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Framing the Brain Game: Neuroimaging and Social Science as the Basis of Expert Testimony in Video Game Litigation and Regulation

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1. Introduction

Media has become an integral and omnipresent force in contemporary society. As technology has progressed, so have the forms of media that are used by the average person. After the advent of movies and television, the next level in the evolution of electronic entertainment is the video game. Video games are interactive computer programs that cover a wide range of storytelling genres.[1] Video games have become a controversial topic because, unlike the passive nature of literature and film, video games require active involvement and participation from the player.[2] They usually involve players controlling the action on screen through an avatar ("player character") and commonly perform violent acts to accomplish a goal or advance the plot of the story.[3] This level of personal involvement in virtual violence has raised moral and legal concerns about the immediate as well as long-term effects on the minds of the players as a result of playing these games.[4]

This paper looks into the use of neuroimaging techniques by experts and social scientists and its application to video games in litigious settings. This paper also explores the reliability of using neuroscience in the courtroom and the relationship between neuroscience and behavior; especially whether this information constitutes admissible and reliable expert testimony. The first section examines the background information necessary for this paper; the presence of video

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[1] "Video games create multiple worlds of fiction: some resemble reality, others are devoid of reality, and many fall somewhere in between. Some video game characters depict human beings; others represent aliens, zombies, mutants, and gods; and still others have characters that transform over the course of the game from humans into other creatures or vice versa. Some of these characters will 'suffer' injuries that would be fatal to a normal human being, but will nonetheless survive due to super powers; others may appear to die but come back to life." Ent. Software Ass'n v. Blagojevich, 404 F. Supp. 2d 1051, 1077 (N.D. Ill. 2005).

[2] "[W]hereas TV viewing is a passive pastime, videogame players actively mete out and receive destruction and death." Mary E. Ballard & J. Rose Wiest, Mortal Kombat (tm): The Effects of Violent Videogame Play on Males' Hostility and Cardiovascular Responding, 26 J. Applied Soc. Psychol. 717, 718 (1996)(citing Joel Cooper & Diane Mackie, Videogames and Aggression in Children, 16 J. Applied Soc. Psychol. 726 (1986)).

[3] "In order to succeed at a violent video game, players must identify and then choose violent strategies. Repeated violent choices result in a continuous cycle of reward. Violence is presented as justified, without negative consequences, and fun." Jeanne B. Funk, Heidi B. Baldacci, Tracie Pasold & Jennifer Baumgardner, Violence Exposure in Real-Life, Video Games, Television, Movies, and the Internet: Is there Desensitization?, 27 J. Adolescence 23, 24 (2004).

[4] American Machine Ass'n v. Kendrick, 244 F.3d 572 (7th Cir. 2001).

games in the legal sphere, a basic overview of expert testimony under the Federal Rules of Evidence, and brief descriptions of various neuroimaging techniques.[5] The next section examines the competing social scientific views on the effects of playing video games and how neuroimaging has been used to examine these effects. The final section addresses and analyzes the issues of using neuroimaging generally as well as specifically within video game litigation.

2. Lighting the Scene: Explanation of the Issues

I. More Than Just a Game?

The foremost concern is the belief that playing violent video games causes an increase in violent behavior[6] and cause a greater increase in the player's level of aggression.[7] Plaintiffs and others allege that playing violent video games can condition and teach people to respond to neutral stimuli with violent behavior and aggression.[8] There are also concerns that exposure to the specific violence in video games can desensitize[9] individuals to all other forms of violence as the players will be less empathetic to others and more accepting of violence in everyday life.[10] Those concerned assume that playing violent video games will have an adverse effect on the

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[5] There are entire articles and books that discuss the intricacies of these techniques. This paper will only have enough description to provide context on how the neuroimaging methods are used in various studies or in cases discussed infra.

[6] "Violence typically is defined by behavioral scientists as physical aggression that is so severe that the target is likely to suffer serious physical injury. [Other broader definitions of violence] include acts against inanimate objects, verbal acts, accidents, and acts of nature." William K. Ford, The Law and Science of Video Game Violence: What Was Lost in Translation, 31 Cardozo Arts & Ent. L.J. 297, 321 (2013)(citing Douglas A. Gentile et al., Public Policy and the Effects of Media Violence on Children, 1 Soc. Issues & Policy Rev. 15, 44 (2007); W. James Potter, On Media Violence, 42 (1st ed., SAGE Publications 1999)).

[7] "Aggression is behavior intended to harm another individual who is motivated to avoid that harm. It is not an affect, emotion, or aggressive thought, plan, or wish. This definition excludes accidental acts that lead to harm…but includes behaviors intended to harm even if the attempt fails[.]" Craig A. Anderson & Brad J. Bushman, Effects of Violent Video Games on Aggressive Behavior, Aggressive Cognition, Aggressive Affect, Physiological Arousal, and Prosocial Behavior: A Meta-Analytic Review of the Scientific Literature, 12 Psychol. Sci. 353, 354 (2001).

[8] L. Rowell Huesmann, The Impact of Electronic Media Violence: Scientific Theory and Research, 41 J. Adolescent Health 6, 8 (2007).

[9] Desensitization is the "habituation of certain natural emotional and physiological reactions." Jodi L. Whitaker & Brad J. Bushman, A Review of the Effects of Violent Video Games on Children and Adolescents, 66 Wash. & Lee L. Rev. 1033, 1047 (2009)(citing Jeanne B. Funk, Children's Exposure to Violent Video Games and Desensitization to Violence, 4 Child & Adolescent Psychiatric Clinics N. Am. 387, 388 (2005)).

[10] Maren Strenziok, Frank Krueger, Gopikrishna Deshpande, Rhoshel K. Lenroot, Eleke van der Meer & Jordan Grafman, Fronto-parietal Regulation of Media Violence Exposure in Adolescents: A Multi-method Study, 6 Scan 537, 538 (2011)(citing J.B. Funk et al., Violence Exposure in Real-Life, Video Games, Television, Movies and the Internet: Is there Desensitization?, 27 J. Adolescence 23 (2004)).

player's welfare and causes violent reactions.[11] Numerous studies have been conducted to test and attempt to prove these concerns.[12] The video game industry created the Entertainment Software Rating Board or ESRB in 1994 to regulate video games as a response to these studies and criticisms.[13]

This effort at self-regulation has not eliminated the concerns over violent video games and many cases are brought against the video game industry. The first type of claim is product liability where the plaintiff's alleges that video games are defective because the games' violent content "shapes behavior and causes its consumers to commit violent acts."[14] Plaintiffs also allege that the video game vendors are aware of the harm caused by their games and design them to cause this harm.[15] The courts have held that it is not feasible to assume that these companies could foresee particular consumers choosing to act violently based on images that they observed.[16]

The second type of litigation involving the video game industry are challenges against legislation that seeks to regulate and restrict violent video games from being purchased by or sold to children.[17] Fourteen states have attempted to pass specific regulations that apply directly

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[11] Douglas A. Gentile, Paul J. Lynch, Jennifer R. Linder & David A. Walsh, The Effects of Violent Video Game Habits on Adolescent Hostility, Aggressive Behaviors, and School Performance, 27 J. Adolescence 5 (2004)(finding that video games caused children to be more hostile, more likely to be involved in physical fights and to have poorer performance at school.)

