COMPUTER ANIMATION OF TRAFFIC ACCIDENTS
Hindsight Bias & Judgments of Blame

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ABSTACT

Computer animation that vividly portrays traffic accidents are increasingly used as analytical and persuasive tools in the American tort system. As this technology continues to develop and its costs further decrease, animations are expected to attract a more diverse audience in areas such as driver education, collision avoidance training, motor carrier preventable accident reviews, reckless homicide investigations and preventable accident countermeasure research. Although impressive and intuitively useful, computer animation is still an emerging technology with benefits as well as pitfalls that are yet to be fully realized. While computer animation may clarify fast-unfolding events, such as traffic accidents, they may also exacerbate hindsight bias, defined as an increased certainty for the predictability of past events, after the events become known. In an experiment that compared judgments of drivers involved in traffic accidents presented via computer animation or text plus diagrams, computer animation was found to increase hindsight bias and make blame judgments more punitive toward the reactive but not the active driver. The impact of computer animation on hindsight bias is also discussed in light of earlier work on counterfactual thinking, point of view, actor-observer effects, and debiasing.

Keywords: computer animation, hindsight bias, counterfactual thinking, actor-observer effect, traffic accident analysis, accident reconstruction, foresight reconstruction.

INTRODUCTION

As high-tech computer animation continues to transform the entertainment industry, its use in more serious applications, such as in the courtroom presentation of traffic accident reconstructions, is becoming increasingly popular. Computer technology now enables scientists to illustrate graphically the dynamics of a traffic accident with remarkable realism. The visual impact of demonstrating "how" a traffic accident happened using animated, three-dimensional, color graphics is novel, dramatic, and extraordinarily effective in capturing an observer's full attention. Because traffic accidents involve a sequence of rapidly changing events that begin and end within seconds, computer animation is generally regarded as the best tool currently available for illustrating their complex dynamics.

Still relatively costly to prepare, animations of traffic accidents are generally reserved for serious legal disputes where the expense can be justified. But as this technology continues to develop and its costs further decrease, animations may well become more commonly used by the courts, and are expected to attract a more diverse audience in areas such as driver education, collision avoidance training, motor carrier preventable accident reviews, reckless homicide investigations and preventable accident countermeasure research. Although impressive and intuitively useful, computer animation is still an emerging technology with benefits as well as pitfalls that are yet to be fully realized.

Currently, in the legal arena where the task is that of judging driver "negligence," one would think that a comprehensive understanding of *how* an accident happened is prerequisite to the fair attribution of fault. It is in this regard that computer animations *appear* to excel. Unfortunately, however, their impressive, fascinating and apparently useful appearance may mask their potential to be misleading when judging the reasonableness of a driver's unsuccessful response to avoid an accident. In legal disputes, attorneys will retain scientific experts to scrutinize animations to verify their accuracy and their compliance with the laws of physics. However, generally not challenged is the fact that animations illustrate the outcome and consequences of a driver's response which cumulate in an often attention-grabbing collision and from points of view that the driver did not have. Yet, drivers are not to be judged on the consequences of their actions, but on the reasonableness of their actions before the harm occurred. This *danger to be misleading* is of importance to any driver who may find himself in the unfortunate position of having to defend his unsuccessful attempt to avoid an accident, whether in a courtroom setting or any other venue were an animation is presented to judge his driving performance.

Indeed, psychological research has identified cognitive processes that may impair one's ability to mentally return to the past after reviewing the outcome of events that turned out badly, and to attempt to foresee what was yet to come from the point of view of those who experienced the events firsthand. Hindsight bias, counterfactual thinking and the actor/observer effect are examples of cognitive processes with well-established research literatures that, unfortunately, remain unfamiliar to many legal experts, safety professionals, accident scientists and accident reconstructionists. Within the context of traffic accident analysis, these biases relate to one significant yet often overlooked point – observers know *now* far more about an accident than the drivers knew *then*.

This is no small problem. Negligence law for example, requires judgment of whether a defendant's conduct breached a duty of care based on the defendant's knowledge *before* the plaintiff's injury (American Law Institute, 1965). In a legal negligence cause of action: *"the actors conduct must be judged in light of the possibilities apparent to him at the time, and not by looking backward 'with the wisdom born of the event.' The standard is one of conduct rather than of consequences. It is not enough that everyone can see now that the risk was great if it was not apparent when the conduct occurred"* (Keeton, 1984). Moreover, "foreseeability is an element of fault; the community deems a person to be at fault only when the injury caused by him is one which could have been anticipated because there was a reasonable likelihood that it could happen" (Stewart v Jefferson Plywood Co., 1970). Clearly, hindsight bias is a potential obstacle along the road to fair judicial outcomes and in any application where animations are used to judge driver performance during an accident. Does computer recreation of traffic accidents exacerbate hindsight bias and influence judgments of blame? This is an important question, perhaps not well appreciated by the proponents of the use of computer animations for traffic accident analysis.

This article explores how computer animation may heighten hindsight bias and alter perceptions of blame within the context of traffic accident analysis. Along the way, we review related theory on counterfactual thinking and the actor/observer effect and point out how these cognitive phenomena might potentially hinder fair judgments. We conclude that the research record yields considerable cause for concern about the use of computer animation of traffic accidents in its current familiar forms, and that this concern demands further research and debate. Moreover, in legal matters, when examining whether "its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury..." as required by Rule 403 in the Federal Rules of Evidence (Federal Rules of Evidence, 2010), these biases demand serious consideration by "gatekeepers" of the court.

