer animations: the potential to mislead by an inaccurate portrayal of the facts, the potential to create lasting impressions that unduly override other testimony or evidence, and the need for heightened guarantees of trustworthiness due to the possibility of editorial distortion by the party preparing the animation.

Clark, 529 S.E.2d at 536 (citation omitted).

[151] Professor Lederer notes that

> [t]he most frequently raised question concerning electronic evidence is the possibility of alteration through undetectable digital skullduggery. To the best of our knowledge, this is technically possible. Whether it is or should be a real concern is by no means clear. Given sufficient funds and time, we believe that the technology exists to permit at least a reasonable possibility of altered or totally fabricated electronic evidence, be it still images, digital audio, or even digital video.

Lederer, *supra* note 9, at 817.

[152] *See* Galves, *supra* note 5, at 299 ("Even with a [computer-generated exhibit] that is perfectly accurate, the animator's choice to zoom in or show a particular viewpoint can send a certain unfair or misleading message.").

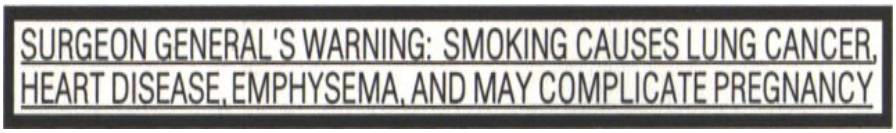
[153] As advertiser JJ Goodell notes:

> It's quite well known that the color red inspires impulsive buying. Our eyes are drawn to the color like ducks to water. Just walk into any supermarket and look at the color most often used on products. It's red. The next one is yellow. Both colors tend to raise your blood pressure just a tad and dilate your pupils. They cause excitement, which goes to prove one thing: color affects us.

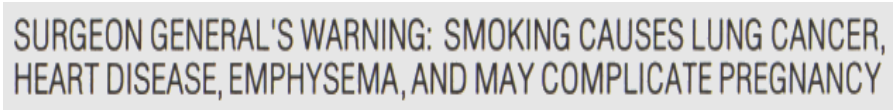
J.J. Goodell, *Some Thoughts on Color*, *at* http://www.teleport.com/~jgoodell/color.htm (1999) (last visited July 24, 2001). To lend some visual support to this statement, consider these two signs and ask yourself which one is easier to read:

Beyond fear of manipulation, there exists a well-founded fear that the highly communicative nature of computer presentations and blind belief in the reliability of computers will turn a jury into a captive audience once it is witness to computer animations or simulations.[154] First, unless CGE is struck down on admissibility grounds,[155] authenticity of CGE usually becomes an issue for the non-expert jury,[156] which, according to some courts, is vulnerable

Sign 1



Sign 2



The first sign is reproduced from EDWARD R. TUFTE, VISUAL EXPLANATIONS: IMAGES AND QUANTITIES, EVIDENCE AND NARRATIVE 65 (1997). The second sign is the author's original work. Between the two signs, the first sign should be much more *uncomfortable* to read. In the words of Professor Tufte, the first sign is

> a sinister piece of disinformation from a billboard advertising cigarettes[.] [A] thick frame clutters the words of warning (by activating the negative white space between word and box) just as a waving hand masks small moves of the fingers in switching coins. The sans serif, capital letters minimize distinctions among letters and words, contributing to the difficulty of reading.

Id. While in the second sign the sans serif lettering that causes confusion has not been removed, the author has added a gray background to illustrate the improving effect that color alone can have upon visual information. As opposed to the first sign, the second sign makes usage of the design principle known as the smallest effective difference and, even with its flaw of sans serif lettering, should still be easier to read. *See id.* at 73 ("In designing information, then, the idea is to use *just notable differences*, visual elements that make a clear difference but no more—contrasts that are definite, effective, *and* minimal."). For more information on this principle, see generally *id.* at 73-77.

[154] *See* Galves, *supra* note 5, at 216 (noting that "concern for unfair prejudice is present when the trial exhibit is a [computer-generated one] . . . because the [exhibit] itself, especially an animation or re-creation, may be so powerful or overly suggestive that it might pose a danger that its probative value is substantially outweighed by the danger of unfair prejudice"); Borelli, *supra* note 2, at 455.

[155] *See* discussion *supra* Part II.

[156] The admissibility of a computer-generated exhibit

> hinges upon the judge's determination under Rule 104(b) that an adequate foundation has been laid for admitting the exhibit. This determination by the judge, however, is only limited to a finding of 'whether there is evidence *sufficient to support a jury finding* of authenticity.' If this threshold requirement is satisfied, then the exhibit is typically admitted—unless there exist other grounds for exclusion. . . . It is important to bear in mind that once an exhibit is admitted under Rule 901, the ultimate decision of whether to accept it as authentic rests entirely within the jury's discretion.

D'Angelo, *supra* note 28, at 568 n.61 (quoting MUELLER & KIRKPATRICK, *supra* note 83, § 9.2, at 1124) (footnotes omitted) (emphasis in original). *See also* JON R. WALTZ, INTRODUCTION TO CRIMINAL EVIDENCE 423 (3d ed. 1991) ("If [demonstrative evidence]

to visual disinformation.[157] Second, the persuasive power of CGE is awesome[158] and can aid a jury immensely in its retention of information.[159] In addition, experimental laboratory trials have revealed that jurors strongly favor the presentation of visual evidence at trial.[160] Third, a trial judge's instructions to the jury may not be sufficient to offset the tendency of jurors to believe what they see, even when physical evidence directly contradicts CGE.[161] Finally, judges may not have the expertise necessary to

is used sparingly, *with scrupulous accuracy*, and only when it holds out genuine promise of making the case more readily understandable by judge and jurors, courts can be expected to be liberal in their rulings on the admissibility question.") (emphasis added).

[157] *See* Fulcher, *supra* note 14, at 70 ("Although courts may exclude a [computer-generated] reconstruction because it unfairly aids one party or it presents inherent classification problems, their primary concern seems to be the risk that juries will confuse issues and afford too much weight to the computer re-creation.").

[158] *See* Clark v. Cantrell, 504 S.E.2d 605, 612 (S.C. Ct. App. 1998), *aff'd as modified*, 529 S.E.2d 528 (S.C. 2000) ("Video animation is a powerful evidentiary tool. Because of the medium's ability to deliver information in a persuasive manner and format, video evidence can have greater weight and longer-lasting impact than conventional testimony.") (citations omitted).

[159] "One study reported that jurors who received combined visual and oral presentations retained 650 percent more information compared to jurors who received only oral presentations." D'Angelo, *supra* note 28, at 576 n.150 (quoting David W. White-Lief, *Effective Demonstrative Evidence: It's Your Most Persuasive Tool*, MASS. LAW WKLY., Jan. 17, 1994, at B37); *see also* Bennett, Jr. et al., *supra* note 2, at 258 ("Social science research also supports the proposition that we assimilate and remember more information that we see, or see and hear, than what we hear alone."); Butera, *supra* note 10, at 513 n.14 (noting theWeiss-McGrath report, which also found a 65 percent increase in juror retention); Galves, *supra* note 5, at 186-89 (noting the three cardinal advantages of ease of imagination, proximity, and improved recall that visual information provides to a jury); Powell, *supra* note 104, at 579-80 & nn.14-18 (noting that jury exposure to visual presentation of evidence has resulted in significant increases in retention).

[160] *See* Lederer, *supra* note 9, at 814 ("[J]urors want evidence to be presented visually to the greatest degree possible."); Clancy, Jr., *supra* note 18, at 204 (footnote omitted) ("Visual information is vivid information. Jurors remember vivid information better and weigh it more heavily than other types of information.").

[161] *See* D'Angelo, *supra* note 28, at 570 ("A trial judge's cautionary instructions may not be sufficient to offset jurors' tendency to believe what they see, even when it is contradicted by the real evidence offered at trial."); Galves, *supra* note 5, at 221 n.186 (quoting Evelyn G. Schaefer & Kristine L. Hansen, *Similar Fact Evidence and Limited Use Instructions: An Empirical Investigation*, 14 CRIM. L.J. 157, 179 (1990)) ("[T]he available empirical evidence strongly challenges the legal presumption that jurors are willing and able to ignore or make limited use of testimony when judicial instructions tell them to do so."). *But see* Bennett, Jr. et al., *supra* note 2, at 259 ("The evidence marshalled by proponents to support the efficacy of computer simulations in swaying jury decisions is largely anecdotal."); Galves, *supra* note 5, at 217-18 (arguing that to believe "that jurors lose all sense of reality and simply believe anything . . . they see depicted on a television or computer screen presupposes . . . naiveté and basic lack of intelligence on the part of juries that is . . . unwarranted as a matter of psychological research, . . . offensive, and even elitist"). Professor Galves further comments that

> jury members usually do not receive instructions advising them not to be swayed by: (1) a slick-talking, charismatic attorney, as opposed to a boring, inarticulate attorney; or (2) the fact that one attorney has many paralegals and co-counsel helping her, as opposed to the other attorney going solo; or, (3) perhaps most appropriate to [computer-generated exhibits], the fact that one attorney has large, professionally printed and very clear and legible (but non-computerized) demonstrative exhibits, while opposing counsel has semi-illegible handwritten

determine whether CGE is probative, prejudicial, or is not really CGE at all but artful disinformation.[162] Hiring judicial experts is an option,[163] but as more cases utilize CGE, hiring experts will become too costly.[164] Thus, it comes as no surprise that judges have asked for admissibility guidelines concerning CGE,[165] especially since there is no bright-line standard that can be used to ascertain when CGE confounds or misleads a jury.[166] Moreover, some courts have actually excluded CGE on grounds that CGE's prejudicial effect simply cannot be countered by any means.[167] Fortunately, however, technology itself has now provided a way to reduce—if not eliminate entirely—CGE's prejudicial impact.[168]

IV. PROPOSAL

IEPSs and CGE are much like fire. Used properly, they are utilitarian and beneficial; used improperly, they are harmful and destructive.[169] Like the power of fire, the persuasive power of IEPSs and CGE must be kept in check. If protocols are established for the use of IEPSs, and IEPSs themselves and

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> notes up on a small, dirty chalkboard.

