

SUPREME COURT OF THE STATE OF NEW YORK
Appellate Division -- First Department

THE PEOPLE OF THE STATE OF NEW YORK,

Respondent,

--against

PEDRO GIL

Defendant-Appellant.

N.Y. County Ind.
No. 10639/93

BRIEF AMICUS CURIAE OF THE
AMERICAN PSYCHOLOGICAL ASSOCIATION
IN SUPPORT OF APPELLANT

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TABLE OF CONTENTS

	<u>Page</u>
INTEREST OF AMICUS CURIAE	1
STATEMENT OF THE CASE	2
SUMMARY OF ARGUMENT	4
ARGUMENT	6
I. DR. MCCLOSKEY'S PROFFERED TESTIMONY WAS HIGHLY RELEVANT TO THE ISSUES BEFORE THE JURY	6
A. Studies in Intuitive Physics Demonstrate that People Regularly Underestimate the Distance that Falling Objects Will Travel Horizontally	7
B. Evidence on Intuitive Physics Would Have Tended to Prove Appellant's Claims and to Disprove the Prosecution's Theory of the Case and Therefore Was Relevant	12
II. THE TESTIMONY OF DR. MCCLOSKEY PROFFERED BELOW IS GENERALLY ACCEPTED AS RELIABLE BY THE SCIENTIFIC COMMUNITY	15
A. Under the Frye Test, Scientific Evidence Should be Admitted If It Has Received Acceptance in Respected Scientific Journals or Has Been Conducted Using Scientific Techniques that Are Accepted as Reliable in the Scientific Community	16
B. Research in Intuitive Physics Is Accepted As Reliable by the Psychological Community	18
III. STUDIES IN THE AREA OF INTUITIVE PHYSICS DEMONSTRATE THAT PEOPLE'S LACK OF UNDERSTANDING OF THE LAWS OF MOTION ARE CLEARLY BEYOND THE KEN OF THE ORDINARY JUROR	22
CONCLUSION	25

TABLE OF AUTHORITIES

CASES

<u>Daubert v. Merrell Dow Pharmaceuticals, Inc.</u> , 113 S. Ct. 2786 (1993)	16, 25
<u>De Long v. County of Erie</u> , 60 N.Y.2d 296 (1983)	4, 22, 24
<u>Dougherty v. Milliken</u> , 163 N.Y. 527, 533 (1900)	23
<u>Frye v. United States</u> , 293 F. 1013 (D.C. Cir. 1923)	<u>passim</u>
<u>People v. Cronin</u> , 60 N.Y.2d 430, 458 N.E.2d 351 (1983)	14, 22
<u>People v. Keindl</u> , 68 N.Y.2d 410, 502 N.E.2d 577 (1986)	21, 23
<u>People v. Hughes</u> , 59 N.Y.2d 523, 453 N.E.2d 484 (1983)	4, 15
<u>People v. Middleton</u> , 54 N.Y.2d 42, 429 N.E.2d 100 (1981)	17
<u>People v. Taylor</u> , 75 N.Y.2d 277, 552 N.E.2d 131 (1990)	<u>passim</u>
<u>People v. Wesley</u> , 83 N.Y.2d 417, 633 N.E.2d 451 (1994)	17

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K. Bordens & B. Abbot, <u>Research Design & Methods: A Process Approach</u> 59 (2d ed. 1991)	19, 21
A. Caramazza, M. McCloskey & B. Green, "Naive Beliefs in 'Sophisticated' Subjects: Misconceptions about Trajectories of Objects," <i>Cognition</i> , Vol. 9, at 117 (1981)	7, 9, 11
A. Champagne, L. Klopfer & J. Anderson, "Factors Influencing the Learning of Classical Mechanics," <i>Am. J. Phys.</i> , Vol. 48, at 1074 (1980)	9, 10, 19
J. Clement, "Students' Preconceptions in Introductory Mechanics," <i>Am. J. Phys.</i> , Vol. 50, at 66 (1982)	11
B. Green, M. McCloskey & A. Caramazza, "The Relation of Knowledge to Problem-solving, with Examples from Kinematics," Proceeding of the NIE-LRDC Conference on Thinking and Learning Skills (Oct. 1980)	10
M. Kaiser, M. McCloskey & D. Proffitt, "Development of Intuitive Theories of Motion: Curvilinear Motion in the Absence of External Forces," <i>Developmental Psychology</i> , Vol. 22, at 67 (1986)	8, 9, 20

M. Kaiser, K. Proffitt & M. McCloskey, "The Development of Beliefs about Falling Objects," <i>Perception and Psychophysics</i> , Vol. 38, at 533 (1985)	8, 11
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M. McCloskey, A. Caramazza & B. Green, "Curvilinear Motion in the Absence of External Forces: Naive Beliefs about the Motion of Objects," <i>Science</i> , Vol. 210, at 1139 (1980).	9, 11
M. McCloskey & R. Kargon, "The Meaning and Use of Historical Models in the Study of Intuitive Physics," in S. Strauss (ed.), <u>Ontogeny, Phylogeny, and Historical Development</u> 49 (1988).	10
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Vol. 7, no. 2, at 227 (1994)	7
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INTEREST OF AMICUS CURIAE