[12] See generally Anderson & Bushman (2001) supra note 7; Mark Griffiths, Violent Video Games and Aggression: A Review of the Literature, 4 Aggression and Violent Behavior 203 (1999); Klaus Mathiak & René Weber, Toward Brain Correlates of Natural Behavior: fMRI during Violent Video Games, 27 Human Brain Mapping 948 (2006); Whitaker & Bushman, supra n. 9.

[13] The ESRB is a "non-profit self regulatory body that assigns ratings for video games and apps." Ratings are based on "age-appropriateness, content, and interactive elements" that are evaluated by a "consensus of at least three specially trained raters who collectively deliberate about what rating should be assigned to a game." The ratings are self-enforced by the industry and are not mandatory for publication of a game, but a majority of retailers will not stock or sell video games that do have the industry rating. ESRB website, Frequently Asked Questions, www.esrb.org/rating/faq.jsp#1 (accessed on 3/1/2014).

[14] James v. Meow Media, Inc., 300 F.3d 683, 698 (6th Cir. 2002).

[15] Wilson v. Midway Games, Inc., 198 F. Supp. 2d 167, 170 (D. Conn. 2002)(alleging that video games harm children by "brainwashing" and addicting players to the "exhilaration of violence.").

[16] Sanders v. Acclaim Ent., Inc., 188 F. Supp. 2d 1264, 1275 (D. Colo. 2002)(holding that video game makers are not required "to anticipate and prevent the idiosyncratic, violent reactions of unidentified, vulnerable individuals to their creative works" as speculative possibilities of harm are not enough to create a legal duty.)

[17] See e.g., Brown v. Ent. Merchants Ass'n, 131 S. Ct. 2729 (2011); Video Software Dealers Ass'n v. Schwarzenegger II, 556 F.3d 950 (9th Cir. 2009).

to video games.[18] Governmental bodies wish to pass these laws because of the state's interest in protecting children they want to protect children from the perceived harms of playing violent video games.[19] These challenges are made because video games are a form of speech and therefore restrictions on them must satisfy strict scrutiny review before being enacted.[20] The majority of courts that have examined these regulations have found that protecting people from psychological and neurological harm is a compelling state interest permitting regulation.[21] Video games could be restricted if these studies could show that video games actually caused someone to commit a violent act[22] or if video games cause a specific and observable increase in violent behavior/aggression that differs from other forms of media.[23] However, the research is

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[18] Cal. Civ. Code Ann. §1746.1-.5 (West 2006)(preempted 2001)(video games that are "patently offensive to prevailing standards in the community as to what is suitable for minors" must be clearly labeled and may not be sold or rented directly to minors); Ga. Code Ann. §16-12-103(2) (2005)(every video game retailer has to post an explanation of the video game rating system); 720 Ill. Comp. Stat. Ann. 5/12A (West 2006)(preempted 2006)(requires state to regulate the sale of violent video games to prevent psychological harm to minors); La. Rev. Stat. Ann. §14:91.14 (West 2006)(video games that appeals to "the minor's morbid interest in violence" must be regulated because "children are the most precious resource of the state" and video games are harmful to the child's physical and psychological wellbeing); Mich. Comp. Laws. Ann. §722.685-693(West 2005)(preempted 2006)(ultra-violent video games may not be sold to minors because of their harmful effects); Minn. Stat. Ann. §325I.06 (West 2006)(repealed 2008)(people under the age of 17 may not purchase games that have been rated AO or M by the ESRB and retailers that sell those games have to post signage in the store about the restriction); N.J. Stat. Ann. §18A:40-44 (2013)(the New Jersey Board of Education recommends that parents reduce a child's exposure to violent video games and distributes information about the adverse effects of violent video games on children); N.Y. Gen. Bus. Law §612 (McKinney 2008)(ESRB ratings must be displayed prominently on the video game's packaging before it may be sold); Ok. Stat. Ann. tit. 21 §1040.75(3)(2006)(stating media that contains "inappropriate violence" is harmful to minors); Tenn. Code Ann. §39-17-301(West 2013)(material that contains "excess violence" may not be purchased, leased, or rented to minors); Rev. Code Wash. Ann. §19.188.010 (West 1994)(state has found that it has a duty to protect public health and safety because electronic media is "conducive to increased violent behaviours, especially in children."); Rev. Code Wash. Ann. §19.188.040 (West 2005)(video game retailers are required to inform the consumer about the existence of the ESRB rating system); Rev. Code Wash Ann. §9.91.180 (West 2003)(preempted 2004)(selling violent video games to minors is a civil infraction punishable by penalties); D.C. Code Ann. §28-3906(a)(2A) (West 2007)(creation of a consumer education program about "educat[ing] consumers about the appropriateness of video and computer games for certain age groups.").

[19] "[C]hildren are the most precious resource of this state and they are worthy of special protection from their government and that the State of Louisiana has an interest in protecting minors from physical, psychological, and financial harm." Ent. Software Ass'n v. Foti, 451 F. Supp. 2d 823, 829 (M.D. La. 2006).

[20] "Like the protected books, plays, and movies that preceded them, video games communicate ideas–and even social messages–through many familiar literary devices...and through features distinctive to the medium. That suffices to confer First Amendment protection." Brown, 131 S. Ct. at 2733.

[21] "If exposing minors to depictions of violence in video games makes them experience feelings of aggression and exhibit violent antisocial or aggressive behavior, the state could have a compelling interest in restricting minor's access to such material." Video Software Dealers Ass'n v. Schwarzenegger I, 2007 WL 2261546 at *6 (N.D. Cal. 2007); but see Foti, 451 F. Supp. 2d at 832(stating that government cannot limit speech "merely because it dislikes the way that expression shapes and individual's thoughts and attitudes" on a general belief of psychological harm.)

[22] Kendrick, 244 F.3d 572 at 579.

[23] Brown, 131 S. Ct. at 2732.

insufficient to prove these facts and so most of these regulations have been preempted or repealed.[24]

II. Basics of Expert Testimony

If evidence of harm from playing video games exists, it should be explained by a qualified expert.[25] But before evidence can be introduced, the court must determine if the evidence is relevant and reliable.[26] One standard for determining the reliability of expert testimony is the "general acceptance test" from Frye.[27] The Frye court held that novel scientific methods are admissible only if the methods have "gained general acceptance in the particular field in which it belongs."[28] Under Frye, judges defer in part to other experts in the field to determine the reliability and admissibility of the expert's offered methodology.

The majority rule alternative to Frye was created by the Supreme Court of the United States in a series of cases collectively referred to as the Daubert trilogy.[29] Under Daubert, judges independently ensure the relevance and reliability of expert testimony by considering it under certain factors.[30] These factors generally are; (1) testability of the methodology,[31] (2) peer-review,[32] (3) potential error rate,[33] and (4) general acceptability in the field.[34] Currently, federal

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[24] See n. 18 supra.