Galves, *supra* note 5, at 222.

[162] *See supra* notes 150-153 and accompanying text.

[163] *See supra* note 146.

[164] *See* Galves, *supra* note 5, at 289 (footnote omitted) ("Even the most wealthy corporate clients are [now] concerned that litigation is already too expensive once . . . expert witnesses' fees . . . and other costs associated with litigation are taken into account.").

[165] Consider Judge Chasanow's critical dissent to the Maryland Court of Appeals' adoption of rules concerning CGE:

> Rule 2-504.3 is an unnecessary and unduly complicated pretrial notice rule that creates special hazards for the party offering even the most benign form of computer-generated evidence. The rule also fails to deal with difficult issues involving admissibility of computer-generated evidence. *The admissibility of computer-generated evidence is the area where trial judges need the most guidance.*

Carbine & McLain, *supra* note 11, at 45 (emphasis added) (quoting Md. Ct. App. Practice and Procedure Rule Order, Feb. 10, 1998 (Chasanow, J. dissenting)).

[166] *See* D'Angelo, *supra* note 28, at 576.

[167] *See* Galves, *supra* note 5, at 217, 220-21 (discussing Racz v. R.T. Merryman Trucking, Inc., No. CIV.A.92-3404, 1994 WL 124857, at *5 (E.D. Pa. Apr. 4, 1994)) and Van Houten-Maynard v. ANR Pipeline Co., No. 89-C0377, 1995 WL 317056, at *12 (N.D. Ill. May 23, 1995) as two examples of courts excluding CGE under Rule 403 due to its prejudicial effect). *See also* D'Angelo, *supra* note 28, at 578-79 (discussing *Racz*); Ellis, Jr. et al., *supra* note 16, at 696 (discussing *Racz*); Wilson et al., *supra* note 11, at 377-78 (discussing *Racz*); Clancy, Jr., *supra* note 18, at 211-13 (discussing *Racz*).

[168] *See* discussion *infra* Part IV.

[169] *See* Linda C. Morell, *New Technology: Experimental Research on the Influence of Computer-Animated Display on Jurors*, 28 SW. U. L. REV. 411, 415 (1999) ("Although both this author's research and that of Kassin and Dunn indicate that computer-animated presentations paired with verbal narration can enhance memory, Kassin and Dunn's research [also] indicates that jurors can be misled."). *But see supra* note 161.

admissibility guidelines are adopted to police the use of CGE, IEPSs and CGE will successfully establish themselves in the courtrooms of the twenty-first century as tools for the promotion of justice.

A. *Solutions to Cost and Fairness Problems Associated with IEPS and CGE*

Both IEPSs and CGE share the dual problems of cost and fairness.[170] The cost and fairness problems of CGE have two dimensions—a judicial dimension and an attorney/litigant dimension. IEPSs share only the latter with CGE. The judicial dimension of the cost and fairness problems with CGE is that fairness hearings on CGE and expert evidence testimony may take up too much of the court's time and resources in a case, thereby offsetting the time-saving benefits of CGE.[171] Fortunately, there is a simple solution here: tailor admissibility standards to a golden mean that will allow CGE to be fairly used at trial and thereby obviate the need for time-consuming (and costly) hearings.[172] Once this is accomplished, judges, via the standards, will act as effective gatekeepers, and experts will be necessary only in the most technical cases.[173]

The attorney/litigant dimension of the cost and fairness problems with IEPSs and CGE is that use of IEPSs and expensive CGE by only one party in a trial might unfairly disadvantage the other party.[174] Here, there exists a partial solution:[175] put

[170] *See* discussion *supra* Parts I.C, III.

[171] *See supra* note 147 and accompanying text.

[172] While this solution is probably more easily proposed than accomplished, significant advances toward "golden mean" standards have already been taken. *See generally* Galves, *supra* note 5, at 261-74 (advocating reforms in the FRE to encourage the usage of CGE). Specific reforms advocated by Professor Galves include establishment of a rule formally recognizing CGE as a distinct form of evidence and creating a legal distinction between computer animations and simulations, *see id.* at 262-63, establishment of a "test for relevance of . . . demonstrative CGE . . .[that] should be no more stringent than that used to evaluate the relevancy of a non-computerized exhibit, such as a letter or photograph," *id.* at 269, instruction to trial judges that Rule 403 should not be used as a judicial counterweight to offset the advantage one party gains through use of CGEs simply because the other party's presentation is less effective, *see id.* at 270, and direction to trial judges that "[o]nly when [computer-generated exhibits] are used substantively [and not demonstratively] must they meet the requirements of Rule 702 and *Daubert*." *Id.* at 273-74.

[173] *See id.* at 261 (noting that through new admissibility standards for CGE, we can benefit the American legal system and "accept the legitimate place of computer technology in the practice of law and in the pursuit of justice").

[174] *See supra* note 154 and accompanying text.

[175] Unfortunately, the problem of economic disparity arising from CGE's use by only one litigant is almost impossible to completely solve and the proposal offered here is, therefore, incomplete. See Galves, *supra* note 5, at 295-97 for some solutions to CGE's economic disparity problem, none of which are completely satisfactory. "The bottom line,

technology in the hands of the court, not attorneys.[176] This has been the approach of the New York State Supreme Court's (New York County) Courtroom 228, also known as Courtroom 2000.[177] Courtroom 2000 is a true courtroom of the future, wired for real-time transcription of trials and also includes its own IEPS, known as DEPS™.[178] Lawyers can reserve the courtroom in advance if they feel that they will need to make use of DEPS™ for organizational purposes, use of CGE, or both.[179] If courts are willing to obtain IEPSs themselves, each and every litigant can have equal access to the efficiency and persuasive advantages of IEPSs.[180] Financing for such a plan can be obtained by charging each attorney litigating in a court's jurisdiction a technology usage fee for the year. This fee would also cover IEPS maintenance and costs incurred when equipment failures inevitably occur.[181] Putting technology in the hands of the court might also mitigate cost equalization problems[182] associated with CGE.[183]

Furthermore, education can prevent lawyers and judges from

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both figuratively and literally, is that most poor and even many 'middle-class' litigants simply cannot afford the out-of-pocket expense required for CGE use." *Id.* at 292. *See also* Lederer, *supra* note 9, at 832 (footnote omitted) ("Unequal legal representation is a constant in our system, and terribly mismatched counsel does not justify relief unless counsel for one party is legally inadequate.").

[176] *See* Galves, *supra* note 5, at 171-72 (advocating that "our courthouses should . . . become cutting-edge leading social institutions in the use of computer technology.").

[177] A summer judicial internship with the Honorable Charles Edward Ramos enabled the author to visit this courtroom and gave him with the motivation to write this Note. Professor Galves has commented more extensively on the courtroom's capabilities:

> New York's experimental high-technology courtroom, known as "Courtroom 2000," includes 16 video monitors placed in key locations, such as the judge's bench, jury box, attorneys' tables and clerk's desk, PC docking stations, an electronic whiteboard, VCRs, and a touch screen monitor at the witness box. "Realtime" translation of the court reporters [sic] transcription is immediately viewable on the monitors for the judge and attorneys. The heart of the system is the Digital Evidence Presentation system, controlled at the attorney's podium via a touch-screen LCD remote control, allows counsel to present documentary evidence or actual exhibits to the judge and jury via television display and allowing counsel to annotate or draw on an overlay of the documents, similar to the system seen in televised sports commentary.

Id. at 172 n.28.

[178] *See supra* note 19.

[179] *See* Memorandum from the Sup. Ct. of the State of N.Y., Courtroom 2000 (July 2000) (on file with the *Cardozo Law Review*) (noting that attorneys in Courtroom 2000 can present computer animations and that the "Courtroom accommodates Commercial Division cases and cases from outside the Division . . . .").

[180] *See* Galves, *supra* note 5, at 297 ("[A] courtroom takes the initiative and becomes automated on its own and then offers the technology option to the attorneys [that] . . . would minimize any wealth disparity between the litigants and quite literally 'level the playing field,' at least with respect to equipment technology.").

[181] *See supra* note 72 and accompanying text.

[182] *See supra* notes 145-148 and accompanying text.

[183] *See* Galves, *supra* note 5, at 297. To aid litigants who could not normally present CGE due to their economic situation, "[t]he court could also provide a library of stock CGE programs for litigants much like proposals for court-appointed experts for the indigent." *Id.*

being disadvantaged in a high-tech courtroom.[184] The lawyers and judges of the future must be educated in the basics of computer technology and its use in the courtroom so as to ensure adequate representation for litigants.[185] They need not become computer programmers. However, law schools should follow the example of the William & Mary Law School, which has made instruction in high technology and its use in litigation a required course in its law school curriculum.[186]

B. *Effective CGE Presentation: The Use of IEPSs to Prevent Jury Prejudice*

The problem of jury prejudice is a problem particular to CGE, for IEPSs themselves are not prejudicial.[187] Rather, it is what IEPSs *represent* to the judge or jury—namely CGE—that can be prejudicial.[188] Here, however, the legal system can use technology to solve technology's problems. Through the use of IEPSs to assure the accuracy of CGE, CGE's persuasive power can be brought under control.

Ultimately, CGE can be considered as a type of cumulative evidence, a product of a large number of variables coming together in one environment.[189] In this aspect, CGE is similar in substance to the function of an IEPS. Whereas an IEPS' function is information integration,[190] an animation or simulation *is itself* information integration in a visual medium.[191] Applying an IEPS'

[184] *See* Galves, *supra* note 5, at 278-81 (noting the potential benefits of a judicial conference on CGE and the benefits of training in CGE for law students).