STATE OF THE ART: COMPUTER ANIMATION

Computer animation is essentially a series of sequential still frame images created with the use of computer graphics software and displayed in rapid succession (typically 30 frames per second) to portray vehicle movement as is done cinematographically in motion-pictures and cartoons. The data required to position the vehicles within the animation from frame to frame is obtained from interpretation of physical evidence, witness observations, hand calculations or mathematical computer simulation and artistic judgment. The difference between computer simulation and computer animation is sometimes unclear to those not familiar with the technology. Simulation is a scientific method of analysis whereas animation is a graphic method for visualizing the results of the analysis. Computer animation is typically prepared to help lay observers understand the results of what may be a complex scientific and mathematical reconstruction.

Objects depicted within animation frames can be displayed in detail ranging from crude wire-frame stick figures on the low end to photo-realistic images of vehicles, roads and surrounding scenery on the high end. The technology has matured to the point where animations are routinely made on the high end, approaching photographic quality. The realism of some computer animations, as we have seen in films like *Toy Story, Monsters Inc* and *Meet the Robinsons,* can be quite remarkable.

However, whereas the characters in Toy Story can easily be made to defy the laws of physics, real vehicles cannot, raising the concern that an animated reconstruction is only as valid as its underlying analysis. A simulation can be made to follow precisely the physical laws of nature based on available empirical evidence such as skid marks, gouge marks, fluid trails, debris, points of rest, vehicle crush damage, etc. Animations that are comparable to actual video recordings in their realism might mask the fact that many parameters of the animations are subject to interpretation. For the viewer, the vividness of the animation might mask aspects of the animation that are based on the analyst's and animation specialist's interpretation versus how it actually appeared and what actually occurred.

An animation will orient the observer's full attention through the narrow window of a computer monitor from any perspective desired, including from directly overhead, from behind or the side and from the point of view of any driver. Overhead perspectives can clearly illustrate the simultaneous convergence of the involved vehicles on their respective collision courses. Some animations even utilize split screens and show two different views simultaneously. An animation can be presented in real time but also in slow motion to give observers more time to comprehend the fast-moving action. An animation can be played and replayed from several different perspectives, zoomed in and zoomed out, until every physical aspect of the accident episode has been thoroughly addressed. Importantly, however, the drivers were clearly not so well informed from their point of view in the driver's seat before the injuries occurred.

Being primarily a visual tool, an animation will illustrate a *physical explanation* of the movements of the vehicles involved, all of which can be based on mathematical simulation, defined by the evidence and the laws of physics. Animations, at least in their current familiar forms, cannot illustrate a *behavioral explanation* for *why* the active driver erred in the first place or *why* the reactive driver responded in a way that was ultimately not successful. Behavioral explanations depend on the ability of the observer to visualize the situation that confronted the driver(s) during the seconds before the injuries occurred and to judge what was or was not foreseeable from the driver's point of view during that time and under the same or similar circumstances. This, as we shall see in the following sections, is not an easy task under the best of circumstances.

JUDGING "FORESEEABILITY" OF ONCE FUTURE EVENTS

Typical two vehicle traffic accidents begin when the error of one driver, call him "active," suddenly disrupts the otherwise stable and routine travel of another driver, call him "reactive" (Malaterre, 1988). The active driver may err, perhaps because of a slip, lapse or mistake (Reason, 1990). The error demands that the reactive driver take notice and quickly respond to avoid a collision. The reactive driver may brake, swerve or do nothing, impulsively betting on a response to prevent an accident (Prynne & Martin, 1995). Some will claim that although the active driver may have created a conflict, the reactive driver was responsible for causing the conflict to escalate to an accident. Typical claims made against the reactive driver include failure to drive defensively, not anticipating the conflict, inattention, poor judgment, overreacting and taking the right-of-way when it was not safe to do so (Dilich, Kopernik, & Goebelbecker, 2003). Thus, the involved parties often dispute the causes of a traffic accident, especially when there were serious injuries for which someone will most certainly be blamed.

When traffic accidents enter into litigation to resolve disputes about who was responsible, the injured plaintiff will attempt to prove that the defendant driver's conduct was "negligent" and caused the injuries. A negligence cause of action involves several elements that must be addressed before negligence and then liability can ultimately be established. The traditional elements are duty, breach of duty, proximate cause and damages. One of the most important factors to consider in establishing both negligence and liability is the "foreseeability" of harm before the harm occurred.

Foreseeability of the unreasonable risk of harm is one of the most important factors in evaluating reasonableness; yet judging foreseeability in hindsight remains an extraordinarily difficult cognitive task. Whereas people routinely attempt to foresee the chance of events occurring in the future, it feels odd and almost meaningless to look back and try to foresee the chance of events that have already occurred. For example, while we routinely estimate the chance of rain tomorrow, because it matter to us, estimating the chance of rain yesterday sounds meaningless (Teigen, 1998). Few have experience in making such backward cognitive predictions, especially in matters where their judgment may lead to serious consequences for others. Yet, when the event was a serious accident and people try to make sense of what happened and attribute responsibility for the error(s) that caused the injuries, such backward predictions become the decisive factor in judging foreseeability. It is specifically with regard to judging *foreseeability* of once future events where animations can distort an observer's judgment.