[25] Experts may testify if they are qualified by "knowledge, skill, experience, training or education" in some scientific, technical, or other specialized knowledge" that helps "the trier of fact to understand the evidence or to determine a fact in issue." Fed. R. Evid. 702. Additionally the expert's qualification must "be grounded in an accepted body of learning or experience in the expert's field." Fed. R. Evid. 702 advisory comm. n. (citing American College of Trial Lawyers, Standards and Procedures for Determining the Admissibility of Expert Testimony after Daubert, 157 F.R.D. 571, 579 (1994)).

[26] "Evidence is relevant if: (a) it has any tendency to make a fact more or less probable than it would be without the evidence; and (b) the fact is of consequence in determining the action." Fed. R. Evid. 401.

[27] Frye v. U.S., 293 F. 1013 (D.D.C. 1923)(expert testified for using systolic blood pressure as a deception test)

[28] Id. at 1014.

[29] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993); General Electric Co. v. Joiner, 522 U.S. 136 (1997); Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).

[30] There are many other factors that the court may take into consideration to make its determination but the listed factors are the ones that were later incorporated into the Federal Rules of Evidence. A factor should be used if it is applicable to the case at hand. The court does have discretion in determining the admissibility of experts to a point but the court may not abuse this discretion and prohibit otherwise relevant expert testimony. See Joiner, 522 U.S. 136.

[31] Testability requires the bases of the expert's opinion to have been tested by other persons within the field of study. Daubert, 509 U.S. at 593.

[32] The policy reasoning is that if the theory or technique has been examined by others in the field, they can lend more credence to the reliability of the methodology used to create the expert's opinion. Id. at 594

[33] Id. at 593.

courts examine all expert evidence under these factors regardless of whether or not it is scientific.[35]

Additionally, the Federal Rules of Evidence requires that a qualified expert use "sufficient facts or data" in conjunction with "reliable principles and methods" to come to their opinion.[36] The general acceptance standard applies to the expert's methodology and not her conclusion.[37] General acceptance reliability in the scientific field differs somewhat from the legal standard of reliability.[38] Scientifically speaking, general acceptance in the field is based more on scientific validity rather than reliability.

Expert testimony must also satisfy a fitness requirement which requires the "expert's opinion logically relate [sic] to some specific issue in dispute under the substantive law" and the "basis for the expert's opinion generalizes to a legal issue in dispute."[39] Even scientifically reliable and valid testimony will be excluded if it is unfit.[40]

III. Neuroimaging Techniques and Uses

Neuroimaging is one example of a specialized field in video game litigation that requires expert testimony. Neurologists can use different images created by various methods to evaluate brain structure and functions. Many experts claim that they can then use these images to explain what effects, if any, that violent video games would have on actions and behaviors. Neuroimaging is divided into two basic categories: functional and structural. Functional neuroimaging looks at how the brain functions while it performs a task over a period of time

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[34] The court incorporated the Frye standard to be considered in addition to the other factors instead of eliminating it entirely. Id. at 594.

[35] Kumho, supra note 28 (holding that the Fed. R. Evid. uses a flexible test that errs on the side of admissibility and since the rule language makes no distinction between scientific and specialized knowledge, than neither should the court).

[36] Fed. R. Evid. 702(b),(c), and (d).

[37] Grady v. Frito-Lay, Inc., 839 A.2d 1038 (Pa. 2003).

[38] A principle is scientifically valid when it supports what it attempting to show. This differs from reliability which is when the application of the scientific principle produces consistent results. Daubert, 509 U.S. at 590 n. 9 (1993)(citing Bert Black, A Unified Theory of Scientific Evidence, 56 Fordham L. Rev. 595, 599 (1988)).

[39] David L. Faigman, Admissibility of Neuroscientific Expert Testimony, in A Primer on Criminal Law and Neuroscience 89, 93 (Stephen J. Morse & Adina L. Roskies eds., Oxford U. Press 2013).

[40] "Expert testimony which does not relate to any issue in the case is not relevant and, ergo, non-helpful." Daubert, 509 U.S. at 591(citing 3 Weinstein & Berger ¶ 702[02], p. 702–18).

whereas structural neuroimaging takes a static image of a brain's underlying structure.[41] Structural imaging "provides images of gross anatomical features, but not of underlying neuronal or metabolic activity" which is observed through functional imaging techniques.[42] Each imaging method has its own strengths and weaknesses and it is the neurologist's responsibility to determine which method should be used.

An example of structural neuroimaging tests are Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT). In these tests, a radioactive organic tracer is injected into the bloodstream.[43] The tracer emits nuclear decay as it metabolized.[44] The rate of metabolism is proportional to the level of activity in the brain.[45] The image created is a computer analysis of the brain's metabolic activity.[46] PET and SPECT differ mainly based on the differing metabolism and rate of decay of the type of tracer used. SPECT tracers have a longer half-life for decomposition but have a slower rate of decay so the images that are created are less accurate but more clear than PET images.[47]

Electroencephalography (EEG) is a non-invasive structural imaging method that measures and "records the electrical current produced by the brain activity measured via electrodes attached to the subject's scalp."[48] Accuracy of an EEG is limited because it measures electric signals from the scalp and not the brain as a whole.[49]

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[41] Structural neuroimaging creates "extremely detailed images of soft tissue, [but] these images are static [and] they do not reflect change over time unless the time scale is large on the order of days or years." In contrast, functional neuroimaging techniques can create images rapidly and show changes that occur in seconds but the increased speed of imaging sacrifices the clarity of the images created. Charles Adelsheim, Functional Magnetic Resonance Detection of Deception: Great as Fundamental Research, Inadequate as Substantive Evidence, 62 Mercer L. Rev. 885, 890 (2011).

[42] Teneille Brown & Emily Murphy, Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States, 62 Stan. L. Rev. 1119, 1127 (2010).

[43] Susan E. Rushing et al., PET and SPECT, in Neuroimaging in Forensic Psychiatry 4, 9 (Joseph R. Simpson ed., 1st ed., Wiley-Blackwell 2012).

[44] Jane C. Moriarty, Flickering Admissibility: Neuroimaging Evidence in the U.S. Courts, 26 Behav. Sci. & L. 29, 31 (2008).

[45] Id.

[46] Id. (citing Francine Cournos & Debroah L. Cabaniss, Clinical Evaluation and Treatment Planning: A Multimodal Approach, in Psychiatry 478 (Allan Tasman et al., eds., 2d ed. 2003); Rushing et al., supra n. 42 at 9.

[47] Id., at 32.

[48] Brown & Murphy, supra n.41.

[49] Id.