[185] *See* Butera, *supra* note 10, at 522 (footnote omitted) (noting that in the future, "even the minimally competent attorney will be required to consider and evaluate demonstrative computer simulations."); Dilworth, *supra* note 11 ("In the years ahead, computer skills may be a requirement for establishing one's professional competence."); Galves, *supra* note 5, at 278-87 (advocating a comprehensive education plan for judges, practitioners, and law students).

[186] *See* Lederer, *supra* note 9, at 829 ("Beginning with the Class of 1999, the William & Mary Law School added mandatory courtroom technology training to the Legal Skills curriculum, effectively making it a graduation requirement.").

[187] Recall that IEPSs are not evidence themselves but only tools for the presentation of evidence. *See supra* note 36 and accompanying text.

[188] *See* Galves, *supra* note 5, at 219 (noting that hypothetical CGE, which would portray space aliens as being culprits of crime instead of a human suspect, would probably not be excluded at trial on grounds of unfair prejudice).

[189] *See* Lally v. Volkswagen Aktiengesellschaft, 698 N.E.2d 28, 40 (Mass. App. Ct. 1998) ("Thus, the animation was merely cumulative of other evidence in the case and could not, therefore, have prejudiced the plaintiffs."); *see also* Galves, *supra* note 5, at 226 (conceding that CGE can fall under Rule 403's prohibition against cumulative evidence but also noting that a computer-generated exhibit "that is shown only once and simply helps a witness explain his testimony to the jury is not [unduly cumulative]").

[190] *See supra* notes 27-32 and accompanying text.

[191] *See* Butera, *supra* note 10, at 517 (footnote omitted) ("Computer animation is produced by collecting all information possible, loading it into the computer system,

function to CGE, one can theoretically use an IEPS to integrate information integration, and when one does this, the problem of jury prejudice associated with CGE virtually disappears. In other words, an IEPS can be used to construct CGE animations or simulations in "real-time" for the jury[192]—to reveal the actual

deciding on the animation features of the presentation, rendering the still frames, and finally recording the still frames onto videotape."); Fulcher, *supra* note 14, at 59 (footnote omitted) ("While courtroom animations usually are not humorous, some rely on the same underlying concept used in cartoons, mixing visual graphics with a sense of movement to embody a process or event.").

[192] Today's IEPS operator has the capability of displaying and manipulating photographs or images necessary for "on the fly" construction of animations, *see* Wilson et al., *supra* note 11, at 372, and can do much, much more. A modern IEPS gives its users:

> (1) The ability to "zoom" or magnify small details of photographic evidence and documents, allowing the jury to focus on the issue under examination and participate in the examination from the jury box. A video writer, which allows the expert or attorney to draw and annotate on the video image, can further focus the concentration of the jury.
>
> (2) The ability to present video clips on demand, eliminating the distracting fast-forward and rewind when searching for a specific segment of the video tape. Video clips can be indexed by any criteria, instantly accessed, and played in any order. This increases the attorney's ability to keep the jury's attention when presenting key evidence. Digital video also allows perfect "freeze frame" capability without the "jitters" and horizontal lines created by VCR's. Combined with the video writer, digital images become a powerful tool for presenting video in the courtroom.
>
> (3) The ability to extract a single frame from a video tape for enlargement and color printing. Computers are capable of enhancing a single video frame for color hard copy. This ability becomes critical when the key evidence is contained in one passing second of the video tape.
>
> (4) The ability to enhance a bad photograph. Too often, a key piece of photographic evidence was taken by someone unfamiliar with the camera equipment being used. Through high resolution scanning of the original negative, image processing software and digital filters may be able to bring out the important details in a bad photograph.
>
> (5) The ability to create professional quality demonstrative exhibits the day before trial, as compared to traditional hard copy which requires preparation weeks in advance. On-the-fly changes allow data to be manipulated and presented even while the trial is underway. Composites of photography, computer graphics, and annotations can make powerful visual summaries of a multitude of independent facts.
>
> (6) The ability to create computer-generated three-dimensional scale models from engineering drawings, CAD (Computer-Aided Design) files, and photographs. The computer allows the jurors to view an accurate depiction of an object or group of objects from any perspective. Motion data can be applied to accurately depict a sequence of events. Transparency can be used to reveal the internal workings or structures of an object. Textures can be used to enhance the detail of an object, resulting in a photo-realistic depiction. Three-dimensional animation is a valuable tool when multiple perspectives of a single event are required. Two-dimensional animation is an economical alternative when a single flat perspective is sufficient.
>
> (7) The ability to re-create an event that occurred in the past. Using the data from a reconstruction analysis, computers can recreate events to depict an expert's opinion in a clear and concise manner. This technique can be applied to vehicular, maritime, and aviation accidents. It is also useful in explaining the instigation and propagation of a fire or explosion.
>
> (8) The ability to accurately re-create an object that no longer exists, or does not exist in its original form. Special techniques allow extraction of three

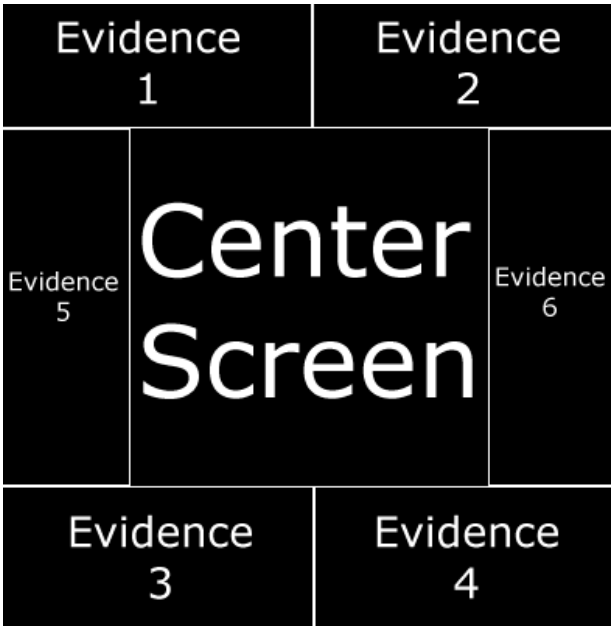
process of information integration that is the essence of a CGE exhibit[193] so that when a jury is finally exposed to the same CGE

> dimensional information from two dimensional imagery. For instance, utilizing multiple photographs of a post-collision vehicle taken from different perspectives, a three-dimensional model of the damaged vehicle can be constructed to obtain dimensions and damage information. This technique can be applied to any object or scene where multiple perspective photographs are available.
>
> (9) The ability to immediately access any part of the presentation, including video, audio, photographs, documents, computer graphics, and animation. Multimedia allows the jury to maintain perspective during the presentation of interrelated pieces of evidence from multiple formats. Moreover, the interactive ability of multimedia can enhance and direct the correlation of all components in the visual presentation of a particular case.

Wilson et al., *supra* note 11, at 373-74.

[193] Consider, for example, a claim of products liability. A car is alleged to have a faulty gas tank design. The plaintiff claims that when his car collided with a truck, the gas tank exploded, leaving him seriously injured. To illustrate the plaintiff's case, plaintiff's counsel wishes to rely upon a computer simulation or reconstruction of the accident. However, instead of simply calling an accident expert to the stand, having him testify, and then showing the jury the simulation, plaintiff's counsel decides to actually create the computer simulation in "real time" for the jury and then show the finished product. This can be easily accomplished through the use of an IEPS. See *supra* note 192 for a detailed description of the capabilities of today's IEPSs.

First, the attorney presents to the jury a blank screen with a center area. Surrounding this center area blank screen are six evidence items—all previously authenticated and ruled admissible—shown in six separate frames.



These six evidentiary items are sections from a post-accident report generated by plaintiff's expert's lab and constitute the variables that will be used to construct the computer simulation. As direct examination proceeds, each of the six evidence variables will be discussed by plaintiff's expert and then presented to the jury as a zoom-in or up-close image in the center screen. At the end of the evidence presentation, the IEPS' computer is used to display all the evidence items in one time sequence. In other words,

the IEPS' computer displays a final animation that the jury has seen created before its own eyes from evidence that, unless previously objected to by opposing counsel, was not in and of itself prejudicial.

To better understand this process, consider the following hypothetical testimony in our gas tank case, given by plaintiff's expert:

> Q [Plaintiff's counsel]: "In your report, [Evidence 1, detailing the skid marks analysis, is now inserted into the center screen and enlarged for the jury], what did your skid mark analysis reveal?"
>
> A [Plaintiff's expert]: "The car was traveling at approximately twenty-five miles per hour, the truck at approximately forty miles per hour. The car and truck both began to brake when they were about thirty feet apart."
>
> Q: "Can you please draw on the center screen the approximate location of the car and truck when they began to brake?"
>
> A: "Yes."

The jury then sees the text of the skid marks analysis fade out, and a car and a truck appear on the center screen, spaced out at thirty feet.

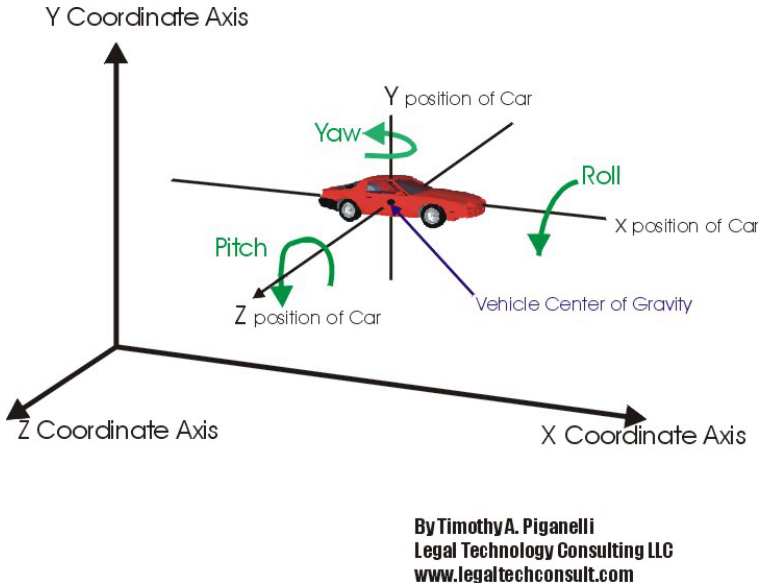
> Q: "Based upon the explosion of the gas tank, [Evidence 2, scientific analysis of the explosion, is now presented to the jury blown up on the center screen], where exactly was the area of impact of the truck?"
>
> A: "Passenger side of the vehicle, twenty inches above the right rear tire, extending twenty inches on both sides."
>
> Q: "Can you please draw this on the center screen?"