HINDSIGHT BIAS

The hindsight bias is reflected in an inability to appreciate the complexity, unpredictability, and even confusion of the events leading to negative outcomes such as traffic accidents. Once the facts become known, observers often exaggerate the certainty of a given outcome, believing that they "knew it all along." (Fischhoff, 1975b; Hawkins, Hastie, 1990; Roese, 2004). New evidence reveals that hindsight bias also influences basic visual perception, in that people believe that they "saw it all along" (Harley, Carlsen, & Loftus, 2004). That is, people are overconfident in their ability to have recognized familiar but obscured objects, but only after they learn exactly what those objects are. A striking example is a 6-year study conducted in a Mayo Clinic lung cancer-screening program. Whereas radiologists examining chest radiographs may see no evidence of tumor, different radiologists subsequently reviewing the same radiographs, *once a tumor has been confirmed*, are much more likely to see evidence of a tumor where the earlier radiologists saw none (Muhm, Miller, Fontana, Sanderson, & Uhlenhopp, 1983). Harley et al (2004) commented: "The 'overlooked' tumors became visible in hindsight not because they were more detectable to begin with, but because the physicians had the benefit of outcome knowledge" (p. 961). Importantly, the newest laboratory evidence confirms that visual hindsight bias is larger for more difficult or complicated judgment tasks (Harley et al., 2004).

Other researchers have confirmed the prevalence of hindsight bias specifically within the context of accident analysis. In a report for the U.S. Department of Defense concerning the analysis of human error, Woods et al. (1994) strongly warned of the pitfalls of hindsight bias. The authors recognized that most traces of causality begin with the outcome and trace backwards in time until they encounter a human whose actions seem to be, in hindsight, inappropriate or sub-optimal. The dilemmas facing the practitioner in situ – the uncertainties, tradeoffs and attentional demands – all may be under-emphasized when an incident is viewed in hindsight.

Where does this hindsight bias come from? Although several factors contribute to it, the main reason is that when outcome information becomes known, it is rapidly integrated and connected with other, related information stored in human memory (Blank & Nestler, 2007; Carli, 1999; Hoffrage, Hertwig, & Gigerenzer, 2000). In hindsight, those reasons and insights that are consistent with and fit the outcome, such as a car crash, become associated in memory with the basic facts and details of the accident. These might include, for example, the fact that a collision actually occurred, the actual responses attempted by each of the drivers, the precise location of the collision, the precise location of one vehicle relative to the other at impact, and the degree of damage and injury. As a consequence, an aura of certainty and understanding pervades perceptions of the past that the drivers did not have at the time their respective situations were unfolding (Hawkins & Hastie, 1990; Carli, 1999; Joslyn, Loftus, McNoughton, & Powers, 2001). What actually happened becomes a vivid and precise point of reference for what should not have happened and then what could have been done differently for a better outcome. This same process may underlie jurors' inability to disregard evidence presented inappropriately in court (Hawkins & Hastie, 1990). Once the bell has rung, it cannot be unrung!

If a computer animation were to be played only one time, only in real time, only from the driver's point of view and stopped right when the threat of a collision was first apparent, naive observers might get a sense of the uncertainty and ambiguity of what might come next. They might imagine several different possible outcomes, some minor and some serious, some harmless and some lethal. This is not the way computer animations are typically used, however. Rather, viewers have considerable background knowledge about the accident by the time they see the animation. Further, the animations typically play through the entire accident episode, portraying the aftermath in vivid detail. They are typically repeated several times, sometimes from different points of view, further dramatizing the outcome. Animations exploit "wisdom born of the event" by removing the challenge to foresee, thus minimizing any appreciation of the driver's uncertainty, surprise or confusion.

A fundamental problem with computer animation is that "unfortunately, people always judge conduct on its consequences" (Baron & Hershey, 1988). Ironically, the very consequences (i.e., in most cases a gruesome accident) that are irrelevant and must be ignored when judging a driver's conduct are the most dynamic, compelling and fascinating part of an animation to watch. The seconds prior to the collision, when multiple possibilities are apparent and when the driver's conduct ought to be judged, are usually ordinary and uneventful. The omniscient view, the attentional focus, the uninvolvement, and the time for extended consideration are all luxuries afforded to observers of animations in hindsight that were not available to the drivers at the point in time, before the collision, when their conduct must be judged. Are animations inadvertently encouraging viewers to test their own imagined ability to avoid the accident, blessed with hindsight and several chances to do better, as their reference for what was reasonable?

Hindsight Bias, Modes of Presentation, and Blame

Hindsight bias is of grave concern to the legal community primarily because it directly impedes just perceptions of blame (Harley, 2007). Reason (1990) cautioned that when blessed with both uninvolvement and hindsight, there is a great temptation for retrospective observers to slip into a censorious frame of mind and to wonder at how people could have been so blind, stupid, arrogant, ignorant or reckless. Indeed, several prior research studies have demonstrated how hindsight bias can influence the perceived reasonableness of conduct in diverse cases involving an illegal search and seizure lawsuit brought against police officers (Casper, Benedict, & Perry, 1989), an environmental pollution disaster (Brown, Williams, & Lees-Haley, 1994), prenatal testing regarding genetic disorders (Menec &Weiner, 2000), mental health malpractice litigation (Wexler & Schopp, 1989), and decisions by therapists regarding potentially dangerous patients (LaBine & LaBine, 1996). In all these studies, the knowledge that a negative outcome had occurred directly affected participants' perception of liability, and the extent of perceived responsibility, blame, or negligence that presumably rests with the involved parties (Kamin & Rachlinski, 1995; Hastie, Schkade, & Payne, 1999).