The American Psychological Association (hereafter "APA"), a nonprofit scientific and professional organization founded in 1892, is the major association of psychologists in the United States. APA has more than 84,000 members, including the vast majority of psychologists holding doctoral degrees from accredited universities in the United States. APA seeks to inform the Court about the significant body of research on systematic, common misconceptions of physical laws and the extent to which psychologists can provide meaningful expert assistance to a jury on the subject. Further, APA believes that the reasoning of the trial court in rejecting scientific evidence -- if upheld -- will result in the exclusion of much expert testimony of great value to triers of fact. APA believes that it can provide important and relevant information that will not be provided by the parties and will be of assistance to the Court in deciding this case.

STATEMENT OF THE CASE

Appellant threw a bucket of plaster from a rooftop that hit and killed a police officer. He was charged with and acquitted of murder in the second degree. To choose between the two lesser included offenses -- manslaughter in the second degree and criminally negligent homicide -- the jury had to determine whether appellant was aware of (and consciously disregarded) a substantial risk to human life or simply failed to perceive such a risk. Appellant testified before the grand jury that he was attempting to throw the bucket onto an empty sidewalk and that he did not expect the bucket to overshoot the sidewalk and travel into the street (where the officer was standing). The prosecution introduced appellant's grand jury testimony, but argued to the jury that it should infer that the appellant intended to throw the bucket into the street because that is where the bucket fell.

Appellant sought to introduce the testimony of Dr. Michael McCloskey, an experimental psychologist from the Johns Hopkins University and one of the foremost experts in the area of intuitive physics -- the study of people's misconceptions of basic physical laws. Had he been permitted to testify, Dr. McCloskey would have informed the jury about the significant body of empirical research demonstrating that people commonly misunderstand the operation of physical laws and, in particular, that people regularly fail to account for the horizontal motion of falling objects. Dr. McCloskey also would have presented evidence concerning an experiment he

performed that substantially replicated appellant's actions and demonstrated that, in a situation virtually identical to that faced by appellant, the vast majority of people overshoot their target.

The trial court, without an evidentiary hearing, refused to admit Dr. McCloskey's testimony, maintaining that evidence on intuitive physics was not relevant to any issue before the jury and therefore was inadmissible. The court also appeared to hold that, even if the evidence was relevant, Dr. McCloskey could testify only if he had performed an experiment that exactly replicated the situation faced by appellant. Lastly, the court determined that scientific evidence on intuitive physics was not "beyond the ken" of the ordinary juror and therefore was unnecessary. Despite those rulings, the trial court did admit expert testimony from Dr. Michael Mael, a physicist, who explained the Newtonian laws of physics to the jury. At the end of the trial, appellant was convicted of manslaughter in the second degree.

Amicus submits this brief because the trial court's approach to the introduction of scientific testimony does not comport with established law in the State of New York and, if upheld, would result in the exclusion of much scientific evidence of great value to triers of fact.

SUMMARY OF ARGUMENT

Under New York law, scientific evidence is admissible if it (1) satisfies the common law test for relevance applicable to any other evidence, (2) is generally accepted as reliable in the relevant scientific community, see Frye v. United States, 293 F. 1013 (D.C. Cir. 1923); People v. Hughes, 59 N.Y.2d 523, 537, 453 N.E.2d 484, 490 (1983) (applying the Frye test), and (3) is "beyond the ken" of the ordinary juror. See De Long v. County of Erie, 60 N.Y.2d 296, 457 N.E.2d 717 (1983). The trial court either failed to apply or misapplied all three parts of this test.

1. The significant body of scientific literature on intuitive physics demonstrates that people regularly and systematically misunderstand the laws of physics. Even after education in physics a substantial number of people hold misconceptions about the path of projectiles in motion, and, in particular, about the distance that a falling object will travel horizontally. Studies in intuitive physics, including the experiment that Dr. McCloskey conducted, demonstrate that people regularly underestimate the distance that an object thrown from a building will travel. Part I.A infra.

Scientific evidence on intuitive physics was directly relevant to the central issue before the jury -- whether appellant perceived the risk that he would overshoot his target and endanger the lives of others. The prosecution focused its case on the incorrect assumption that a person throwing a projectile from a rooftop will hit what he or she

intended. That is exactly the assumption that research in intuitive physics and Dr. McCloskey's experiment show to be false. It follows that the trial court erred in excluding Dr. McCloskey's testimony as irrelevant. Part I.B infra.