After the explosion analysis fades out, the jury sees the point of impact on the center screen.

The same procedure is then repeated with Evidence 3-6 (which could be the presence of stormy weather (leaving the eventual animation with a gray hue), the fact that the truck was skidding slightly due to rain before the accident occurred, the fact that the car was also skidding, and how the explosion progressed inside the car (i.e., which areas of the car were consumed and when)). Finally, after the plaintiff's counsel concludes direct examination, effectively presenting all relevant data of the accident to the jury, plaintiff's counsel asks plaintiff's expert if it is possible to synthesize all of these variables into a simulation of what has occurred. Plaintiff's expert will presumably respond in the affirmative and the jury members will observe a computer simulation of the accident constructed from the evidence variables that they have previously witnessed.

Please note that the author has only highlighted and simplified here some of the variables that would be incorporated into the final simulation. According to Professor Galves, a real-life accident reconstruction animation before a jury would be significantly more intricate:

> [A]ccording to trial consultant Timothy Piganelli, to test a litigant's theory of how a car accident must have occurred by creating a simulation, a "motion table" must be created giving various coordinate positions for the center of gravity at every frame of the simulation animation measured against six key coordinates: the three-dimensional x, y, and z positions, along with the roll angle, pitch angle, and yaw angle. [An image provided by Professor Galves' CD-ROM illustrates these six coordinate variables:



> *See* Galves, *supra* note 5, at 185 n.65 (image on Professor Galves' CD-ROM)]. After creating a motion table, each frame must be graphed against time. Finally, the positions and timing must be measured against an actual test of similar or nearly similar conditions and the laws of physics to see if the litigant's theory of the case is even possible as a matter of physical science. In other words, the simulation must "confirm" the real graphs of position versus time; if not, the events depicted in the simulation are impossible, and the litigant's theory of the case would be implausible—a significant issue about which the jury should be made aware.

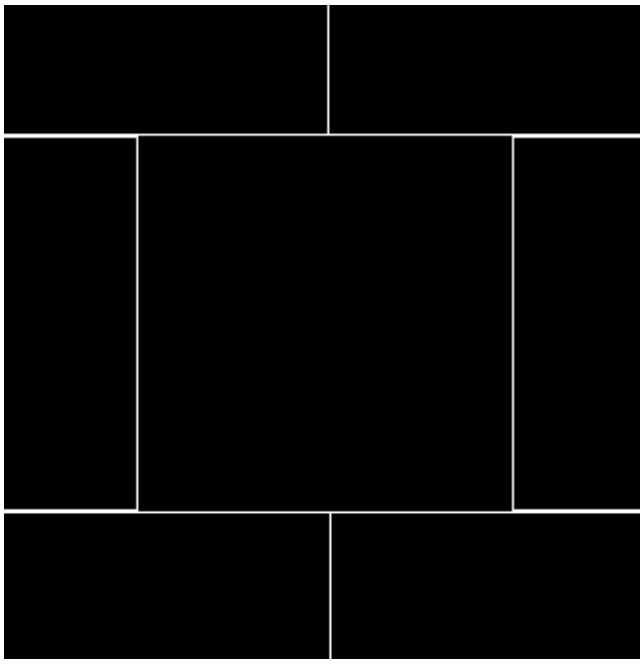
Id. at 185 n.65 (citations omitted). Under the author's system for presenting animations, the jury would not just be aware of the issue of implausibility but would *decide* the issue for itself after it has viewed every variable inputted into the final animation. In addition to its major advantage, the elimination of prejudice in the courtroom, the author's system also provides for a secondary tactical advantage of temporal control, which has been noted by Professor Galves:

> [S]howing a [computer-generated exhibit] in a controlled manner, "a little at a time" so that it "builds" as the witness's testimony proceeds, is much more effective than displaying a large static diagram, like a posterboard display that is already complete on which the witness points out different portions of the diagram as they proceed through their testimony. Indeed, a [computer-generated exhibit] that builds a complex diagram a little portion at a time is actually less of a narrative than a non-computerized exhibit of, for example, a posterboard time-line of factual events, because jurors can view or read the posterboard content before the witness gets to that portion of his testimony. A non-computerized posterboard time line of all the factual events according to a witness might be displayed in its entirety for the jury to see. The entire story would be revealed at the very beginning of the testimony—right as the witness began explaining the first item on the time line. A computerized time-line animation, on the other hand, has the benefit of revealing only one item at a time as the witness explains it. That way, the jury cannot wander ahead of the testimony and inspect later events before the witness addresses them. This is tactically more desirable because the jury's attention is exactly at the same place as the witness's testimony and the attorney has better control over what the jury is seeing as the witness is testifying.

Id. at 234-35 (footnotes omitted). Thus, the author's system for presenting CGE through IEPSs not only benefits the jury by enhancing its comprehension and eliminating the

exhibit at trial, it will have been "inoculated" against prejudice.

And now for a visual demonstration of this concept. Picture yourself as a juror hearing testimony in a products liability case that involves an allegedly faulty heart valve in a courtroom of the future. The plaintiff, a widow, has brought suit against a heart valve manufacturer for designing a faulty product. In the jury box are video monitors. On your monitor is the blank screen of plaintiff's evidence presentation software (part of his/her IEPS):



Plaintiff's expert, a pathologist, has been called to the stand. After some preliminary questions pertaining to plaintiff's expert's qualifications, the testimony that really interests you begins:[194]

Q [Plaintiff's counsel]: "Did you perform an autopsy on Mr. Smith [the victim] after his death?"

A [Plaintiff's expert]: "Yes."

Q: "And what did you find?"

A: "Upon reaching the heart, I found an artificial heart valve whose surface was covered with a blood clot, what we in the medical community call thrombosis."

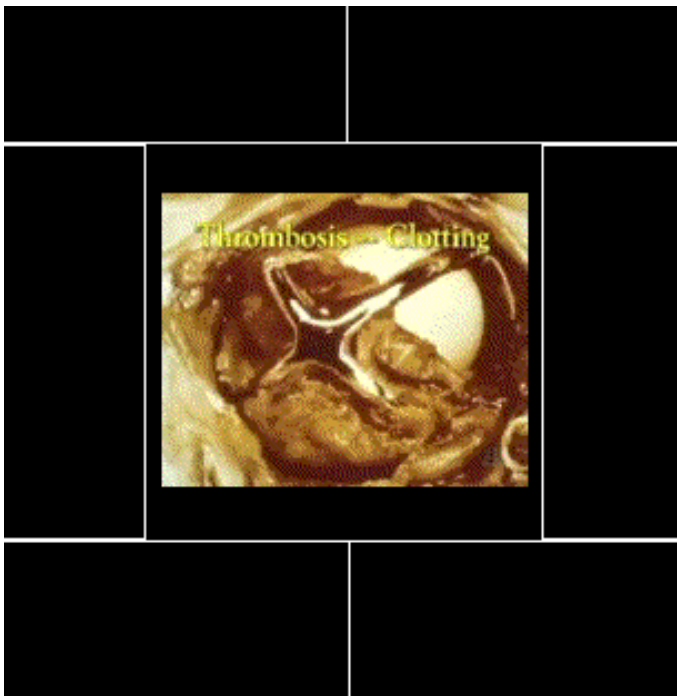
aspect of prejudice from trial but aids attorneys through giving them a tactical advantage of time-controlled understanding. Moreover, the system that the author has proposed gives attorneys yet another advantage: it prevents them from making the error of presenting CGE before a witness has testified to its substance. *See supra* notes 97-101 and accompanying text discussing narrative testimony objections under FED. R. EVID. 611(c).

[194] For the sake of simplicity, the author assumes, somewhat unrealistically, that the individual exhibits and final resulting computer animation referenced by plaintiff's expert in the following hypothetical testimony have been admitted into evidence without any objection by defense counsel.

Q: "Is this valve depicted in any of the autopsy pictures that you took?"

A: "Yes. The valve is depicted in the picture labeled 'Thrombosis—Clotting.'"

[The following picture has appeared on your monitor in the center screen]:



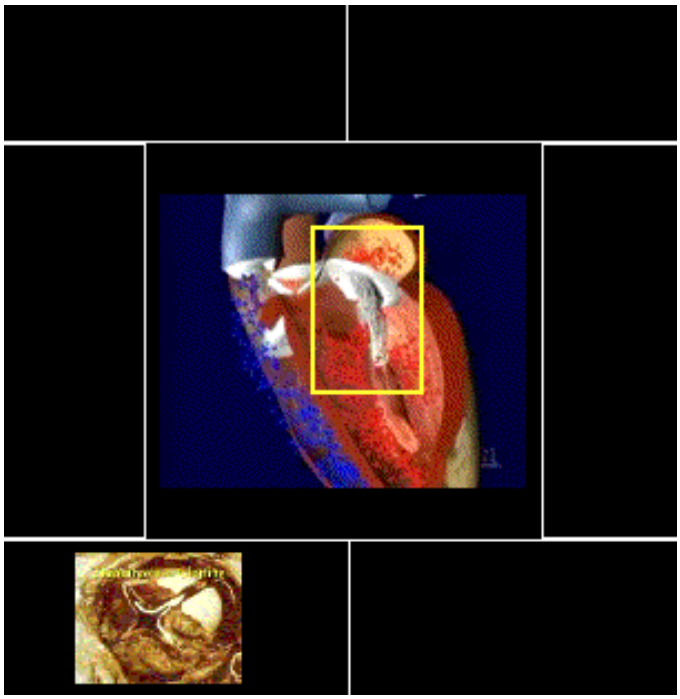
Q: "Thank you. Ladies and gentlemen of the jury, please note this picture and its label. Doctor, are you familiar with the workings of a normal heart valve?"