Although the above research has examined hindsight bias in a legal context, only a few studies have recognized the psychological implications of computer animation per se (Feigenson & Dunn, 2003; Fiedler, 2003). Currently available evidence is somewhat inconsistent. An early study found a biasing effect of video animation (Kassin & Dunn, 1997), whereas a later one reported null results (Bennett, Liebman, & Fetter, 1999). Dunn, Salovey, and Feigenson (2006) investigated whether there are biasing effects depending on the type of presentation (animation vs. diagram) that both involved legal parties utilized (i.e., type of presentation was fully crossed with involved legal party). The authors found biasing effects of animation in an unfamiliar context (plane accident), but not in a familiar one (automobile accident). However, participants in the study were presented with an abundance of trial information before the experimental manipulation, which leaves open the possibility that the results are due to idiosyncrasies of the information presented during the trial as opposed to familiarity with the subject matter per se.

The current study examined the impact of computer animation on hindsight bias. We presented the same information regarding a traffic accident in two ways: computer animation versus text-plus-diagrams. As the index of hindsight bias, we compared judgments made in foresight (before the accident occurred) to those made in hindsight. We further examined how these factors influenced judgments of blame.

Some of these data appeared in a previous publication (Roese et al., 2006), which included 3 additional experimental conditions alongside the 4 conditions discussed in the present article. This earlier publication emphasized the theoretical implications of a propensity effect (i.e., hindsight bias reversal when a collision feels imminent). Only data regarding the likelihood dependent measure were presented; data regarding the blame dependent measure (more relevant to the issue of hindsight bias in the courtroom) appears here for the first time. As well, procedural and statistical details left out of the previous publication (because of its brief report format) are presented here for the first time.

METHOD

Participants

Participants were 117 (61 women, 56 men) undergraduate students from the University of Illinois who completed the experiment for course credit (age M = 18.8, SD = 1.51). The experiment employed a 2 × 2 factorial design, in which two modes of presentation (computer animation vs. text/diagram) were crossed with two outcome conditions (foresight vs. hindsight).

Stimuli and Procedure

Participants were told that they would see information pertaining to traffic situations, and that some cases would involve accidents and some not (in actuality, both cases involved serious accidents). The standard index of hindsight bias is the between-participant contrast between those who see the outcome (hindsight condition) and those who see only the run-up to the outcome, but not the actual outcome itself (foresight condition). Participants in the hindsight condition saw the full accident cases, which ended after the vehicles collided and then came to rest. In the foresight condition, the cases terminated before a collision became imminent, i.e., as the vehicles converged but before they became near enough to suggest an inevitable accident. All testing took place using Pentium 4 desktop computers with 17” CRT monitors.

The computer animations were prepared for real court cases and provided to us by Eleventh Hour Animation of Skokie, IL. The first depicted an automobile following a semi-trailer on a 2-lane highway, attempting a pass, then colliding with a second semi-trailer approaching from the opposite direction (duration = 19 s). The second depicted a semi-trailer avoiding a slow-moving automobile turning in front of it onto a 2-lane highway, then colliding with a bus approaching from the opposite direction (duration = 11 s). Both animations portrayed events in color from an oblique (bird’s eye) view that illustrated the simultaneous convergence of vehicles. The text/diagram control versions of these two cases included a short paragraph-length text description, accompanied by simple plan-view diagrams, assembled into a sequence of PowerPoint slides that were controlled by the Medialab software. Order of presentation of the two accident cases was randomized.

Two dependent measures were used. Intended to gauge hindsight bias, the first was a likelihood estimate for the occurrence of a serious accident. Participants gave estimates for three possible outcomes: no accident, minor accident, and serious accident. Because the latter is what actually occurred, this estimate was taken as the index of hindsight bias. Participants assigned likelihoods ranging from 0 to 100% using a computer interface that forced them to sum the three outcome likelihoods to 100%. For those in the foresight condition, these were likelihood predictions for the three possible outcomes. For those in the hindsight condition, the judgment task was to disregard their knowledge of the observed serious accident outcome, place themselves in the shoes of those in the foresight condition, and estimate the likelihoods that those participants perceived. To hold number of viewings constant, those in the no-outcome conditions were shown the same stimuli twice.

An important issue involved in the procedure used in this experiment is that the hindsight discounting instructions demanded temporal specificity. That is, unlike previous hindsight bias research, which typically used a brief verbal instruction to disregard a line of text, judgments of unfolding, dynamic events require additional specification of precisely which point in time participants should go back (thus discounting events that came after that point in time). Indeed, this question turned out to be so critical that it spawned a separate line of research (Roese et al., 2006). In the present experiment, the time point was illustrated by presenting the events a second time but stopping it at the key point, with participants asked to disregard whatever came next. The point in time was not, however, the same point in time at which the foresight condition sequence terminated, but rather came a little after. Although this procedure was ideal for studying the propensity effect (described in Roese et al., 2006), it is suboptimal for present purposes in that it results in an overestimate of hindsight bias effect size. Because our main hypothesis focused on the moderating effect of mode of presentation on hindsight bias (i.e., the relative difference in hindsight magnitude between text/diagram and forensic animation conditions), this drawback in no way compromises our conclusion that forensic animation exacerbates the hindsight bias.