A neurologist may also use Magnetic Resonance Imaging (MRI) to look at the soft tissue structures of the brain. This method of structural imaging works by aligning the naturally occurring but chaotic magnetic fields within the body.[50] The neurologist then uses a radio frequency pulse to excite the magnetic field in the brain which breaks the alignment that has been created by the MRI machine.[51] A computer then analyzes the changes in these excited portions of the brain (which are called "voxels") and combines this information to make an image.[52]

One of the most favored methods of functional neuroimaging is Functional Magnetic Resonance Imaging (fMRI).[53] In fMRI, dynamic measurements are made of the brain functions over time.[54] The images are created by measuring changes in the ratio of oxygenated to deoxygenated blood being supplied to different portions of the brain while an individual performs a particular task chosen by the fMRI operator.[55] This measurement is based on the "Blood Oxygen Level Dependent" or BOLD response and is possible because the magnetic reactions of iron in hemoglobin can change based on the level of oxygen saturation in the blood.[56] Teneille Brown and Emily Murphy explain,

> In simple terms, when a region of the brain is "activated" in response to a perception or to enable a behavior, that region receives more oxygenated blood. Because oxygenated blood behaves differently in a magnetic field, the large magnet in the fMRI device can measure this influx. If the local oxygen use is more than adequately supplied by the influx of blood, then a positive BOLD response will result. If the local demand for oxygen exceeds that provided by the regional flow, then a negative BOLD response will result.[57]

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[50] Adelsheim, supra n. 40 at 888 (citing Scott A. Huettel, Allen W. Song & Gregory McCarthy Functional Magnetic Resonance Imaging (1st ed., Sinauer Assoc., Inc. 2004)).

[51] Adelsheim, supra n. 40.

[52] Owen D. Jones, Joshua W. Buckholtz, Jeffery D. Schall & René Marois, Brain Imaging for Legal Thinkers: A Guide for the Perplexed, 2009 Stan. Tech. L. Rev. 5, 17 (2009).

[53] Walter Sinnott-Armstrong, Adina Roskies, Teneille Brown & Emily Murphy, Brain Images as Legal Evidence, 5 Episteme 359, 361 (2008)

[54] "At its most basic, fMRI can be understood as a tool for learning which regions of the brain are working, how much, and for how long, during particular tasks." Jones et al., supra n. 51 at 17.

[55] Sinnott-Armstrong et al., supra n. 52 at 361.

[56] See Erin D. Bigler, Mark Allen & Gary K. Stimac, MRI and Functional MRI, in Neuroimaging in Forensic Psychiatry 27, 32 (Joseph R. Simpson ed., Wiley-Blackwell 2012).

[57] Brown & Murphy, supra n.41 at 1139.

The uses of neuroimaging both in and out of the courtroom have expanded and progressed along with technology itself. In the medical field, neuroimaging techniques are mainly used for diagnostic purposes, such as determining if a patient has suffered some sort of brain damage.[58] In the legal field, attorneys are attempting to introduce neuroimaging as substantive proof to "causally link the image to the litigant's behavior" or mental state.[59] It has been proposed that neuroimaging can be used to predict future dangerousness.[60] Some experts claim that neuroimaging techniques can be used in criminal trials to determine a defendant's intent or guilt.[61] Other experts state that neuroimaging can be used as a type of lie detection.[62] Still others use neuroimaging to establish an affirmative defense for insanity.[63] However, even with all of these possible uses, not every jurisdiction has recognized neuroimaging as a proper basis for expert testimony in all instances.[64] While the rules of evidence encourage admissibility,[65] judges have discretion in admitting evidence that will be heard by a jury and can choose to exclude it if necessary to prevent confusion.[66] Even if neuroimaging shows activation in particular brain structures while a particular task is performed, these images should not be admissible as substantial proof of a particular behavior and the court should limit this testimony to medical diagnosis at this time.[67]

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[58] Moriarty (2008), supra n. 43 at 40.

[59] Jane C. Moriarty, Daniel D. Langleben & James M. Provenzale, Brain Trauma, PET Scans and Forensic Complexity, 31 Behav. Sci. & L. 702, 709 (2013)

[60] J. W. Looney, Neuroscience's New Techniques for Evaluating Future Dangerousness: Are We Returning to Lombroso's Biological Criminality?, 32 UALR L. Rev. 301 (2010).

[61] Sinnott-Armstrong et al., supra n. 52.

[62] Jane C. Moriarty, Visions of Deception: Neuroimages and the Search for Truth, 42 Akron L. Rev. 739 (2009).

[63] Nathan J. Kolla & Jonathan D. Brodie, Application of Neuroimaging in Relationship to Competence to Stand Trial and Insanity, in Neuroimaging in Forensic Psychiatry 147 (Joseph R. Simpson ed., Wiley-Blackwell 2012).

[64] Lyn M. Gaudet, Julia R. Lushing & Kent A. Kiehl, Functional Magnetic Resonance Imaging in Court, 5(2) Am. J. Bioethics Neuroscience 37, 44 (2014)(citing U.S. v. Semrau, 693 F.3d 510 (6th Cir. 2012) where the court found that fMRI evidence lacked general acceptance and established error rates and standards to be admissible as substantive evidence of veracity.)

[65] See Daubert, 509 U.S. at 579(finding that the "liberal thrust" of the rules of evidence lean toward admissibility.)

[66] "The court may exclude relevant evidence if its probative value is substantially outweighed by a danger of one or more of the following: unfair prejudice, confusing the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence." Fed. R. Evid. 403.

[67] "[T]he current use of fMRI findings to establish the cause of certain behaviors, or responsibility, motivation, or propensity for them is premature and ignores the complexity of brain function." Laura S. Khoshbin & Shahram Koshbin, Imaging the Mind, Minding the Image: An Historical Introduction to Brain Imaging and the Law, 33 Am. J.L. & Med. 171, 172 (2007).

3. Setting up the Shot: Competing Positions

I. Developing Images: Expert Testimony in Video Game Litigation

Some proponents are advocating not only that neuroimaging is a proper basis for expert testimony, but that these images can be used to prove that media violence causes psychological and neurologic harm.[68] There have been a multitude of studies that have examined the relationship between observing violent media and levels of aggressive/violent behavior.[69] Though violent video games are a relatively new concern there is well-established research on the effects of violent passive media which can be used as foundation for video game research.[70] Dr. Craig A. Anderson created the "General Learning Model" (GLM) [71] to explain the harm that is caused by violent media and video games.[72] It is his opinion that video games cause harm by teaching and priming people to respond to stimuli with aggression based on their previous observations of aggression and violence. [73] Therefore players will be more likely to respond to a broader range of situations with violence because they have learned through playing video games that violence and aggression are a viable response to most stimuli. Additional studies claim that repeated exposures to violence have a negative effect on players by habituating violence which allows players to "think about and plan proactive aggressive acts without experiencing negative affect."[74]

Studies have observed that players often will have a physical as well as psychological reaction when playing video games. Most often the researchers observed players having

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[68] See Kevin W. Saunders, A Disconnect Between Law and Neuroscience: Modern Brain Science, Media Influences, and Juvenile Justice, 2005 Utah L. Rev. 695 (2005).

[69] See generally Brown, 131 S. Ct. at 2772-2779(Breyer, J., dissenting) for an appendix of over a hundred studies on the effects of video games that have been reviewed by the court.

[70] Karen E. Dill & Jody C. Dill, Video Game Violence: A Review of the Empirical Literature, 3(4) Aggression & Violent Behavior 407, 409 (1998).

[71] Christopher P. Barlett, Craig A. Anderson & Edward L. Swing, Video Game Effects–Confirmed, Suspected, and Speculative. A Review of the Evidence, 40 Simulation & Gaming 377, 379 (2009).