2. Although the trial court did not make an express finding on the general acceptance of intuitive physics in the scientific community, it nonetheless refused to admit testimony about intuitive physics because neither Dr. McCloskey (nor any other scientist) had exactly replicated the facts of the case. This requirement finds no support in the law and represents a complete departure from the Frye test, which allows any scientific evidence that is generally accepted as reliable to be admitted. Part II.A infra.

Had the trial court properly applied the Frye test, it would have looked to the vast body of scientific literature published in peer-reviewed journals establishing that the empirical findings of intuitive physics are generally accepted as reliable in the field of psychology. By itself, such publication should satisfy the requirements of the Frye test. Moreover, empirical studies in intuitive physics, including Dr. McCloskey's experiment relating to this case, were conducted using accepted scientific techniques. As such, even absent publication in respected journals, this research, including Dr. McCloskey's experiment, satisfies the Frye test. Part II.B infra.

3. By its very nature, intuitive physics is beyond the ken of the ordinary juror. Research in intuitive physics, including Dr. McCloskey's experiment, demonstrates that people are unaware of basic physical laws and that this affects them in performing real-world tasks -- particularly tasks that they do not routinely perform. Not only is the average person likely to err in performing such tasks, but most people are themselves unaware that they and others misconceive physical laws. Thus, average jurors are likely to be misled by their own misconceptions of physical laws when those misconceptions relate to the evidence presented at a trial. Part III infra.

ARGUMENT

I. DR. MCCLOSKEY'S PROFFERED TESTIMONY WAS HIGHLY RELEVANT TO THE ISSUES BEFORE THE JURY

At the trial, the jury had to determine, among other things, whether appellant evinced "an awareness and conscious disregard of a substantial and unjustifiable risk of death" (manslaughter) or "failed to perceive a substantial and unjustifiable risk of death" (criminally negligent homicide). As a result, the appellant's understanding of the possibility that the bucket might travel significantly farther than he intended was highly relevant to the jury's choice between the two lesser included offenses. Intuitive physics, in turn, was highly relevant to the jury's assessment of the appellant's state of mind.

A. Studies in Intuitive Physics Demonstrate that People Regularly Underestimate the Distance that Falling Objects Will Travel Horizontally

The study of intuitive physics by psychologists focuses on how people develop an understanding of the physical world.^{1/} As part of this research, psychologists (as well as physics educators), have conducted numerous studies on people's understanding of the Newtonian laws of motion. This empirical research has consistently revealed a striking conclusion: while people do abstract some general principles concerning the operation of the laws of physics in the world around them, those principles are at odds with Newtonian laws of physics; in other words, the Newtonian laws of physics are counter-intuitive. See A. Caramazza, M. McCloskey & B. Green, "Naive Beliefs in 'Sophisticated' Subjects: Misconceptions about Trajectories of Objects," Cognition, Vol. 9, at 117 (1981); M. McCloskey, "Intuitive Physics," Scientific American, Vol. 248, no. 4, at 122 (1983).

Psychological research has demonstrated that misconceptions about the laws of physics derive from early experience. Because children have difficulty thinking in two dimensions, they tend to focus on only one component of an

^{1/} Intuitive or naive physics refers to a broad area of psychological research that dates back to the beginning of this century. See B. Smith & R. Casatt, "Naive Physics," Philosophical Psychology, Vol. 7, no. 2, at 227 (1994). Dr. McCloskey's research on people's systematic misconceptions of the laws of mechanics is a specialty within the area of intuitive physics. This brief focuses solely on this specialty within the area of intuitive physics.

object's motion. Realizing that an object falls when it is not supported underneath, they often assume that the vertical component of motion determines the path of a falling object and ignore the horizontal motion of the object. See M. Kaiser, K. Proffitt & M. McCloskey, "The Development of Beliefs about Falling Objects," *Perception and Psychophysics*, Vol. 38, at 533 (1985). Even when children grow older and learn that gravity does not immediately negate an object's horizontal velocity, children still believe that an object will drop straight down after travelling forward a short distance. Id. From these experiences, children abstract general principles that do not comport with the Newtonian laws of physics. See M. Kaiser, M. McCloskey & D. Proffitt, "Development of Intuitive Theories of Motion: Curvilinear Motion in the Absence of External Forces," *Developmental Psychology*, Vol. 22, at 67 (1986).

These misconceptions of the laws of mechanics persist into adulthood and manifest themselves in several common situations. For example, beginning physics students have difficulty understanding the concepts of position, velocity, and acceleration, even in one dimension. See D. Trowbridge & L. McDermott, "An Investigation of Student Understanding of the Concept of Velocity in One Dimension," *Am. J. Phys.*, Vol. 48, at 1020 (1980); D. Trowbridge & L. McDermott, "An Investigation of Student Understanding of the Concept of Acceleration in One Dimension," *Am. J. Phys.*, Vol. 49, at 242 (1981). Even after instruction, more than 50

percent of students are unable to apply the concept of acceleration in a particular situation. Id. Although the Newtonian laws of physics dictate that an object falls at an accelerating rate regardless of the object's mass, college students continue to believe that objects fall either at constant velocity or at a rate proportional to their mass. See B. Shanon, "Aristotelianism, Newtonians, and the Physics of the Layman," *Perception*, at Vol. 5, at 241 (1976); A. Champagne, L. Klopfer & J. Anderson, "Factors Influencing the Learning of Classical Mechanics," *Am. J. Phys.*, Vol. 48, at 1074 (1980).