The second dependent variable was blame, assessed using 3 Likert scales. Only those participants in the hindsight condition completed these measures, as it would be odd to assign blame for an outcome that has not in fact happened. The following 3 ratings were answered on 11-point scales marked with 0 and 10 as endpoints: blame (endpoints labeled "not at all to blame" and "completely to blame), responsibility (endpoints labeled "not at all responsible" and "completely responsible"), and cause (endpoints labeled "not at all a cause" and "the total cause"). The order with which these items were rated was randomized across participants. Further, each of these three ratings was completed for each of three targets: 1) the active driver (initiated the chain of events resulting in collision), 2) the reactive driver (responded first to the active driver's actions), and 3) bystander driver (a third driver who unlikely to be seen as responsible for the collision).

Results

We tested whether computer animation exacerbates the hindsight bias relative to the text/diagram condition using a 2 (outcome: foresight vs. hindsight) × 2 (presentation mode: animation vs. text/diagram) ANOVA. The outcome main effect was significant, showing that overall hindsight participants gave greater likelihood estimates for a serious automobile accident ($M = 34.1\%$) than did foresight participants ($M = 19.5\%$), $F(1, 113) = 23.0$, $p < .001$, $d = .90$. More important, the interaction was also significant, $F(1, 113) = 3.93$, $p = .05$, $d = .37$. Although the hindsight was significant in the text/diagram conditions (*M*s = 30.5% vs. 21.9% for hindsight vs. foresight, respectively), $t(60) = 2.04$, $p = .05$, $d = .52$, the effect was much stronger within the computer animation conditions (*M*s = 37.6% vs. 17.0%), $t(53) = 4.69$, $p < .001$, $d = 1.34$. The text/diagram hindsight bias effect size (.52) falls between the mean effect sizes of .36 and .61 reported for this type of hindsight bias paradigm in two meta-analytic reviews (Guilbault et al., 2004; Christensen-Szalanski & Willham, 1991, respectively). In both reviews, the relevant paradigm was labeled "case history;" elsewhere it has been labeled the "hypothetical paradigm" (see Roese, 2004). Placed against this benchmark, the effect of forensic animation very clearly seems to be one that more than doubles the magnitude of hindsight bias typically reported, results depicted in Figure 1.