[72] There many other theories on how video games affect players psychologically such as the social learning theory or the general arousal model but most of the scientific literature that the court relies on is Anderson's. See generally John L. Sherry, The Effects of Violent Video Games on Aggression: A Meta-Analysis, 27 Human Commun. Research 309 (2001).

[73] "Violent video game exposure may shape the player's behavior because constant playing reinforces the belief that hurting others is a successful way to resolve conflict." Barlett et al., (2009) supra note 70 at 380

[74] Huesmann (2007), supra note 8 at 8.

increases in blood pressure, heart rates and skin conductance from playing video games.[75] The player's physiological responses change based on the type of game they are playing and proportionally increase based on the level of violence in the game.[76] These physiological reactions can affect how the player interprets emotions and behavioral responses.[77]

A linkage between physiological responses to psychological stimuli infers that there could be neurologic responses to playing video games. If so, then these neurologic responses could be observed using neuroimaging techniques. [78] For example, M. J. Koepp performed a PET scan using tracers that attached to dopamine[79] receptors and observed that there was an increase in the amount of dopamine when people played violent video games.[80] Dopamine release is most often associated with the brain attempting to learn a behavior. This could mean that violent video games are teaching violent behaviors to impressionable players.

Additionally, there are studies that have been conducted that allege that there is a link between activation in certain brain structures and certain behaviors like aggression.[81] It can be assumed that if similar activation occurs in the portions of the brain that are linked to aggression while people are playing video games then video games caused that activation. In one such study, Dr. Bruce D. Barthalow observed via EEG that exposure to images from violent video games resulted in a "reduction of normal inhibitions against aggression and [made] individuals less responsive to the pain and suffering experienced by victims of violence."[82] He

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[75] Barlett et al., (2009) supra note 70 at 380.

[76] René Weber, Ute Ritterfeld & Anna Kostygina, Aggression and Violence as Effects of Playing Violent Video Games, in Playing Video Games: Motives, Responses, and Consequences 347, 352 (Peter Vorderer & Jennings Bryant eds., Taylor & Francis 2009)(citing Douglas A. Gentile, Paul J. Lynch, Jennifer R. Linder & David A. Walsh, The Effects of Violent Video Game Habits on Adolescent Hostility, Aggressive Behaviors, and School Performance, 27 J. Adolescence 5 (2004)).

[77] Whitaker & Bushman, supra n. 9 at 1039.

[78] Mary E. Ballard & J. Rose Wiest (1996), supra note 2.

[79] Dopamine is a neurotransmitter that is associated with the "anticipatory or appetitive phase of motivated behavior, where dopamine is involved in learning which environmental stimuli or actions predict rewarding or aversive outcomes" in animal studies. M. J. Koepp, R. N. Gunn, A. D. Lawrence, V. J. Cunningham, A. Dagher, T. Jones, D. J. Brooks, C. J. Bench & P. M. Grasby, Evidence for Striatal Dopamine Release During a Video Game, 393 Nature 266, 266 (1998).

[80] Saunders, supra n. 67 at 728(citing M. J. Koepp et al., 393 Nature at 266).

[81] Jana L. Bufkin & Vickie R. Luttrell, Neuroimaging Studies of Aggressive and Violent Behavior: Current Findings and Implications for Criminology and Criminal Justice, 6 Trauma Violence & Abuse 176 (2005).

[82] Bruce D. Bartholow, Brad J. Bushman & Marc A. Sestir, Chronic Violent Video Game Exposure and Desensitization to Violence: Behavioral and Event-Related Brain Potential Data, 42 J. Experimental Soc. Psychol. 532 (2005).

reported that "[r]epeated exposure to media violence...reduces [violence's] psychological impact and eventually produces aggressive approach-related motivational states, theoretically leading to stable increases in aggression."[83]

By using an fMRI, Dr. William G. Kronenberger and his colleagues detected the effect of media violence on brain activity in average children compared to children with disruptive behavior disorders.[84] They found that there was a decrease of brain activity in structures assumed to control executive functions.[85] This was significant because executive functions control impulsive behavior and personal restraint.[86] Decreases in these behaviors can lead to an overall increase in violent behavior because the person can longer prevent themselves from engaging in violent actions.[87]

While there are some studies that have attempted to prove causation, most of the research on the effects of media violence is correlational.[88] The cumulative correlational effect of these studies is sufficient to prove the harm that is caused by violent video games and other violent media even if causation has not been shown.[89] Causation data is always preferred but "correlational evidence can also be used to support causal arguments" and the lack of causative information is not damning to show proof.[90] Statistically speaking, the relationship between media violence and aggression is almost on par with the averaged correlational relationship between smoking and lung cancer.[91] Even though every person who smokes may not get lung

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[83] Id. at 532.

[84] William G. Kronenberger, Vincent P. Mathews, David W. Dunn, Yang Wang, Elisabeth A. Wood, Ann L. Giauque, Joelle J. Larsen, Mary E. Rembusch, Mark J. Lowe & Tie-Qiang Li, Media Violence and Executive Functioning in Aggressive and Control Adolescents, 61 J. Clinical Psychol. 725 (2005).

[85] Id.

[86] Id.

[87] "[F]ailure or deficit in the executive functioning area is likely to underlie impulsive, poorly planned, aggressive behavior." Id. at 725.

[88] "Experimental studies have shown that playing violent video games directly *causes* players to behave more aggressively." Whitaker & Bushman, supra n. 9 at 1037(emphasis supplied)(citing Craig A. Anderson & Brad J. Bushman, The Effects of Media Violence on Society, 295 Science 2377 (2002)).

[89] "At this time, well over 1000 studies...based on over 30 years of research, is that viewing entertainment violence can lead to increases in aggressive attitudes, values and behavior, particularly in children." Congressional Public Health Summit, Joint Statement on the Impact of Entertainment Violence on Children, http://www.psychology.iastate.edu/faculty/caa/VGVpolicyDocs/00AAP%20-%20Joint%20Statement.pdf (accessed on 4/19/2014).

[90] Ford, supra n. 6 at 346 (citations omitted).

[91] Huesmann (2007), supra note 8 at 11.

cancer that does not mean that smoking is not dangerous: even though every child that plays video games does not harm others that does not mean that they are not being affected negatively by video games.[92] While proof of causation would be helpful for the courts, social scientists do not consider it necessary to show that the harm from violent video games definitively exists.[93]

II. Negative Exposure: Issues with Expert Testimony in Video Game Litigation

Though researchers may be satisfied with correlational results, the courts require proof of causation before restricting the fundamental right to speech that encompasses video games.[94] While there have been many studies on the alleged harm caused by video games none of them have been able to definitively prove that video games caused an individual to harm another person.[95] The most that these studies can show is correlation and even so, most researchers overestimate the effect that video games have on players.[96] While there is a good deal of research on the speculative link between video games and behavior, none of it has been able to authoritatively prove that video games cause violence to the satisfaction of the court.[97] Every court has rejected every expert and every study that claims an increase in aggression or violent behavior causally stems from playing violent video games.[98]

Researchers are unable to determine what causes these behaviors because there are a "constellation of risk factors for aggressive or anti-social behavior."[99] There are a multitude of

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[92] Saunders, supra n. 67 at 725.