These misconceptions are even more prevalent when people are confronted by objects that have both horizontal and vertical motion.^{2/} Newtonian physics predicts that an object thrown from a building begins to accelerate toward earth immediately, while continuing in a horizontal direction, due to inertia. The result is a flight path that is parabolic in shape: the object never falls fully

^{2/} People also misunderstand curvilinear motion. For example, 30% of college students believe that an object that is traveling in a circular motion will continue to travel in a circle even after a force ceases to be applied. See M. McCloskey, A. Caramazza & B. Green, "Curvilinear Motion in the Absence of External Forces: Naive Beliefs about the Motion of Objects," *Science*, Vol. 210, at 1139 (1980); M. Kaiser, M. McCloskey & D. Proffitt, supra, at 67 (finding similar results with preschool children). Similarly, 75% of people do not understand simple problems related to the motion of a pendulum. See A. Caramazza, M. McCloskey & B. Green, "Naive Beliefs," supra, at 117; see also J. Pittenger, "Estimation of Pendulum Length from Motion Information," 23rd Annual Meeting of the Psychonomic Society (Nov. 11, 1982) (noting that observers of the motion of a pendulum have only a crude understanding of physical laws).

vertically. Many people have difficulty understanding the idea that falling objects that have been affected by a horizontal force will continue to move horizontally while they fall; a substantial number of people believe that, at some point, the object will fall straight down because it will be overcome by gravity.^{3/} See B. Green, M. McCloskey & A. Caramazza, "The Relation of Knowledge to Problem-solving, with Examples from Kinematics," *Proceeding of the NIE-LRDC Conference on Thinking and Learning Skills* (Oct. 1980) (47% percent of subjects believed that a ball dropped from a moving airplane will fall straight down or backwards); M. McCloskey, A. Washburn & L. Felch, "Intuitive Physics: The Straight-Down Belief and Its Origin," *Journal of Experimental Psychology: Learning, Memory and Cognition*, Vol. 9, no. 4, at 636 (1983) (55% of subjects believed a ball dropped by a moving person will fall straight down or backwards); M. McCloskey, "Naive Theories of Motion," *supra*, at 299 (22% of

^{3/} History also provides additional support for the findings of intuitive physics. From Aristotle in the 4th century B.C. to Galileo in the 15th century A.D., scientists believed that the force imparted to a thrown object would dissipate and that the object would eventually fall straight down. It was not until the 18th century that Isaac Newton discovered the mathematical relationship between force, mass, and acceleration and correctly set forth the laws of mechanics that govern projectile motion. Psychologists have noted that the errors that people regularly make resemble the theories of pre-Newtonian scientists, suggesting that Aristotle's and Galileo's views are more intuitive than Newtonian physics. See M. McCloskey & R. Kargon, "The Meaning and Use of Historical Models in the Study of Intuitive Physics," in S. Strauss (ed.), *Ontogeny, Phylogeny, and Historical Development* 49 (1988); A. Champagne, L. Klopfer & J. Anderson, *supra*, at 1074; M. McCloskey, "Naive Theories of Motion," in D. Gentner & A. Stevens (eds.), *Mental Models* 299 (1983).

college students believed that a object that rolls off a cliff will eventually fall straight down). These misconceptions lead people regularly to underestimate how far a falling object will travel horizontally. See M. Kaiser, K. Proffitt & M. McCloskey, supra, at 533; M. McCloskey, A. Washburn & L. Felch, supra, at 636.^{4/}

Dr. McCloskey's experiment that replicated the situation faced by appellant confirmed this last point dramatically. Dr. McCloskey had nineteen men do exactly what appellant did -- throw a bucket of plaster from a building. The results were exactly what one would expect: seventeen of 19 men threw the bucket of cement beyond the target -- some as much as 25 feet beyond -- despite the fact that almost all of the respondents thought they had hit the target or fallen short. (More than half thought they had fallen short.) When they were given the opportunity to see how they had

^{4/} Even after physics instruction, a substantial number of people continue to make the same errors. See M. McCloskey, A. Caramazza & B. Green, "Curvilinear Motion, supra (errors declined from 49% to 34% after instruction in high school physics); M. McCloskey, A. Washburn & L. Felch, supra (40% of those untrained in physics and 62% of those trained in physics answered correctly); see also R. Whitaker, "Aristotle Is Not Dead: Student Understanding of Trajectory Motion," Am. J. Phys., Vol. 51, no. 4, at 352 (April 1983); A. Caramazza, M. McCloskey & B. Green, "Naive Beliefs," supra, at 117. Indeed, even those who correctly predict the movement of objects often explain their analysis using pre-Newtonian understandings of projectile motion. See J. Clement, "Students' Preconceptions in Introductory Mechanics," Am. J. Phys., Vol. 50, at 66 (1982); M. McCloskey, "Intuitive Physics," supra, at 122. In many cases, physics education simply provides students with a new terminology to express their erroneous beliefs. See M. McCloskey, A. Caramazza & B. Green, "Curvilinear Motion," supra, at 1141.

performed, 16 of 19 said that the bucket traveled farther than they expected.