A: "Yes."

Q: "Could you please tell us what a normal heart valve does?"

A: "Sure. To make my explanation easier to understand, I would like to refer to the diagram that Dr. McGee [the deceased's cardiologist] used earlier."

[The following picture now appears on your center screen. Note how the picture of the thrombosis has been moved to one of the smaller frames].



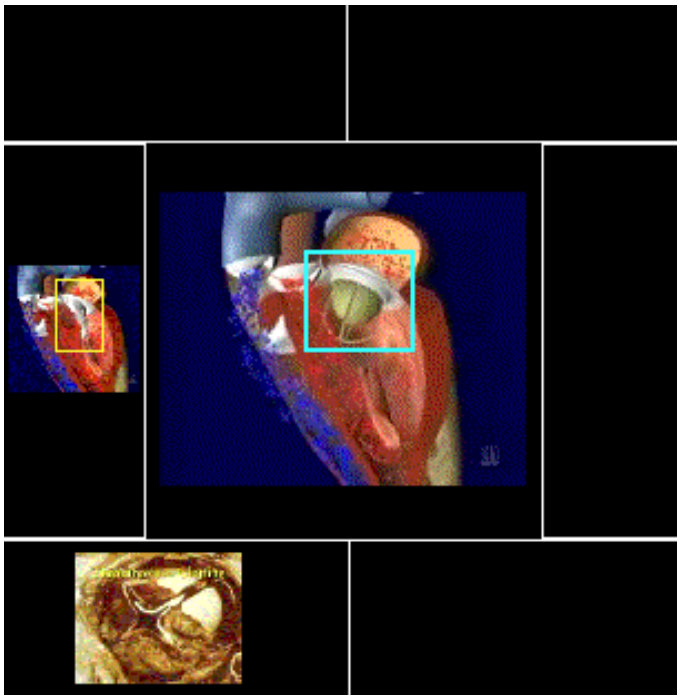
A (cont.): "As you can see, the heart has two major areas, one for deoxygenated blood, colored in blue, and one for oxygenated blood, colored in red. The mitral valve, located in the area marked by the yellow box, prevents oxygenated blood from flowing backwards into the upper chamber known as the left atrium. Put another way, the mitral valve, the valve that we're dealing with in our case today, allows blood in the left ventricle, the heart's lower-left chamber, to be pumped out of the heart through the aorta, a major artery, without leaking back into the left atrium."[195]

Q: "How then does an artificial mitral valve work?"

A: "The artificial mitral valve simply takes the place of the normal mitral valve and serves the same function. If I may again refer to one of Dr. McGee's diagrams. . ."

[Once again, another picture appears on your center screen].

[195] The author thanks his father, Dr. Neal J. Weinreb, M.D., F.A.C.P., for this paragraph of information and the information concerning hemodynamics in the next question/answer sequence. Interview with Dr. Neal. J. Weinreb, M.D., F.A.C.P., in New York, N.Y. (Oct. 2000).



"Here, the artificial mitral valve is depicted in the cyan box. Theoretically, this type of valve should create normal blood flow, also known as hemodynamics, within the heart. However, in this case, something went wrong."

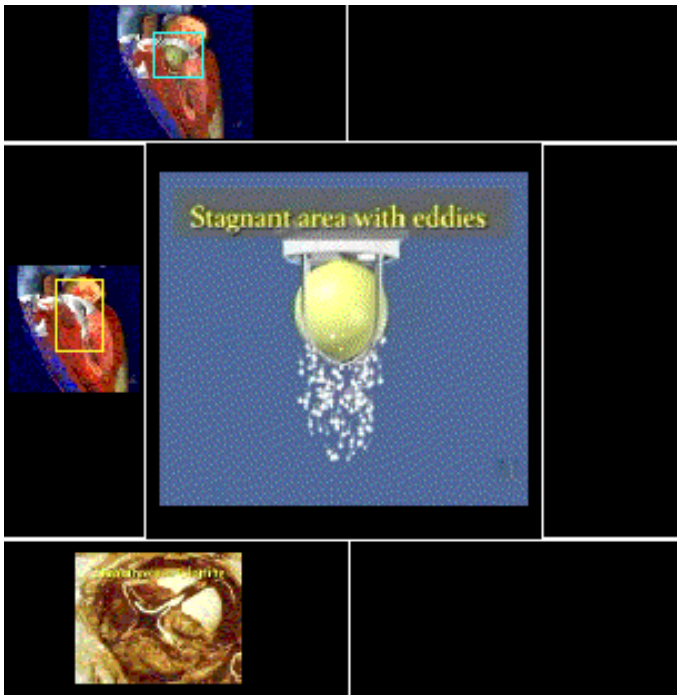
Q: "In your medical opinion, doctor, what happened in this case?"

A: "Well . . . to answer this question, I have to explain more about the workings and design of an artificial mitral valve."

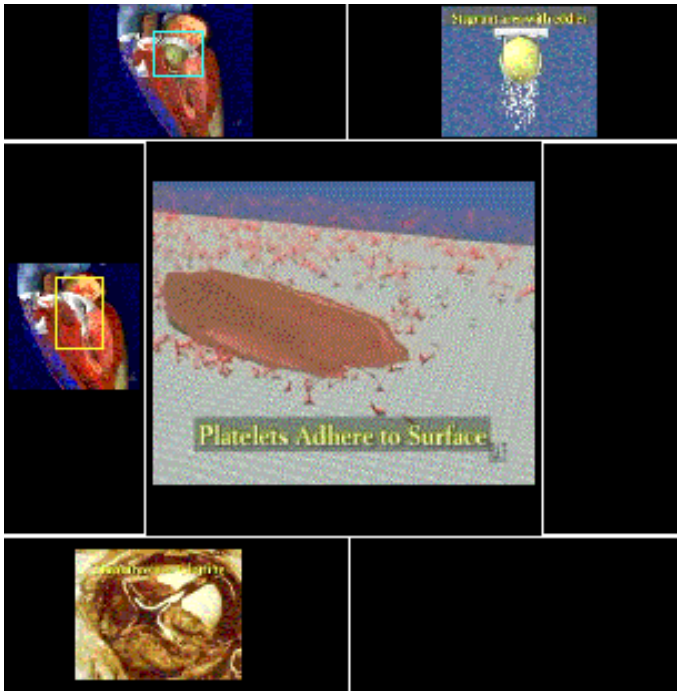
Q: "Please do so."

A: "Ok. An artificial heart valve that is properly designed is not supposed to allow for 'stagnant areas' within the heart, where blood can collect on the surface of the valve. Let me explain this further through the use of another diagram."

[Once more, you look towards the center screen of your monitor].

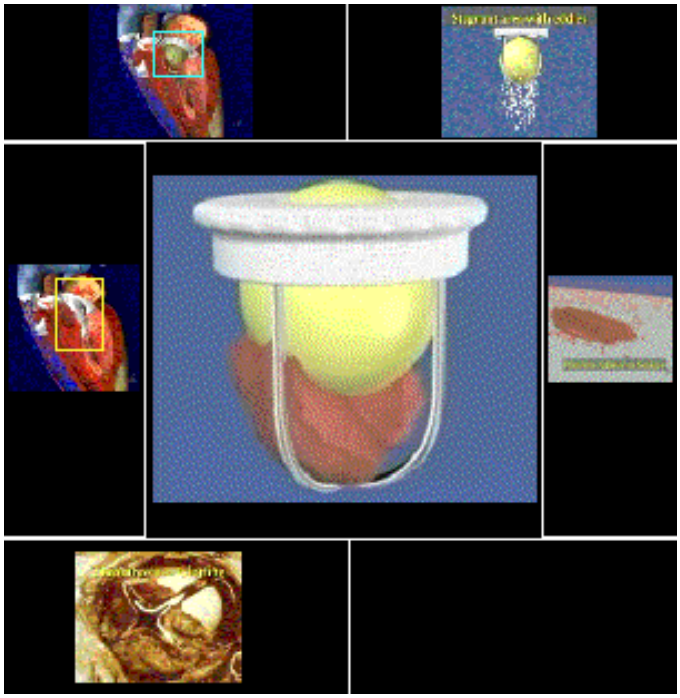


"A stagnant area is created when blood pools around the bottom of the valve. As this blood pools around the bottom surface of the valve, platelets—the elements of the blood that cause clotting—amass and cause a large clot. Another illustrative diagram will be useful again here."



A (cont'd): "Finally, the clot grows so large that the artificial mitral valve ceases to function, and blood, unable to get into the left ventricle, flows backward and causes heart failure."

[For one last time, you turn to your monitor for the placement of the final evidence variable.]



Q: "Doctor, one last question: Based upon your medical expertise and your autopsy, is it possible that a design flaw in the artificial mitral valve in this case caused Mr. Smith's heart failure?"