[93] "[T]he scientific debate about whether exposure to media violence causes increases in aggressive behavior is over and should have been over 30 years ago." Ford, supra n. 6 at 297(quoting Craig A. Anderson, Douglas A. Gentile & Katherine E. Buckley, Violent Video Game Effects on Children and Adolescents, 4 (1st ed., Oxford University Press 2007)).

[94] Schwarzenegger II, 556 F.3d at 962.

[95] "[Researchers have failed to present substantial evidence showing that playing violent video games causes minors to have aggressive feeling s or engage in aggressive behavior. At most, researchers have been able to show a correlation between playing violent video games and a slightly increased level of aggressive thoughts and behavior." Blagojevich, 404 F. Supp. 2d at 1074.

[96] "None of the research establishes or suggests a causal link between minors playing violent video games and actual psychological or neurological harm, and inferences to that effect would not be reasonable. In fact some of the studies caution against inferring causation." Schwarzenegger II, 556 F.3d at 964

[97] See Foti, 451 F. Supp. 2d at 832 (finding that the connection between violent video games and negative effects on minors was "tenuous and speculative").

[98] See e.g., Brown, 131 S. Ct. 2729; Foti, 451 F. Supp. 2d 823; Ent. Software Ass'n v. Granholm, 426 F. Supp. 2d 646 (E.D. Mich. 2006); Ent. Software Ass'n v. Hatch, 443 F. Supp. 2d 1065 (D. Minn. 2006); Interactive Digital Software Ass'n v. St. Louis Co. Mo., 329 F.3d 954 (8th Cir. 2003); Video Software Dealers Ass'n v. Maleng, 325 F. Supp. 2d 1180 (W.D. Wash. 2004).

[99] Maleng, 325 F. Supp. 2d at 1188.

other factors that are much more likely to cause violent behavior and aggression, such as drugs, alcohol or child abuse. [100] A weakness of many of the studies and meta-analysis that claim that video games cause violent behavior is a failure to control or even consider these other factors in their results. In meta-analyses that correct for these factors, there are substantial decreases in the correlational relationship between violent video games and negative effects on subjects.[101]

Researchers are unable to come to a consensus on the cognitive process behind aggression and violence and how these behaviors manifest in neuroimaging.[102] Violence is a multifaceted concept and at this time there is no definitive link between particular brain structure and violent behavior.[103] Some experts claim that aggression and violent behaviors manifest from the prefrontal lobe while others link this behavior to other portions of the brain. [104] Other research states that violence is not controlled by just one portion of the brain but multiple sections working in synchronicity. [105] The brain is exceedingly complex and there is "virtually no one-to-one mapping of a particular function to a particular brain region." [106] Since any behavior cannot be attributed to one portion of the brain then it is unlikely that any one factor—like video games—can be the definitive catalyst of violent behavior as is claimed.[107]

Neuroimaging may be able show what the structure the brain is in or that the brain is functioning in a certain way but the images do not show *why*. While researchers can suppose that activation or abnormality in a certain portion of the brain shows the existence of a behavior,

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[100] Eclipse Enterprises, Inc. v. Gulotta, 134 F.3d 63, 65 (2d Cir. 1997)(finding that drugs, alcohol, and child abuse were more likely to cause violent behavior than violent media.)

[101] See e.g., Sherry (2001), supra note 71; Michael R. Ward, Video Games and Adolescents Fighting, 53 J.L. & Econ. 611 (2010).

[102] Joseph H. Baskin, Judith G. Edersheim & Bruce H. Price, Is a Picture Worth a Thousand Words? Neuroimaging in the Courtroom, 33 Am. J.L. & Med. 239 (2007).

[103] "While the brain has some role in producing violent behavior, it is not clear whether there is or ever will be a linear, identifiable relationship between the two." Id. at 240.

[104] M.C. Brower & B.H. Price, Neuropsychiatry of Frontal Lobe Dysfunction in Violent and Criminal Behaviour: A Critical Review, 71 J. Neurology, Neurosurgery & Psych. 720 (2001).

[105] "Brain activity is a global phenomenon, not merely a localized one within compartments of the brain, even for simple behaviors." Steven K. Erickson, Blaming the Brain, 11 Minn. J.L. Sci. & Tech. 27, 32 (2010).

[106] Brown & Murphy, supra n.41 at 1160.

[107] Khoshbin & Koshbin, supra n. 66 at 186.

they cannot be certain that this is what is actually occurring.[108] Until there is more certainty about what these images actually show they should not be admitted as evidence for substantive proof of thought or behavior.[109]

Researchers have found numerous flaws in the methodologies of video game studies. They range from improper testing protocol, to bias, to the testing parameters that are used in the studies.[110] For example, Klaus Mathiak and René Weber have cited other conditions and factors that can be linked to the neuroimaging results. They determined activation in the brain while playing video games is the result of player's mental engagement in the game and is not a sign of aggression; it is simply the brain performing a cognitive task.[111] Even more recent studies are adapting Anderson's General Learning Model[112] and finding that the increased brain activity demonstrated may be related to the player's frustration in learning the game controls and mechanics rather than social aggression.[113] More certainty is required before these images should be admitted as substantive evidence in a court of law.

4. Getting the Picture: Analysis of Neuroimaging and Social Science Expert Testimony in Video Game Litigation

The courts have found that expert testimony using neuroimaging as proof of a link between video games and violence is not trustworthy.[114] This is not to say that all expert testimony on neuroimaging should be banned from the courtroom in all circumstances.[115] There

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[108] "While there is little doubt that fMRI works well for neural research, there are innumerable questions about the extent of what can be stated with certainty about the interpretation of the images generated." Moriarty (2009), supra n. 61.

[109] "In accord with the weight of authority, we believe that knowledge of the relationship between brain activity and behavior is still quite limited and it is premature to admit such evidence." Moriarty et al., supra n. 58 at 708 (citations omitted).

[110] See e.g., Blagojevich, 404 F. Supp. 2d at 1066 (Dr. Howard Nusbaum finding that the fMRI research submitted to the court used improper methodology and improper inferences which were not generally accepted within the scientific community).

[111] Klaus Mathiak & René Weber, Toward Brain Correlates of Natural Behavior: fMRI during Violent Video Games, 27 Human Brain Mapping 948 (2006).

[112] Barlett et al., (2009) supra note 70 at 379.

[113] Andrew K. Przybylski, Edward L. Deci, C. Scott Rigby & Richard M. Ryan, Competence-Impeding Electronic Games and Players' Aggressive Feelings, Thoughts, and Behaviors, 106(3) J. Personality & Soc. Psychol. 441 (2014).

[114] Kendrick, 244 F.3d 572; Brown, 131 S. Ct. 2729; Blagojevich, 404 F. Supp. 2d 1051.

[115] Use of neuroimaging in the court room usually fits into one of three categories: (1) forensic proof of injury; (2) epidemiological evidence in toxic tort cases; (3) to attempt to prove sanity or criminal responsibility. See Jennifer

is precedent of neuroimaging being used successfully in the courts for other circumstances (like proof of traumatic brain injury.)[116] However, at this time, neuroimaging lacks necessary standardization and fitness under Daubert for it to be a proper basis for expert testimony in video game litigation as substantive evidence of harm and should be limited to medical diagnoses and not causation.