Psychological research in intuitive physics has thus demonstrated that most people, faced with a situation like the one presented here, will overthrow their target and that they are unaware that they do not understand how the laws of physics will operate in that situation. As explained below, testimony on such research was clearly relevant to the issues before the jury.

B. Evidence on Intuitive Physics Would Have Tended to Prove Appellant's Claims and to Disprove the Prosecution's Theory of the Case and Therefore Was Relevant

As the trial court recognized, "whether the [appellant] intended to hit the sidewalk or reach the street," Hearing before the Honorable Harold Rothwax on January 3, 1995, at 13 [hereinafter "Hearing"], and whether appellant "was aware of the risk," id. at 15, are central to a determination of appellant's state of mind and his perception of the risk. Nevertheless, the trial court held that testimony on intuitive physics would not assist the jury because appellant's assertion that the bucket did not land where he intended was "an issue of credibility, not one of physics." Id. at 14.

In so holding, the trial court failed to apply the common law test of relevance to Dr. McCloskey's testimony and therefore improperly subjected scientific evidence to a different and higher threshold of relevance. The only issue

properly before the trial court was whether Dr. McCloskey's testimony would logically tend to prove or disprove a fact at issue in the case. And there can be no doubt that Dr. McCloskey's testimony would have done so.

Appellant testified before the grand jury that he did not intend to throw the bucket into a crowded area and that he failed to perceive the possibility that his throw might significantly overshoot his target. If the jury were to accept this proposition, it could find that appellant simply failed to perceive the risk and thus was guilty of negligent, rather than reckless, conduct. Dr. McCloskey would have testified that most people underestimate the distance that an object will travel horizontally when thrown from a height due to their misconceptions about the laws of physics. Dr. McCloskey's testimony therefore would have "provide[d] a possible explanation for the [appellant's] behavior that is consistent with [appellant's] claim. . . . As such, it is relevant." People v. Taylor, 75 N.Y.2d 277, 292, 552 N.E.2d 131, 138 (1990).

The relevance of Dr. McCloskey's testimony is amply demonstrated by the fact that the prosecution sought to exploit the very misconceptions about the laws of physics that evidence on intuitive physics would have rebutted. In both her opening statement and summation, the prosecutor argued that the jury should infer that appellant intended the bucket to hit the police officer because that is where the bucket landed. As explained above, research in intuitive

physics, including Dr. McCloskey's experiment, demonstrates that this inference is flawed. Dr. McCloskey's testimony therefore would have rebutted the errant inference that, because the bucket of plaster hit a police officer, the thrower must have recognized that there was a substantial risk that the bucket would hit someone.^{5/}

The trial court's view that expert testimony cannot validly inform a jury's assessment of a defendant's credibility or state of mind,^{6/} see Hearing at 13-17, finds no support in the law. Dr. McCloskey did not examine the appellant and his testimony was not introduced to bolster appellant's credibility. Rather, his evidence would have helped the jury to decide whether they accepted the prosecutor's or the appellant's version of events^{7/} and to overcome their own misconceptions about the operation of

^{5/} Indeed, with respect to the issue of relevance, this case parallels Taylor exactly. The Court of Appeals in Taylor held that expert testimony should be introduced because the defendant in that case would seek to persuade the jurors to draw an inference directly contrary to the scientific research: "Indeed, the defense would clearly want the jury to infer that because the victim was not upset following the attack, she must not have been raped." Taylor, 75 N.Y.2d at 293, 552 N.E.2d at 138.

^{6/} Under New York law, an expert witness is permitted to testify concerning ultimate issues in the case. See People v. Cronin, 60 N.Y.2d 430, 433, 458 N.E.2d 351, 352 (1983). As in this case, Cronin dealt with the issue of the defendant's intent.

^{7/} Testimony on intuitive physics is neither pro-prosecution or pro-defendant. If a defendant sought to convince a jury that he overestimated how far a falling object would travel horizontally and therefore did not perceive that there was a risk to people below, the prosecution could introduce expert testimony, such as Dr. McCloskey's, in rebuttal.

physical laws. Indeed, the trial court's admission of the evidence of a physicist to explain the laws of mechanics to the jury all but concedes the relevance of Dr. McCloskey's testimony. Although a physicist can explain to a jury the mathematical equations governing projectile motion, only a psychologist versed in intuitive physics can explain the misconceptions that most people hold about the laws of physics and how those misconceptions affect performance of specific tasks, such as throwing an object from a building.