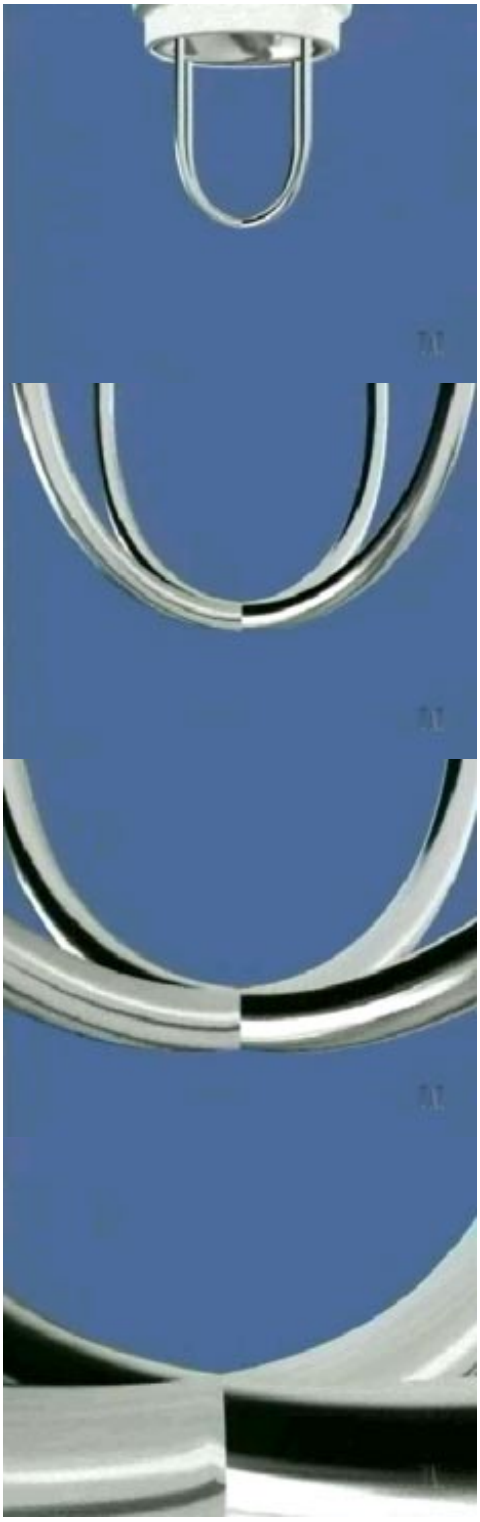
A: "Yes. I believe, based upon my autopsy and medical expertise, that Mr. Smith's valve stopped working due to a blood clot that was, in turn, a product of a design flaw in the artificial mitral valve. To summarize my findings concisely, I would like to present a computer animation of what I believe to have occurred in this case."[196]

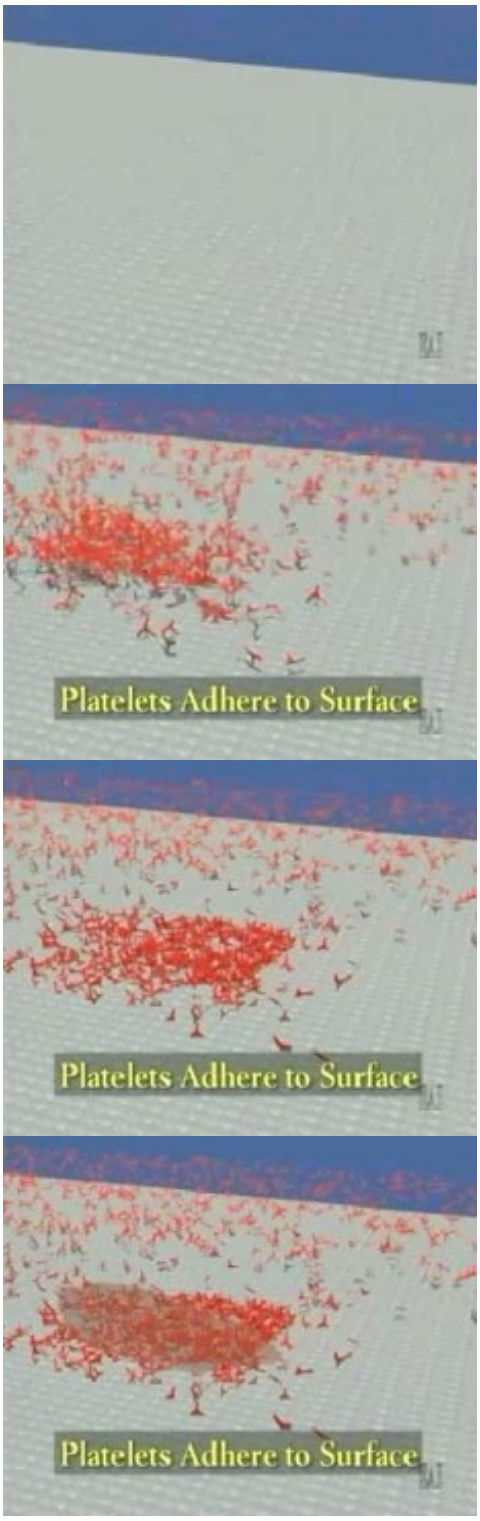
[With all the evidence variables in place, you turn your attention to the center screen].[197]

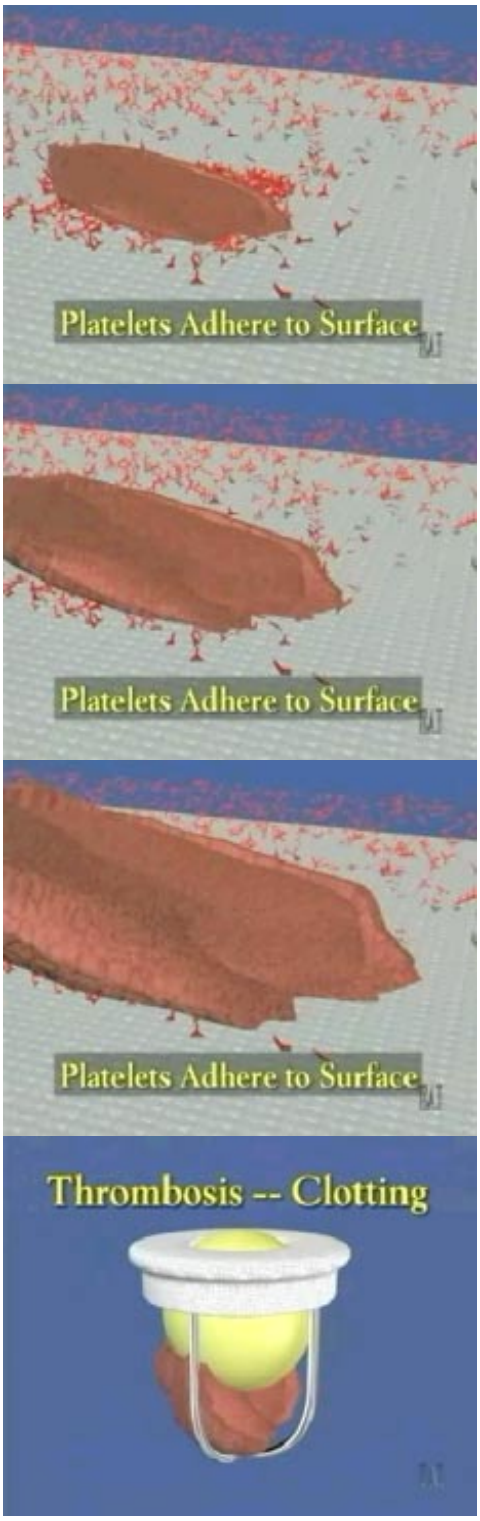
[196] The author assumes here that plaintiff's counsel has had the animation authenticated and admitted into evidence either pre-trial or at an earlier trial stage before presenting it to the jury. See *supra* notes 82-89, detailing authentication procedures for demonstrative CGE.

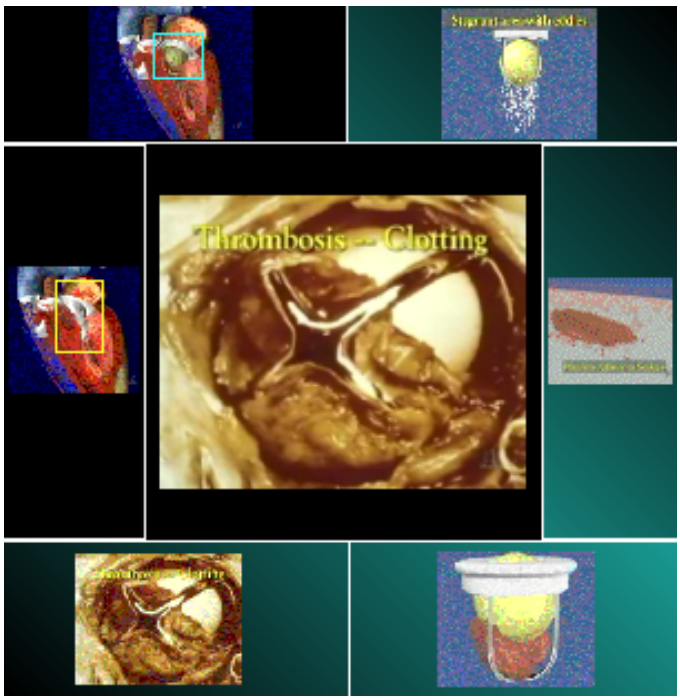
[197] To make this animation flow more smoothly on paper, the author has decided only to put the last frame of the animation in the last black center screen. Also, note the black and blue/cyan shading on the last black center screen, indicating which frames actually appeared in the animation.


Stagnant area with eddies




Platelets Adhere to Surface
Platelets Adhere to Surface
Platelets Adhere to Surface


Platelets Adhere to Surface
Platelets Adhere to Surface
Platelets Adhere to Surface
Thrombosis -- Clotting



Q: "Thank you, Doctor, for your assistance. Your Honor, I have no further questions."

Naturally, this type of presentation poses risks for the

plaintiff. If any of the individual evidence items are not portrayed as the jury would have envisioned, or if the defense counsel casts serious doubt upon the presentation's veracity through cross-examination[198] or through a counter-animation,[199] the plaintiff's animation will have failed. On the other hand, assuming that none of the underlying evidence has been tampered with, it is nearly impossible for such a presentation to be substantially more prejudicial than probative.[200] Step-by-step, the jury has witnessed each and every non-prejudicial variable used in constructing the animation, and the animation has only assisted the jury in understanding what transpired when all of these variables came together. It has thus become the ultimate in demonstrative evidence[201]—that which greatly aids the jury's understanding of testimony[202] with virtually no significant prejudicial effect—through the use of an IEPS. In summary, an IEPS, which provides an attorney with immediate access to evidence, also provides the means to integrate that evidence into a cumulative, non-prejudicial CGE presentation, which is based upon deductions instead of assumptions. In this manner, CGE's power can be adequately checked. Thus, one part of the solution to the problem of CGE prejudice is to require attorneys to construct animations step-by-step for the jury, through the use of IEPSs, in "real-time," and with precision.[203]

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[198] *See* Butera, *supra* note 10, at 521 (footnote omitted) ("Using effective cross-examination, the knowledgeable advocate can convey to both the judge and jury the unreliability of a poorly executed demonstrative computer simulation."); Clancy, Jr., *supra* note 18, at 224 ("On cross-examination, the lawyer could offer a similar [computer-generated reconstruction] with the proper alternatives to the challenged position, demonstrating a vivid alternative.").