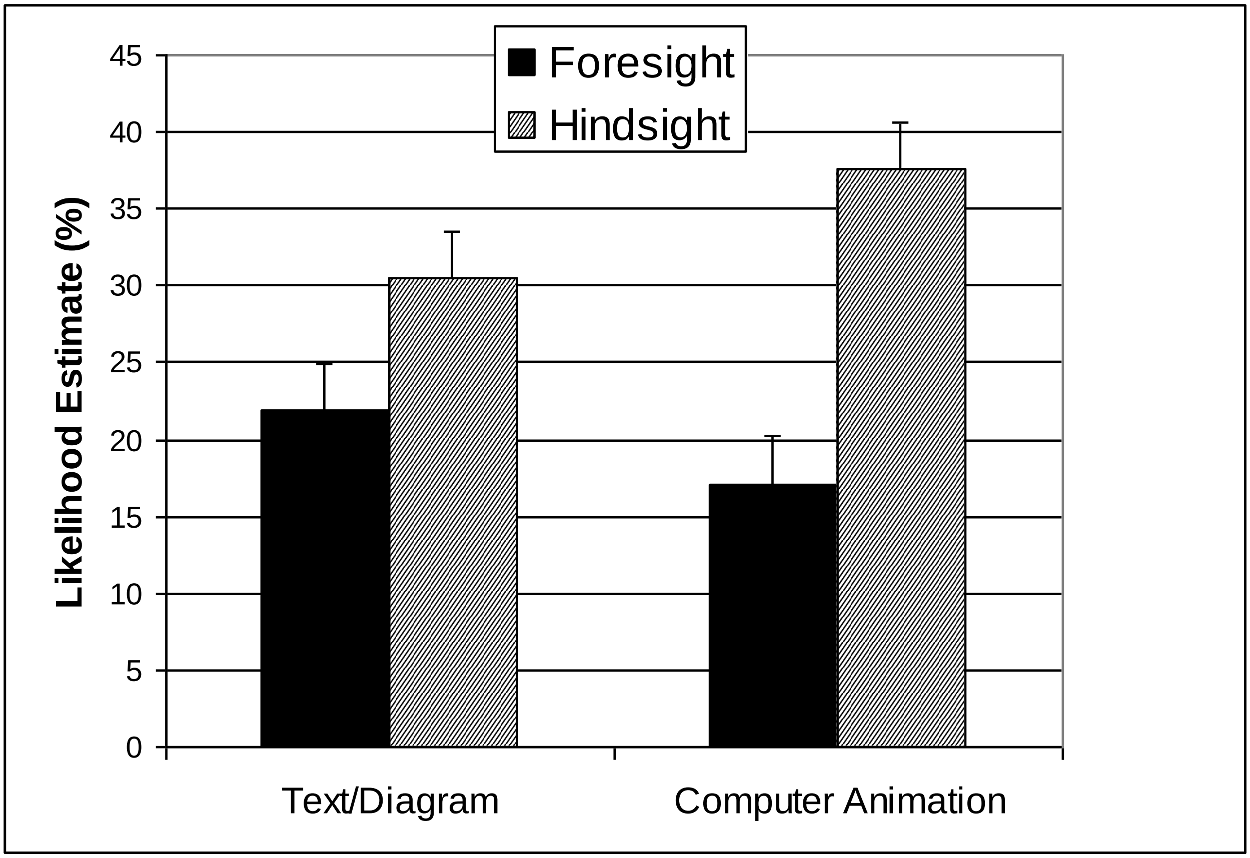

Figure 1: Effect of Computer Animation on Hindsight Bias

We next examined the effect of computer animation on blame judgments. Recall that only participants in the hindsight conditions completed these measures, which consisted of 3 Likert ratings for each of three drivers involved in the accidents. On average these ratings were highly correlated (mean $r = .71$, of 18 possible correlations), and so were averaged to create a single index of blame for each of the three drivers, averaged across the two driving cases. Mean blame ratings were assessed using a 2 presentation mode (animation vs. text/diagram) × 2 (target: active driver, reactive driver, bystander driver) ANOVA, with the latter factor a within-participant variable. The key finding was a significant interaction effect, $F(1, 59) = 5.21$, $p = .03$, $d = .59$, which is depicted in Figure 2.

Pairwise contrasts showed that whereas blame ratings for the active driver and the bystander driver did not vary as a function of the presentation mode manipulation (ps = .47, .44), blame ratings for the reactive driver were heightened in the animation condition ($M = 4.76$) relative to the text/diagram condition ($M = 3.71$), $t(59) = 3.03$, $p = .004$, $d = .79$. In other words, the reactive driver was thought to be more responsible for an accident that was presented using animation than with text/diagrams.

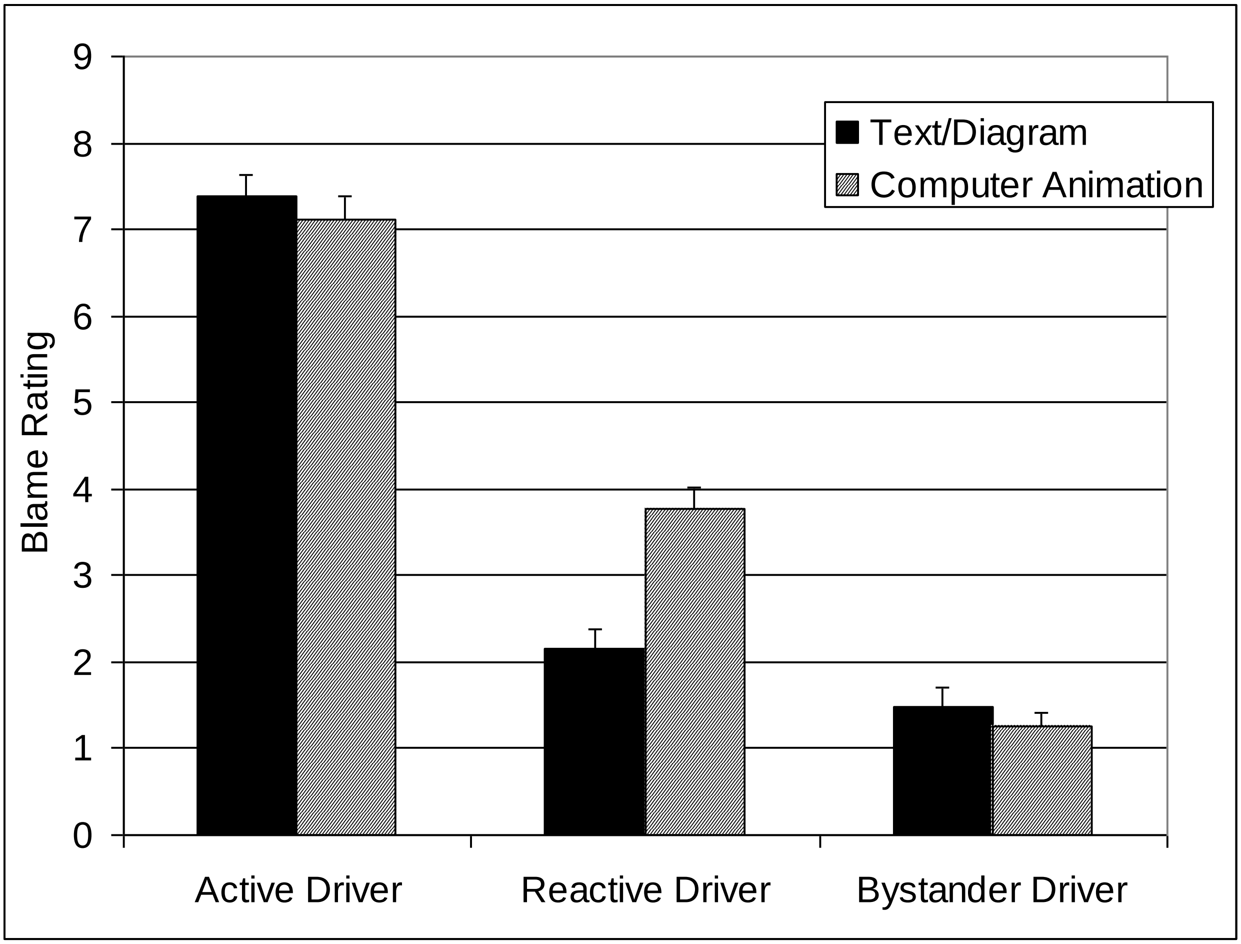

Figure 2: Effect of Computer Animation on Blame Ratings

GENERAL DISCUSSION

The present experiment demonstrated that computer animation exacerbates hindsight bias relative to similar case information presented using text and diagrams. In addition, the experiment suggests that it is reactive drivers who bear the brunt of this biasing effect. That is, reactive drivers were blamed more when the case information was presented using computer animation, but no such effects were observed in participant's blame judgments regarding the active driver or a third, bystander driver. We turn next to several implications of our analysis of the hindsight bias and computer animation, and as well raise several new questions that we hope will be addressed in future research.