The trial court therefore erred in holding that Dr. McCloskey's testimony was irrelevant to the issues at trial.

II. THE TESTIMONY OF DR. MCCLOSKEY PROFFERED BELOW IS GENERALLY ACCEPTED AS RELIABLE BY THE SCIENTIFIC COMMUNITY

The New York courts apply the test established in Frye v. United States, 293 F. 1013 (D.C. Cir. 1923), in determining whether scientific evidence in a particular field may be admitted. See People v. Hughes, 59 N.Y.2d 523, 537, 453 N.E.2d 484, 490 (1983). The only purpose of the Frye test is to prevent the introduction of evidence based on unproven scientific techniques. Under the Frye test, scientific testimony by an expert witness is admissible if the evidence at issue is of "general acceptance in the particular field to which it belongs." Id. at 1014.

The Frye test clearly was met here. As demonstrated by the extensive literature in intuitive physics and the reliability of the techniques used in the empirical

studies performed by psychologists, there are few things less controversial in psychology than the basic findings of intuitive physics. Moreover, Dr. McCloskey's experiment, which simply confirmed the application of intuitive physics to the specific facts of this case, complied with accepted scientific techniques and therefore also satisfied the Frye test.

A. Under the Frye Test, Scientific Evidence Should be Admitted If It Has Received Acceptance in Respected Scientific Journals or Has Been Conducted Using Scientific Techniques that Are Accepted as Reliable in the Scientific Community

When determining whether an area of scientific knowledge is generally accepted as reliable, a court should first look to the scientific literature in the field. Where the literature reveals numerous studies reaching the same or similar conclusions and little or no disagreement among scientists, the court should find the evidence is generally accepted as reliable. In particular, when research is published in peer-reviewed journals, the court can trust that the research has been properly examined and criticized by the relevant scientific community. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S. Ct. 2786, 2797 (1993) ("The fact of publication (or lack thereof) in a peer-reviewed journal thus will be a relevant, though not dispositive, consideration in assessing the scientific validity of a particular technique or methodology"). In the peer review process, journal editors submit manuscripts to professionals in the same field of study to judge the author's methodology,

results, and conclusions. "Acceptance of a paper in a peer review journal is an informal means by which the work is judged as meeting scientifically acceptable standards." J. Kupfersmid & D. Wonderly, An Author's Guide to Publishing Better Articles in Better Journals in the Behavioral Sciences 55 (1994). By itself, that satisfies the Frye test.

The Frye test does not, however, require that an expert's findings be reflected in prior publications. If a scientific researcher has used "accepted techniques" which, "when properly performed, generate results accepted as reliable within the scientific community generally," the Frye test is satisfied. People v. Wesley, 83 N.Y.2d 417, 424, 633 N.E.2d 451, 454 (1994). As long as the researcher employed a methodology that has received acceptance in the relevant field, there is no reason to "separately establish[] scientific reliability in each case." People v. Middleton, 54 N.Y. 2d 42, 45, 429 N.E. 2d 100, 101 (1981). Thus, a court should admit otherwise relevant scientific testimony whenever the underlying experiments used accepted techniques and there is no significant body of contrary research.^{8/}

Rather than consider the extensive literature on intuitive physics or the reliability of the techniques used by Dr. McCloskey and others, the trial court instead refused to admit Dr. McCloskey's testimony because none of his (or

^{8/} Although not an issue in this case, the New York Court of Appeals has noted that a particular procedure or area of study need not be "unanimously indorsed" by the scientific community to satisfy the Frye test. Middleton, 54 N.Y.2d at 49, 429 N.E.2d at 103.

others') experiments precisely replicated the facts of the case.^{2/} Hearing at 9-12. This apparent requirement that Dr. McCloskey replicate the factual scenario of the case exactly is wholly inconsistent with the Frye test.

Traditionally accepted expert testimony concerning such matters as rape trauma and child abuse syndromes could never be based on replications of the factual situations about which the expert testifies. Nor is there any valid reason that they should. The purpose of scientific evidence is to assist the jury, not to re-enact the crime. It is for this reason that the Frye test -- which seeks only to ensure that unproven scientific techniques not be the subject of expert testimony -- does not impose such a requirement. By creating such a requirement, the trial court did not apply the Frye test and improperly excluded Dr. McCloskey's testimony.

B. Research in Intuitive Physics Is Accepted As Reliable by the Psychological Community

As explained more fully in Part I.A supra, there is an extensive literature on intuitive physics, much of it published in well-respected peer-reviewed journals. Dr. McCloskey performed much of the foundational research in the

^{2/} The trial judge's concern that the building in Dr. McCloskey's experiment was shorter than the appellant's building was unfounded. The only effect of the building's height is to understate the distance by which the men would overshoot the target -- and that is an issue for physicists, not psychologists.

area, but his conclusions have been confirmed by many others.^{10/} See, e. g., D. Proffitt, M. Kaiser & S. Whelan, "Understanding Wheel Dynamics," Cognitive Psychology, Vol. 27, at 342 (1990). Indeed, a review of the relevant scientific literature reveals an absence of any research that contradicts the basic conclusions of intuitive physics.^{11/} The court need look no farther to find that testimony on intuitive physics satisfies the Frye test.