[199] *See* Clancy, Jr., *supra* note 18, at 225 ("[T]he best way to contradict an inaccurate [computer-generated reconstruction] is with another [computer-generated reconstruction].").

[200] *See* FED. R. EVID. 403.

[201] *See* Fulcher, *supra* note 14, at 60 (footnote omitted) ("Demonstrative evidence is admitted if it fairly and accurately depicts the underlying testimony and *assists the jury in understanding that testimony.*") (emphasis added). Similarly, presentation of properly authenticated substantive CGE by a qualified expert according to the author's technique will also serve to fulfill the aim of scientific evidence. "If scientific, technical, or other specialized knowledge *will assist the trier of fact to understand the evidence or to determine a fact in issue*, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." FED. R. EVID. 702 (emphasis added).

[202] *See supra* note 159 and accompanying text.

[203] Attorneys have already begun to move in this direction. Consider the Snoop Doggy Dogg case again:

> The first portion of the video depicted a series of overhead cross-sections of the victim's body which illustrated the *exact angle of both shots*. The video's smooth motion and 3-D graphics allowed the jury to see, *from all possible angles*, the *exact entry and exit points* of both wounds sustained by the victim. Additionally, through the use of slow motion and real-time images, the defense was able to show how the angle and force of the first shot made the victim's body turn slightly, causing the second shot to enter his back. The video also re-created the

C. *Judicial Control: Prevention of Jury Prejudice Through Six Principles of Reasoning*

The other part to solving the problem of CGE prejudice is to create admissibility guidelines that will help to eliminate prejudice without mitigating the usefulness of CGE and thereby fill a gap in many jurisdictions' evidentiary laws.[204] To accomplish this goal, the judicial system must turn to experts on visual evidence.[205] One such expert is Professor Tufte, who recommends that "[v]isual representations of evidence should be governed by principles of reasoning about quantitative evidence. For information displays, design reasoning must correspond to scientific reasoning. Clear and precise seeing becomes as one with clear and precise thinking."[206]

To facilitate such thinking, Professor Tufte sets forth principles that aid reasoning about visual evidence. These include:

> scene of the shooting and illustrated: (1) *the height of the Jeep's passenger window*; (2) *the victim's height in relation to the Jeep*; and (3) *the exact distance and angle of the shots* as they traveled from the Jeep toward the victim. The defense's re-creation effectively showed jurors that the victim must have been standing near the Jeep at the time of the shooting *because of the height, angle, and distance of the shots*.

D'Angelo, *supra* note 28, at 565-66 (footnote omitted) (emphasis added). Notice, however, that the jury was not shown sequentially how the computer simulation video was constructed. Rather, the jury was simply shown the final product. Thus, while the level of precision in this presentation might have been extraordinary, the members of the jury might have been prejudiced in that they never were allowed to decide for themselves whether Snoop's defense team had accurately portrayed the individual evidence variables that comprised its animation.

[204] *See* Bray v. Bi-State Dev. Corp., 949 S.W.2d 93, 99 (Mo. Ct. App. 1997) ("Few jurisdictions have attempted to enunciate a formula or fixed set of guidelines to govern the establishment of a foundation for computer-generated evidence other than business records."). *But see id.* ("However, there is a developing consensus . . . which agrees on how the accuracy of CGE can be established and gives a trial court sufficient parameters to exercise its discretion in this area without the need for a precise formula."). However, while the consensus may be present now, there is no guarantee that it will last into the future. Two years after the court's decision in *Bray*, Judge Chasanow of the Maryland Court of Appeals explicitly requested guidance for trial judges in the area of CGE admissibility, *see supra* note 165, suggesting that the *Bray* court's consensus is not so stable after all. *See also* Butera, *supra* note 10, at 525 (footnote omitted) ("The admissibility of computer simulations continues to provide confusion for both the bench and bar."); Galves, *supra* note 5, at 221 (noting that no rule in the FRE speaks to an attorney being "too illustrative" or an expert witness being "too credible," provided that what an attorney or expert witness presents is a fair and accurate portrayal of testimony).

[205] In addition, the judicial system must turn to legal scholars for elucidation as to the scope of evidentiary standards. Since the legal aspects of these standards and recommendations for change have been discussed at considerable length elsewhere, *see generally* Galves, *supra* note 5, at 198-275, the author has limited himself to advocating changes based only upon the perceptual or visual—as opposed to legal—aspects of visual evidence. Judges may wish to consider these perceptual aspects when they inevitably encounter situations in which their discretion is necessary and admissibility standards do not provide "bright-line" answers. One such example of a "gray area" involves animations that make use of audio narration. *See* Joseph, *supra* note 101, at 335.

[206] TUFTE, *supra* note 153, at 53.

> (1) *documenting* the sources and characteristics of data [used in producing visual evidence], (2) insistently enforcing appropriate *comparisons*, (3) demonstrating mechanisms of *cause and effect*, (4) expressing those mechanisms *quantitatively*, (5) recognizing the inherently *multivariate* nature of analytic problems [that are to be solved by the evidence], and (6) inspecting and evaluating *alternative explanations*.[207]

Professor Tufte elaborates upon each of these recommendations through the case of Dr. John Snow, the famous English physician whose studies of cholera transmission allegedly stopped an epidemic that raged throughout London in 1854.[208]

It is with these principles of reasoning about visual evidence

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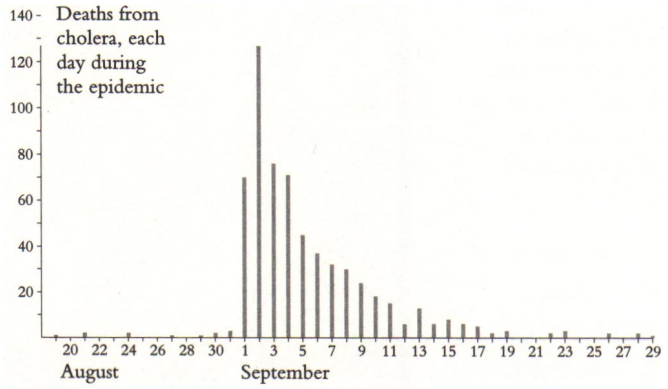
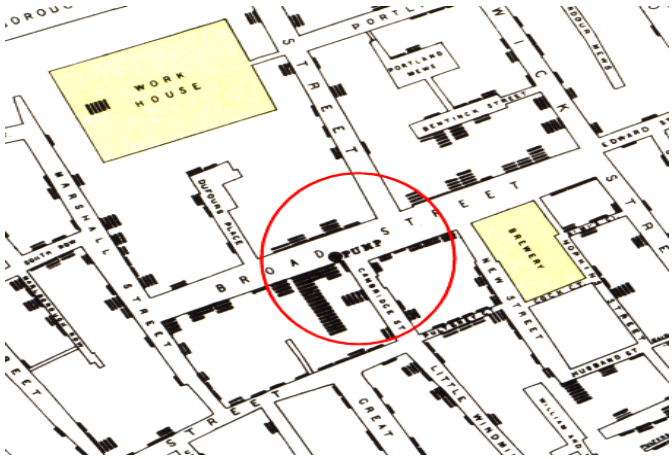
[207] *Id.* (emphasis in original)

[208] The following is a synopsis of the epidemic and Dr. Snow's application of Professor Tufte's principles of reasoning. See id. at 27-29 for further details on the history of the epidemic. Professor Tufte first notes that Dr. Snow, upon learning of the epidemic, "obtained a [dated] list of 83 deaths from cholera," *id.* at 28-29, and proceeded to graph this data and later data of other deaths according to dates of death. According to Professor Tufte, Dr. Snow's initial time-series graph would have been similar to this graph:



Id. at 29. However, Dr. Snow did not stop here but also proceeded to graph his data according to the geographical layout of London, thereby producing a map:



in mind that the judge of tomorrow should approach CGE admissibility issues in his or her courtroom when the law does not provide a clear answer. For a judge, "[t]he point is to get it right, not to win the case, not to sweep under the rug all the assorted puzzles and inconsistencies that frequently occur in collections of data."[209] These six guidelines, derived from the skepticism of science, provide a judge with a system for use in complicated CGE

See id. at 30-31. The map here is only a small portion of the central sector of Dr. Snow's original map.

Having documented his data, Dr. Snow began to make effective comparisons among the regions in the map by separating regions where casualties were high (indicated by a large number of bars (▮) from regions where casualties were low (indicated by an absence of bars). *See id.* at 30. His comparisons revealed that in the Broad Street water pump area (marked by the red circle), casualties were disproportionately high. Dr. Snow thus hypothesized that the pump's water supply was causing the epidemic. *See id*. However, the lack of deaths at the nearby brewery and the low death rate at the large prison or workhouse (both in yellow) seemed to cast doubt on this theory. *See id*. (quoting Dr. Snow's report that the workhouse had five-hundred and thirty-five inmates, yet only five died of cholera). Moreover, it was held at the time that cholera spread not through water but "through the air or by some other means. . . . [O]ne fantastic theory speculated that cholera vaporously rose out of the burying grounds of plague victims from two centuries earlier." *Id*. at 29 (footnote omitted). Additional individual deaths in outlying areas that initially appeared to be unrelated to the Broad Street pump also did nothing to support Dr. Snow's theory. *See id*. at 32. Without further investigation, there would be no way to prove that London's cholera epidemic was not the result of the city air carrying the disease or some other variable like decaying corpses producing the deadly germ.