I. Testability of Methodology

While there have been extensive studies to see if video games have a causal relationship to violent behavior and aggression, there is no methodology that is sufficient to prove actual harm.[117] Many of the studies that use neuroimaging to look at the effect of video games on brain function do not actually have the subjects playing the video games during the scan. Dr. Kronenberger's fMRI research used a Stroop Color and Word test on subjects who self-reported playing video games or watching violent media within a week of testing.[118] In another Dr. Kronenberger study, the participants only watched video of gameplay and pressed a button when they would have performed the on-screen action.[119] Dr. Bartholow also used self-reporting of previous video game exposure to pick subjects and then showed them images that they identified as violent or not violent.[120] None of these tests are capable to accurately demonstrate the effect of a video game on a player because the tasks being performed are not analogous to game play.

Neuroimaging techniques are a fairly new and technology and the consistency of its results are still being examined. There have been findings that the same subject performing the same task but in different fMRI units can result in different images.[121] The strength of the

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Kulynych, Brain, Mind, and Criminal Behavior: Neuroimages as Scientific Evidence, 36 Jurimetrics 235, 240 (1996).

[116] The MacArthur Foundation has created a database of a majority of the cases that use neuroimaging expert testimony as well as publishing and funding research on using neuroscience for legal purposes. MacArthur Foundation Research Network on Law and Neuroscience, www.lawneuro.org (accessed on March 15, 2014).

[117] "Most researchers and investigators agree that exposure to media violence alone does not cause a child to commit a violent act, and that it is not the sole, or even necessarily the most important, factor contributing to youth aggression, anti-social attitudes, and violence." Ward, supra n. 99 at 612.

[118] William G. Kronenberger, Vincent P. Mathews, David W. Dunn, Yang Wang, Elisabeth A. Wood, Ann L. Giauque, Joelle J. Larsen, Mary E. Rembusch, Mark J. Lowe & Tie-Qiang Li, Media Violence and Executive Functioning in Aggressive and Control Adolescents, 61 J. Clinical Psychol. 725 (2005).

[119] Blagojevich, 404 F. Supp. 2d at 1064(the court did not cite the particular study that was examined).

[120] Bartholow et al., (2005) supra note 81.

[121] Laurence R. Tancredi & Jonathan D. Brodle, The Brain and Behavior: Limitations in the Legal Use of Functional Magnetic Resonance Imaging, 33 Am. J.L. & Med. 271, 281 (2007).

magnetic field used can also affect the reproducibility of results even if it is still the same subject being tested.[122] Replicablity of results can also be skewed by the inconsistencies in the structure of the brain itself between individuals. For most neuroimaging studies, multiple people are scanned, and those scans are combined to create a composited image as a standard for "normal" that is examined to contrast with the individual being tested.[123] The composited images will often show activation that was not observed in the majority of the subjects, which can be misleading.[124] Additionally, a "normal" brain will not always be consistent to the "averaged" model.[125] The existence of a window of variance between the average structure and the structure being examined does not mean that the change in structure has had an impact on behavior.[126]

II. Peer Review

Neurologic analysis of violence can require an analytical leap where the reliability of information is based upon the say so of the expert that is explaining the information called *ipse dixit*.[127] Interpretation of the image is dependent on the researcher and the methods they used to create the image.[128] These standards (such as the computer program that is used and the area of interest that is examined) can differ between research facilities and have an effect on the final image created.[129] There is no consistent methodology from researcher to researcher on how to create these images.[130] This makes review difficult as the other researchers may disagree with the methods used even if they agree with the conclusion created. Courts should not admit evidence that cannot support its own conclusions independent of the researcher that makes them.[131]

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[122] Id. at 282.

[123] Id., at 287.

[124] Blagojevich, 404 F. Supp. 2d at 1066 (discussing testimony by Dr. Nusbaum).

[125] "It can be very difficult to determine, based on anatomical landmarks, which parts of the brain in one person correspond to the standardized anatomical regions on the 'average' structural brain image." Brown & Murphy, supra n.41 at 1146.

[126] Id.

[127] Joiner, 522 U.S. 136.

[128] Adelsheim, supra n. 40.

[129] Brown & Murphy, supra n.41 at 1148.

[130] Sinnott-Armstrong et al., supra n. 52 at 363.

[131] See e.g., Blagojevich, 404 F. Supp. 2d at 1067 (finding that "Dr. Kronenberger's studies cannot support the weight he attempts to put on them via his conclusions" and therefore unreliable expert testimony).

III. Potential Error Rate

There is no known potential error rate for the studies that examine the relationship between playing video games and an increase in negative behaviors. This is not because these studies are infallible; it is because the research methods being used are still experimental and there are "glaring empirical gaps" that effect the error rate.[132] The research must become standardized to a consistent methodology producing consistent results before researchers can determine how reliable their results are for the purposes of an error rate. For now, meta-analysis that describes multiple studies finding overwhelming evidence of the relationship between violent video games and violent behavior can at most claim that there is a *suggestion* of the relationship existing and no definitive proof of its existence.[133] Additionally, many of these meta-analyses do not include research that leads to conflicting conclusions.[134] Researchers will have to prove the actual existence of the relationship before they can claim to prove a known rate of error for the method used to measure the relationship.

IV. General Acceptance

As of this time, there is a level of general acceptance of the belief that video games may have an effect on people. In Brown, the Supreme Court cited statements made by the American Academy of Pediatrics, the American Academy of Child & Adolescent Psychiatry, the American Psychological Association, the American Medical Association, the American Academy of Family Physicians and the American Psychiatric Association.[135] These organizations stated that the "research suggests such exposure ... increases aggressive behavior, ... increases aggressive thoughts, ... increases angry feelings, ... decreases helpful behavior, and ... increases physiological arousal."[136] The Court found these opinions to be lacking, firstly for not being based on scientific research but instead on the "policy or political views of their governing bodies."[137] Secondly, these medical professionals were unable to describe or specify what harm was actual inflicted from playing violent video games. This suggests that there is no general

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[132] Schwarzenegger II, 556 F.3d at 963; see also Griffiths(1999), supra note 12 at 206.

[133] Barlett et al., (2009) supra note 70 at 380.

[134] Blagojevich, 404 F. Supp. 2d at 1062.

[135] Brown, 131 S. Ct. at 2769.

[136] Id.

[137] Granholm, 426 F. Supp. 2d at 653.

acceptance on what kind of harm is inflicted from playing video games which is necessary for regulation purposes.[138] There is not enough data to establish a causal link between playing violent video games and an increase in aggression and/or violent behavior regardless of the methodology employed.[139] If the experts are unable to come to a general consensus what harm, if any, actually existed then the court should not accept neuroimaging testimony on that topic.

There is no general acceptance on using neuroimaging as proof of behavior. While experts have speculated on what brain structures and functions causes behaviors, they have been unable to prove that such a relationship exists.[140] At this time, not enough is understood about the brain to link images of structure and function to behavior.[141] Therefore any images that claim causation are merely speculative because there is no basis to prove that activation or an abnormality in a particular structure relates to a particular behavior.[142] More information is needed before these images can be used as proof of causation.