Moreover, the research conducted by Dr. McCloskey and others was performed using scientific techniques that are generally accepted as reliable in the psychological community. The empirical research in intuitive physics was generated through controlled experiments, designed to reduce significantly or eliminate the possibility of error.^{12/} In

^{10/} Empirical research by physics educators, who sought to understand why students of physics had so much difficulty applying concepts that they learned in class, has confirmed the conclusions of psychologists in the field of intuitive physics. See, e.g., D. Trowbridge & L. McDermott, "An Investigation of Student Understanding of the Concept of Velocity in One Dimension," supra; R. Whitaker, supra; A. Champagne, L. Klopfer & J. Anderson, supra; J. Minstrell, "Explaining the 'At Rest' Condition of an Object," The Physics Teacher, Vol. 20, at 10 (1982); see also L. Resnick, "Mathematics and Science Learning: A New Conception," Science, Vol. 220, at 477 (April 29, 1983).

^{11/} Dr. McCloskey's work has also been cited with approval in numerous textbooks. See, e.g., M. Ashcraft, Human Memory and Cognition (1994); M. Matlin, Cognition (1989).

^{12/} See K. Bordens & B. Abbot, Research Design & Methods: A Process Approach 59 (2d ed. 1991). In order to reduce or eliminate the possibility of error in a controlled experiment, researchers will, for example, 1) randomly assign subjects to treatment conditions in order to avoid bias in sample selection, 2) use blind raters to avoid bias in scoring or rating the outcome of an experiment, 3) impose
(continued...)

those experiments, subjects were selected randomly (most often college students), and included persons with and without formal education in physics (as well as varying degrees of education in physics). See, e.g., M. McCloskey, A. Washburn & L. Felch, supra, at 638. In order to ensure that the results were not caused by the way in which a particular problem was presented to students, researchers used a wide variety of different problem types to confirm their findings. Thus, they studied subjects' understanding of trajectory by having the subjects (1) draw the trajectory of an object on paper, (2) choose the correct trajectory from several choices, (3) perform a task such as hitting a target, and (4) draw the correct trajectory after viewing a computer simulation or videotape. See, e.g., id. (performing paper-and-pencil, actual performance, computer simulation, and video presentation experiments). Where a particular experiment could suggest more than one possible conclusion, psychologists have performed additional experiments to isolate the correct conclusion. See, e.g., M. Kaiser, M. McCloskey & D. Proffitt, supra, at 68 (performing additional experiment to confirm that children's responses to problem were not caused by an inability to draw curved lines). Finally, all of the studies were subjected to standard

^{12/} (...continued)

strict limits on acceptable scientific error, 4) subject their methodology and results to peer reviewers, and 5) test contradictory hypotheses to reduce the effects of a confirmatory bias, i.e., the tendency to see what one expects or wants to see. Id. at 60, 450-51.

statistical analysis and rigid limits on acceptable scientific error. See, e.g., M. McCloskey & D. Kohl, "Naive Physics: The Curvilinear Principle and its Role in Interactions with Moving Objects," J. Experimental Psychology: Learning, Memory, and Cognition, Vol. 9, no. 1, at p. 150 (1983).^{13/}

Dr. McCloskey's experiment that substantially replicated the situation faced by appellant similarly was based on accepted scientific techniques. As in many analog studies,^{14/} Dr. McCloskey devised and performed an experiment under circumstances similar to the facts in the case. In order to reduce or eliminate possible error, Dr. McCloskey chose his subjects randomly. He eliminated from the sample the one subject who failed to comply with the instructions. Dr. McCloskey tested his subjects' understanding in three different ways -- by having them perform a task, asking them how they believed they had performed, and then having them express their reaction after having seen how they did. Dr. McCloskey thereby eliminated

^{13/} Propositions in intuitive physics are thus more susceptible of proof than those in areas, such as rape trauma and child abuse syndromes, which have passed the Frye test in the Court of Appeals. See Taylor, 75 N.Y.2d 277, 552 N.E.2d 131 (1990) (rape trauma syndrome); People v. Keindl, 68 N.Y.2d 410, 502 N.E.2d 577 (1986) (child sex abuse).

^{14/} An analog study is a research project conducted under circumstances that are analogous to the actual events of interest. Along with other research paradigms, such as archival studies, surveys, and natural observation, analog studies are generally accepted as reliable in the psychological community. See generally K. Bordens & B. Abbot, supra, at 148-81.

the possibility that his subjects missed the target because of a failure in manual dexterity, rather than an error in judgment. In addition, he used standard techniques to ensure that his results were statistically significant.