Counterfactual Thinking

Counterfactual thinking refers to imagining how the past might have been different (Mandel et al., 2005; Roese, 1997). What if a driver had braked a bit earlier, or sped up, or slowed down? Might these actions have resulted in the avoidance of the accident? Counterfactual has long been understood by legal scholars to be a component of causation (e.g., Hart & Honoré, 1985). That is, causation of the form "cause in fact" may be established by a "but for" criterion (e.g., driver X is the cause in fact because the accident most certainly would have been avoided but for the actions of driver X; Spellman, & Kincannon, 2001). Psychological research has shown that subtle cues that influence counterfactual thinking also influence causal inference and blame judgments (Macrae, 1992; Roese & Olson, 1996; Wells & Gavanski, 1989).

Counterfactual thinking can exacerbate the hindsight bias. At first glance, this seems a peculiar conclusion, in that beliefs in how an outcome might have been different (counterfactual) would seem to be at odds with and hence weaken beliefs that what did happen had to happen the way it did (hindsight bias). But because counterfactual thinking often helps people to understand and make sense of events, it can indeed make the hindsight bias even worse. For example, a sports fan might react to a loss with the counterfactual judgment that the team would have won were it not for an injury suffered in the fourth quarter. Without that injury, a victory would have been assured, but with it, the loss was inevitable. In this way, the counterfactual points to some causal feature that accounts for the outcome, yielding a satisfying feeling of explanation, clarity, and certainty (Roese & Maniar, 1997; Roese & Olson, 1996).

Therefore, counterfactuals that focus attention on a particular person's actions may also heighten judgments of blame to that person. An animation that throws a spotlight on the reactive driver by depicting an alternative sequence of events contingent on that driver's alternative action (driving a bit slower, say) will correspondingly heighten the amount of blame accorded to that driver. To be fair, the reactive driver *could have* behaved differently, but so too might the active driver, and so too might any number of other variables have been different.

When an observer focuses on the actions of the reactive driver involved in an accident, there is a natural tendency to imagine how the accident could have been avoided if only that driver had done something different. What if the driver was traveling a bit slower? What if the driver responded by swerving right instead of left? What if the driver had responded only one second sooner or for that matter, one second later? Any particular piece of the accident outcome may be altered, with new consequences vividly visualized with the help of computer animation. Importantly, counterfactuals can only *become* counterfactuals after the fact. One needs to know the outcome before a counterfactual alternative to that outcome can have the status of "might have but definitely did not occur." Although counterfactual thinking may be acceptable when determining whether a driver's conduct was in any way causally linked to an accident (i.e., the "but for" test), extending its use to judging *foreseeability* constitutes a potentially gross violation of negligence law by *looking backward with the wisdom born of the event*.

Point of View

Computer animation of traffic accidents channels the observer's attention into the narrow window of a computer monitor. Within this visual world, the animator will have selected a certain visual perspective, or point of view. The view might be a vertical "straight-down" map view, it might be an aerial "bird's eye" view and/or it might even be the driver's first-person view through the windshield. Indeed, in many currently available home computer video games that depict simulations of driving, players have the option of themselves selecting from many such points. For courtroom applications, the animation's point of view may have been selected arbitrarily by the animator, but more likely certain perspectives and vantage points are intentionally requested to support the architect's position. The reason why they might request this is that point of view matters. Point of view can, in and of itself, bias causal judgment.

Point of view and perceptions of responsibility. In research on the actor/observer effect dating to the 1970s, it became clear that point of view plays an important role in causal judgment (Nisbett, Caputo, Legant, & Marecek, 1973; Watson, 1982). The actor/observer effect is defined as the tendency for people to explain their own behavior in terms of situational constraints, but others' behavior in terms of enduring dispositions. Although there are several underlying mechanisms that contribute to the actor/observer effect, one important contributor rests on attention and to the visual salience of self vs. others. In short, people ascribe greater responsibility to those who dominate a visual scene (Lassiter, Geers, Munhall, Handley, & Beers, 2001). Accordingly, a point of view that emphasizes the actions of a person within an observer's visual field will serve to accentuate the causal responsibility ascribed by the observer to that person.

A classic study by Storms (1973) made use of then-novel videotape technology as a means of altering point of view. Participants took part in a procedure involving getting acquainted with a stranger. Four people participated at any one time: two actors who conversed to get acquainted, and two observers who simply watched. These interactions were later judged in terms of characteristics such as friendliness, nervousness, dominance, and also which actor contributed the most to the tone of the interaction. Observers were required to focus their attention on only one person involved in the interaction. Results showed whichever person they focused on was judged to be more responsible for the tone of the interaction. The entire interaction was also videotaped from two different vantage points that highlighted one or the other actor in a headshot. In a later phase of the experiment, observers watched the previously observed interaction again on videotape. If they saw a video depiction from a new vantage point, one that made salient the actions of the other actor, they attributed more responsibility for the interaction to that other actor. Lassiter and Irvine (1986) replicated this finding. In their study, participants watched mock police interrogations on video that varied as to whether visual prominence of the detective versus the suspect. Participants deemed the suspect guiltier when he was more prominent. In short, whichever person or object assumes visual prominence tends to be seen as playing a greater causal role in the situation at hand (see also Pryor & Kriss, 1977; Taylor & Fiske, 1975).