Unwilling to admit defeat, Dr. Snow did investigate further and eventually solved the factual inconsistencies that had been posed against his theory. The workers at the brewery were found to have only imbibed beer instead of water, *see id*. at 30, the workhouse had its own well for drawing water, *see id.*, and other individual inconsistencies were eventually resolved. *See id*. at 32 (noting that cholera victims who lived some distance away from the Broad Street area still had some sort of contact with the region before they passed away). Despite the initial damaging effect of these inconsistencies, Dr. Snow did not omit them from his map and graphs, indicating his objectivity and willingness to consider other explanations. *See id*. ("Both Snow's map and the time-sequence of deaths show several apparently contradictory instances, a number of deaths from cholera with no obvious link to the Broad Street pump."). Eventually, he shut down the Broad Street pump, and the epidemic stopped afterwards. *See id*. at 33.

As a matter of technical precision, it is impossible to deduce whether or not Dr. Snow's intervention really was the cause of the end of the epidemic. *See id.* (noting that modern epidemiologists are "distinctly skeptical about the evidence that links [Dr. Snow's] intervention to the epidemic's end."). However, it is conceded that Dr. Snow proved that the disease was transmitted through water, not air. *See id.* at 29 (emphasis in original) ("He [Snow] is still celebrated for establishing the mode of cholera transmission *and* consequently the method of prevention: keep drinking water, food, and hands clear of infected sewage."). More importantly, Dr. Snow—even if his methodology was somewhat flawed by today's standards for evaluating statistical evidence, s*ee generally id.* at 35-37 (discussing the flaws of Dr. Snow's work in light of modern statistical analysis)—demonstrated all six of Professor Tufte's principles of reasoning in assessing the quality of visual evidence. *See supra* note 207 and accompanying text. Dr. Snow documented the sources and characteristics of his data, enforced appropriate quantitative comparisons through creation of his map, demonstrated mechanisms of cause and effect and expressed those mechanisms quantitatively through the *results* of his map. Furthermore, Dr. Snow recognized the inherently multivariate nature of the problem of determining disease transmission through his admission, inspection, and objective evaluation of alternative explanations to his theory.

[209] TUFTE, *supra* note 153, at 32 (footnote omitted).

cases to counter those who deliberately try to deceive the court through fabrication or manipulation of evidence.[210] To be sure, Professor Tufte's system is not fool-proof; even rocket scientists have been persuaded by faulty visual evidence to send people to their deaths.[211] However, it can be useful in certain circumstances such as presentation of a jury charge[212] and, to a certain extent, can counter the problem of fabrication or manipulation of CGE.[213]

Take, for example, the following two frames extracted from an animation[214] depicting a truck slamming into a telephone pole:

[210] *See supra* notes 150-153 and accompanying text. *See also* TUFTE, *supra* note 153, at 37 ("It is easy now to sort through thousands of plausible varieties of graphical and statistical aggregations—and then to select for publication only those findings strongly favorable to the point of view being advocated.").

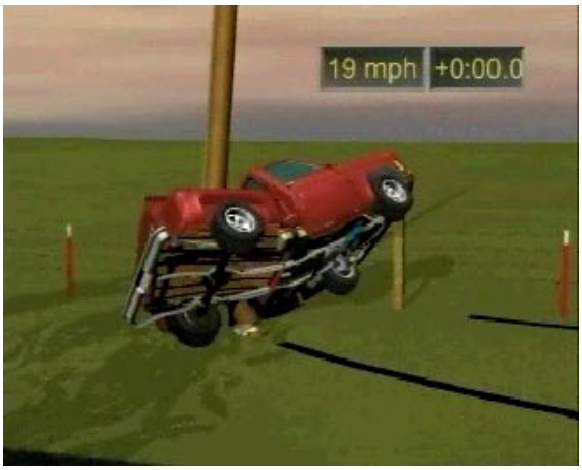
[211] *See generally id.* at 38-52 (discussing and sharply criticizing NASA's decision to launch the Challenger space shuttle).

[212] *See* Butera, *supra* note 10, at 531 (noting that a judge's evaluation of a computer-generated exhibit's visual components can be used to ensure that a jury properly considers the exhibit in rendering a verdict).

[213] *See supra* notes 150-153 and accompanying text.

[214] Galves, *supra* note 5, at 168 n.16 (images taken from Professor Galves' CD-ROM).

Frame 1



Frame 2

Were this animation composed of frames that related just to the red truck, with no other objects in play, there would be little apparent ground to challenge its admissibility.[215] The speed of the truck, the corresponding time index, and the lighting conditions at the time have all been presented to the jury up front. However, this animation originally contained three vehicles, as depicted in Frame 2. Here, a major concern arises. From looking at this

[215] This assumes, of course, that all standing evidentiary requirements that are non-discretionary have been fulfilled and that this animation's admissibility is determined by the judge's discretion. *See* Clark v. Cantrell, 529 S.E.2d 528, 537 (S.C. 2000) ("Finally, the trial court, as with other evidence and testimony, has broad discretion in whether to admit a computer animation, and its decision will be overturned only for an abuse of discretion."); Galves, *supra* note 5, at 277 ("Judicial discretion is the standard of review to admit [computer-generated exhibits] in most circumstances.").

frame of animation, it is impossible for the jury to perceive the exact speed of the other vehicles[216] relative to the truck! In other words, there is a distinct *comparison* problem associated with this animation.[217] It does not answer the significant question of "*Compared with what?*"[218] In the end, whether or not this animation will be admissible will depend upon the details of the specific case to be decided.

But this assumes that the trial judge recognized the question of comparison in the first place. In this case, without Professor Tufte's six principles in mind as a guide to evaluating visual evidence, a judge who has not handled many CGE cases could easily overlook the issue of relative speed. With the six principles in mind, the judge becomes less likely to overlook this issue because consideration of the principles makes him or her more skeptical, more inquisitive, more critical, more demanding, more analytical, and, last but certainly not least, more resistant to visual disinformation. While a master of visual disinformation may be able to outwit such a judge, it is less likely that visual evidence like the first surgeon general's sign[219] will be admitted without having raised a single question in his or her mind. In conclusion, to a certain extent, digital manipulation of evidence and design of evidence as misinformation is an unsolvable problem. However, it is a problem whose consequences can be mitigated through judicious application of Professor Tufte's six principles of visual evidence reasoning.

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[216] The speed of the other vehicles could be displayed in different colors in proximity to the displayed speed of the red truck (51 mph) so as not to interfere with the overall flow of the animation.

[217] A similar problem of relative comparison was detected in a real CGE case:

> Here, the trial court determined that the video animation Cantrell sought to introduce would confuse and mislead the jury. We agree. Cantrell's expert testified that Cantrell was driving twenty-five miles over the speed limit and that she left eighty feet of skid marks prior to the collision. The expert also testified that for the animation to be fair and accurate, it would need to show when Cantrell perceived the hazard *relative to the point of impact.* The video animation, however, is inconsistent with this testimony. *Among other inaccuracies, the video did not accurately portray Cantrell's speed.* It also depicted Anderson turning directly in front of Cantrell, which, as indicated by the eighty feet of skid marks, inaccurately depicts the physical evidence and expert testimony.

Clark, 504 S.E.2d at 613-14 (emphasis added).

[218] TUFTE, *supra* note 153, at 30 (emphasis in original) ("The deep, fundamental question in statistical analysis is *Compared with what?*").

[219] *See supra* note 153 and accompanying images and text.

CONCLUSION: TOWARDS THE FUTURE

Undoubtedly, as technology progresses, there will be an ever-increasing number of IEPS and CGE issues to resolve.[220] Society need not run from or fear these issues but should face these problems head-on[221] and solve them as they arise.[222] For now, the use of IEPSs to check CGE's awesome power, a sort of fire-fighting-fire notion, and use of Professor Tufte's six principles as visual evidence evaluation guidelines will return power back to the fact-finder in the high-tech courtroom of tomorrow and will prevent technology from wreaking havoc in our sacred halls of justice. "It is important to remind ourselves that progress is not an enemy of jurisprudence. However, clinging on to old ways stemming from an irrational fear of change is such an enemy."[223] With technology's use in the courtroom on the rise, there is no question that twenty-first century attorneys will attempt to control the horizontal and the vertical, all that a judge and jury sees and hears.[224] However, with checking technology in place and proper principles in mind, judges and juries will be able to establish outer limits[225] over their control and ensure that society continues to receive true justice.

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[220] For example, technology's progression may alter the standard of review in appellate proceedings. *See generally* Fredric I. Lederer, *The Effect of Courtroom Technologies on and in Appellate Proceedings and Courtrooms*, 2 J. APP. PRAC. & PROCESS 251, 251-74 (2000). In particular, "[i]n one sense the most sweeping change facing the appellate courts is the likely change in the record of trial from text to multi-media, a change that presents at least the possibility of affecting the standard of appellate review." *Id.* at 252.

[221] "Courts must learn to accept advances in technology, just as the public is beginning to obtain a better grasp of the basic fundamentals of computer operation." Fulcher, *supra* note 14, at 76.

[222] The author completely agrees with Professor Galves' assertion:

> Because our society is growing more complex, increasing the sophistication of many of our disputes, our laws and institutions should celebrate and welcome effective, enhanced communication in the search for justice and truth, or at least in the search for an acceptable result in a dispute in our courtrooms. . . . We should do more to adapt fully, both institutionally and individually, to the progress currently being made in communication and advocacy through computer technology.

Galves, *supra* note 5, at 172-73 (footnote omitted).

[223] *Id.* at 301.

[224] *See* Butera, *supra* note 10, at 532 ("The prepared and tenacious litigator will become knowledgeable regarding the terms, concepts, and processes involved in creating the computer simulation . . . .").

[225] Pun fully intended. *See supra* note 1 and accompanying text.