Because of the track record of publication in respected peer-reviewed journals and the reliability of the techniques used in the experiments of Dr. McCloskey and others, the evidence that he would have presented at trial would have been generally accepted by the psychological community. The trial court therefore erred in excluding Dr. McCloskey's testimony.

III. STUDIES IN THE AREA OF INTUITIVE PHYSICS DEMONSTRATE THAT PEOPLE'S LACK OF UNDERSTANDING OF THE LAWS OF MOTION ARE CLEARLY BEYOND THE KEN OF THE ORDINARY JUROR

Expert testimony that is generally accepted as reliable in its particular field is admissible "when it would help clarify an issue calling for professional or technical knowledge, possessed by an expert and beyond the ken of the typical juror." De Long v. County of Erie, 60 N.Y.2d 296, 307, 457 N.E.2d 717, 722 (1983); Taylor, 75 N.Y.2d at 288, 552 N.E.2d at 135. In general, whether a particular issue is "beyond the ken" depends on whether "jurors are able to draw conclusions from the evidence based on their day-to-day experience, their common observation and their knowledge" or "would be benefited by the specialized knowledge of an expert witness." Cronin, 60 N.Y.2d at 433, 458 N.E.2d at 352. Applying this standard, the Court of Appeals has upheld the admission of expert testimony where there is the possibility

that jurors hold misconceptions concerning issues relevant to the case or "where the conclusions to be drawn from the facts 'depend upon professional or scientific knowledge or skill not within the range of ordinary training or intelligence.'" Id. (quoting Dougherty v. Milliken, 163 N.Y. 527, 533 (1900)); Taylor, 75 N.Y.2d at 288, 552 N.E. 2d at 135.

In People v. Taylor, the Court of Appeals held that expert testimony concerning rape trauma syndrome was admissible to combat popular misconceptions about rape. Id. at 288-89, 552 N.E.2d at 136. The Court noted that studies showed that most people "infer[red] consent where the victim has engaged in certain types of behavior prior to the incident." Id. The Court also expressed concern that jurors would make an incorrect inference because the complainant had refused initially to admit that she knew the rapist. Because cultural myths concerning rape might cause the jurors to draw the wrong conclusions, the Court determined that such testimony should be admitted in appropriate cases. Id. at 289, 552 N.E.2d at 136.^{15/}

The logic of Taylor applies with equal force to testimony concerning intuitive physics in this case. The fundamental premise of intuitive physics, proved over and over again, is that, based on "their day-to-day experience, their common observation and their knowledge," many people

^{15/} See also Keindl, 68 N.Y.2d at 422, 502 N.E.2d at 582 (upholding admission of expert testimony concerning the reactions of children who suffer from sexual abuse at the hands of their stepparents).

draw the wrong conclusions about the application of the laws of physics to situations that they do not routinely experience. Absent the assistance of an expert witness who "can assist jurors in reaching a verdict by dispelling misconceptions" about people's understanding of the laws of motion in this particular situation, id., jurors are likely to draw the wrong inference from the fact that appellant's throw hit someone.

The trial court interpreted the phrase "beyond the ken" to preclude any testimony touching on subjects that the jurors regularly experience, whether or not such experiences lead to valid conclusions. That jurors are regularly exposed to particular subject does not, however, mean that they understand all aspects of a particular subject. As Taylor and other cases in the Court of Appeals have held, a court must consider not only whether jurors are regularly exposed to particular subjects, but also whether they are likely to draw the right conclusions from their experiences. For example, although jurors have a general awareness of the services performed by a housewife, that does mean that they comprehend the monetary equivalent of such services. See De Long, 60 N.Y.2d at 308, 457 N.E.2d at 723. Indeed, expert testimony in such a situation is necessary "to dispel the notion that what is provided without financial reward may be considered of little or no financial value in the marketplace." Id.

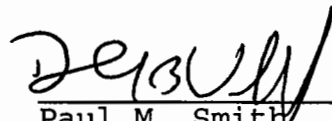
Moreover, failure to admit testimony such as Dr. McCloskey's results in a travesty of the truth-seeking process. Where, as here, scientific research conclusively demonstrates that people are unaware of their own misconceptions and will frequently reach a faulty conclusion, the fact-finding process is not advanced by excluding expert testimony,^{16/} and scientific evidence related to the particular issue is, by definition, "beyond the ken" of the ordinary juror.

^{16/} The federal courts and state courts across the country have been moving to a more liberal approach to the introduction of expert testimony. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S. Ct. 2786 (1993). Under the standard set out by the Supreme Court in Daubert, expert testimony need not be "beyond the ken" of the ordinary juror; reliable scientific evidence need only be of assistance to the jury in order to be admissible.

CONCLUSION

For the foregoing reasons, the trial court should have admitted Dr. McCloskey's expert testimony concerning intuitive physics.

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