This line of research indicates that skillful manipulation of point-of-view may be used to influence judgments of blame. A computer animation that places one driver's vehicle in the central field of view, or zooms in on this vehicle during the crash, may result in exaggerated perceptions of causal responsibility on the part of viewers.

Debiasing

Given the pitfalls in judgment that video animation might create, an important practical question is how such cognitive biases might be eradicated. Debiasing refers to techniques designed to mitigate bias in general, but past research indicates only mixed success (Hawkins & Hastie, 1990; Arkes, 1991; Stallard & Worthington, 1998). Unfortunately, hindsight bias has proven remarkably resistant to many efforts at debiasing. Recent research does suggest a glimmer of hope, however, for minimizing the influences of specific causal factors discussed above.

The "alternative explanation" technique has recently been shown to be effective for debiasing (e.g., Hirt, Karde, & Markman, 2004). This technique compels observers to consider, in detail, *multiple* causal explanations, rather than the causal explanation that may be highlighted by a single counterfactual animation. Via consideration of alternative explanations, "new causal skids are greased." "If the occurring event cued its own causal chains, then considering the non-occurring event ought to accomplish the analogous result, thereby reducing the bias" (Arkes, 1991; see also Hirt & Markman, 1995). This technique tends to be more effective to the extent that full, deep, and vivid evidence corresponding to each alternative is either presented or is encouraged to be constructed by individuals (Kamin & Rachlinski, 1995). Accordingly, one possible solution might involve the presentation of several animations emphasizing two or more causal explanations (e.g., one counterfactual animation might dramatize a causal explanation centering on the reactive driver's action – "what if he had braked sooner?"; another might emphasize the active driver – "what if she had waited before making the left turn?"; still another might emphasize situational factors – "what if the setting sun was not in the driver's eyes?"). The underlying logic is that in using the animations to illuminate alternative explanations, jurors do not become fixated on a single explanation, which is known to worsen hindsight bias. If the court permits the presentation of even one counterfactual that illustrates what the reactive driver, for example, *could have* and *should have* done differently to have avoided the collision, then several other alternative counterfactuals should also be permitted to neutralize the potential for this bias.

Research on the actor/observer effect suggests that visual point of view can influence causal judgments. This same line of work suggests that care in presentation of multiple points of view as part of a coherent presentation would serve to minimize the biasing effect of a single point of view. In other words, presenting several animations of the same event from several views (three or four, for example) will render each party's behavior salient and ameliorate the actor/observer bias by equalizing the attention observers pay to the drivers' behavior. Likewise, an aerial viewpoint might predispose observers to equally consider the behavior of the active and reactive driver. Although this technique may help to minimize the actor/observer bias, it may also, unfortunately, exacerbate the hindsight bias by providing observers with additional outcome information from multiple points of view.

Smith and Greene (2005) investigated the usefulness of bifurcation in a traffic accident trial in order to reduce hindsight bias and its associated consequences. Contrary to a unitary trial in which all issues are presented before deciding the case, a bifurcated trial involves some kind of separation of the liability verdict from damage awards. In one form of bifurcation, the two stages of the trial are conducted with two different juries, ensuring that one jury hears only evidence that pertains to establishing liability, and a different jury hears only evidence that pertains to the award of damages. Participants in one condition learned about all available evidence, including the conduct of the defendant and the injuries sustained by the plaintiff (control condition). In a second condition, participants were given the same information but were admonished throughout the presentation on how to use the information appropriately. Participants in the two other conditions either learned only about the conduct of the defendant or only about the outcome of the accident (bifurcated presentation). Bifurcation relative to the control condition reduced negligence judgments, judgments of harm, and damage awards for economic losses, whereas admonitions were ineffective in reducing the inappropriate blending of conduct and consequences by mock jurors.

Strict controls might be placed on a jury's exposure to animations. Because the involved drivers experienced the event only one time from only their respective points of view, in a unitary trial, a jury might be shown the animation only one time, only in real time, only from the driver's point of view and only up to when the threat was first becoming apparent, thus quashing the tendency to hyperanalyze the performance of the driver(s) from multiple standpoints. On the extreme, perhaps the jury should be shown the animation only at the very beginning of trial, before they even learn about the nature of the accident or its outcome. Although the jury would likely be more focused than were the drivers involved, this technique might preserve some of the uncertainty involved, and thus better appreciate the experience of the driver in the moments before the accident.

CONCLUSIONS:

Computer animation is clearly here to stay, and as costs to produce it decline its use is sure to expand. Computer animation appears on first glance to be a useful tool for clarifying complex information, particularly cases involving events that unfold rapidly, as in traffic accidents. Our research indicates that hindsight bias, however, may be exacerbated by the use of computer animation, and that judgments of blame may be influenced as a result. In particular, it is the reactive driver who likely bears the brunt of the biasing impact of computer animation. Although this research is at a preliminary stage, we have reviewed several other lines of research on counterfactual thinking, point of view, actor/observer effects, and debiasing techniques that shed additional light on this topic. We hope this overview stimulates new attention to the psychological consequences of using computer animations when judging the performance of drivers in traffic accidents, whether in a courtroom setting or any other venue.

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