V. Jury Comprehension of Neuroimaging Testimony

One issue that can withhold neuroimaging from being a proper basis of expert testimony is that it has great potential to prejudice the jury. Expert evidence should only be admitted to the court if the "probative value in helping the jury evaluate the opinion substantially outweighs their prejudicial effect."[143] Neuroimaging is a highly specialized and technical field and is arguably on the cutting edge of technology. Because of this, there is the concern that the jury will put undue weight on the evidence and testimony because of inherent belief in the expert based on the impressive images presented.[144] Misplaced trust may open the door to admitting evidence that is

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[138] "Although some reputable professional individuals and organizations have expressed particular concern about the interactive nature of video games, there is no generally-accepted study that supports that concern." Schwarzenegger I, WL 2261546 at *11.

[139] "[Expert's] studies have been rejected by ever court to consider them, and with good reason: they do not prove that violent video games cause minors to act aggressively." Brown, supra note 17 at 2739.

[140] Bufkin & Luttrell (2005), supra note 80 at 177.

[141] "We simply do not yet have the technology or the understanding to link the brain structure and activity to behavior in any legally meaningful way." Jay D. Aronson, The Law's Use of Brain Evidence, 6 Annu. Rev. L. Soc. Sci. 93, 94 (2010).

[142] "Thus, the finding of a PET abnormality as an indicator of a predisposing factor to a certain behavior is an inference and, often, a weak one." Moriarty et al., supra n. 58.

[143] Fed. R. Evid. 702.

[144] "Some commentators worry that the visual impact of brain images may be so great, and the memory of them so vivid, that they unfairly prejudice the jury in favor of the party offering them and that for that reason only they should sometimes be excluded from evidence." Owen D. Jones, Anthony D. Wagner, David L. Faigman & Marcus E. Raichle, Neuroscientist in Court, 14 Nature 730, 733 (2013).

not scientifically valid or legally reliable.[145] This information may be more impressive than reliable and may mislead the jury to develop an erroneous conclusion and should therefore be excluded.[146]

VI. Fitness

A variety of the studies used in video game litigation analyze the results of exposure to violent media in general and not video games specifically. Much of the early research that has been used as a basis for current opinions on the effects of video games is extrapolated from viewing the effects of television or movies.[147] Testimony that is based on that research is unfit because it is not narrowly tailored to the legal issue of the case, which is the effect of video game violence not media violence. Though all media and entertainment is interactive to some degree, opponents claim that video games differ from other forms of media because of its almost immersive interactivity.[148] The unique harm of video games could not be expressed with research on the other passive forms of media because while the harm of violence could be similar it is not identical. This research would be unfit and should be excluded in video game litigation.

There are also issues regarding the fit of the populations of those studies. For example, many of the regulations that are created for video games concern protecting the welfare of children, but many of the participants of the studies are either teenage males[149] or are made up from particular groups that do not reflect the effects of video games on children.[150] Furthermore,

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[145] There is a tendency for some experts to overstate the use of their images ("overclaim syndrome") which is an issue because studies have found that juries will tend give greater weight to psychological studies that include neuroimages over studies that lack those images. Michael S. Gazzaniga, The Law and Neuroscience, 60 Neuron 412, 413 (2008)(citing Deena S. Weisberg et al., The Seductive Allure of Neuroscience Explanations, 20 J. Cognitive Neuroscience 470 (2008)); contra Moriarty et. al, supra n. 58 at 711(citing studies that "suggest that juries are not overwhelmingly influenced by realistic brain images as was originally believed.")

[146] "[There is] potential danger of giving undue weight to evidence and testimony derived from imperfect testing and analysis. Moreover, imprecise or exaggerated expert testimony has sometimes contributed to the admission of erroneous or misleading evidence." J.R.H. Law, Cherry-Picking Memories: Why Neuroimaging-Based Lie Detection Requires a New Framework for the Admissibility of Scientific Evidence Under FRE 702 and Daubert, 14 Yale J.L. & Tech. 1, 18 (2011)(quoting National Research Council, Strengthening Forensic Science in the United States: A Path Forward, 4 (2009)).

[147] Dill & Dill (1998), supra note 69 at 409.

[148] Kendrick, 244 F.3d at 577.

[149] Ballard & Wiest, (1996) supra note 2.

[150] Craig A. Anderson & Christine R. Murphy, Violent Video Games and Aggressive Behavior in Young Women, 29 Aggressive Behavior 423 (2003).

most of these studies have a very small sample size and unable to state with certainty the significance of their studies within the general population.[151]

VII. Validity

Use of neuroimaging also presents an issue of temporal validity. Regardless of the method that is used, neuroimaging can only evaluate the brain in its present state at the time of the image was captured and cannot look into the past or the future.[152] The images could then be used to infer propensity for a certain action or conduct at a different point in time. It is important to keep in mind that none of the pictures created through neuroimaging are actual photographs, but images that are created from data inputs and are "a vivid way to represent the location and magnitude of statistical differences in signal across large data sets."[153] Neuroimaging cannot be used to "read" a person's mind and cannot be used as definitive proof of thought. This prevents neuroimaging results from being used substantively to show a person's psychological state at a particular time like for example, their mental state during the commission of a crime.[154] This means that the images are unfit to show particularities that are at issue in a case. It also means that the images may not be scientifically valid to look at a person's mental state at the time of a crime because the images do not show the past mental state but brain function or structure at the time of the scan.

These researchers also cite numerous flaws in the methodologies that are being used to show that playing violent video games causes violent behavior. The main flaw being is the testing measure that is used. Research into aggression does not actually measure aggression because researchers cannot quantify what aggression is with particularity. When researchers are testing for aggression and behavior they are not observing actual aggression but proxy measures that are often associated with aggression.[155] Only some of these proxy measures are considered well validated but they do not make up the majority of the research that is done on this subject.[156]

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[151] Strenziok et al. (2011), supra n. 10 (study size of 22 teenaged males).

[152] Jones et al., supra n. 51 at 39.

[153] Sinnott-Armstrong et al., supra n. 52 at 362.

[154] "The mere presence of EEG abnormalities or frontal neurological signs also does not explain whether, or how, such findings contributed to behavior at the time of an alleged crime." Brower & Price (2001), supra note 81 at 723.

[155] Christopher J. Ferguson & John Kilburn, The Public Health Risks of Media Violence: A Meta-Analytic Review, 154 J. Pediatrics 759, 760 (2009)

[156] Id.

5. Conclusion

While there may be research studies in the future that find such a link, the current research is insufficient to demonstrate a definitive and causal connection to playing videogames and violent behavior and aggression that can be observed through neuroimaging. This is not to say that all neuroimaging and neuroscience does not meet the reliability standards that are required under the law. There has already been an increase in the courts of using neuroscience as the basis of expert testimony, especially in criminal cases. Nevertheless, there is no standardized and reliable basis using neuroimaging techniques to definitively prove that playing violent videogames causes aggression or violent behavior that could be used as the basis of expert testimony in a court of law. Until more research becomes available to show the validity and reliability of these methods they should not be used to prove behavior.