

CARSWELL

**ANNUAL REVIEW
OF
CIVIL LITIGATION**

2017

**THE HONOURABLE
MR. JUSTICE TODD L. ARCHIBALD
SUPERIOR COURT OF JUSTICE (ONTARIO)**



THOMSON REUTERS®

© 2017 Thomson Reuters Canada

NOTICE AND DISCLAIMER: All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher (Thomson Reuters Canada, a division of Thomson Reuters Canada Limited).

Thomson Reuters Canada and all persons involved in the preparation and sale of this publication disclaim any warranty as to accuracy or currency of the publication. This publication is provided on the understanding and basis that none of Thomson Reuters Canada, the author/s or other persons involved in the creation of this publication shall be responsible for the accuracy or currency of the contents, or for the results of any action taken on the basis of the information contained in this publication, or for any errors or omissions contained herein.

No one involved in this publication is attempting herein to render legal, accounting or other professional advice. If legal advice or other expert assistance is required, the services of a competent professional should be sought. The analysis contained herein should in no way be construed as being either official or unofficial policy of any governmental body.

A cataloguing record for this publication is available from Library and Archives Canada.

ISBN 978-0-7798-7863-5

Scan the QR code to the right with your smartphone to send your comments regarding our products and services. Free QR Code Readers are available from your mobile device app store. You can also email us at cars-well.feedback@thomsonreuters.com

TELL US HOW WE'RE DOING

Scan the QR code to the right with your smartphone to send your comments regarding our products and services.

Free QR Code Readers are available from your mobile device app store.

You can also email us at feedback.legaltaxcanada@tr.com



THOMSON REUTERS CANADA, A DIVISION OF THOMSON REUTERS CANADA LIMITED

One Corporate Plaza

2075 Kennedy Road

Toronto, Ontario

M1T 3V4

www.carswell.com

Customer Support

1-416-609-3800 (Toronto & International)

1-800-387-5164 (Toll Free Canada & U.S.)

Fax 1-416-298-5082 (Toronto)

Fax 1-877-750-9041 (Toll Free Canada Only)

Email CustomerSupport.LegalTaxCanada@TR.com

Failing to Predict the Past: Will Legal Causation Kill Tort Law in Cyberspace?

R. LEE AKAZAKI, C.S.*

I. INTRODUCTION

A lawyer jaywalks across a Toronto street to avoid being late for a firm risk management committee meeting. While she does so, she texts her colleague in Calgary with instructions on containing the legal liabilities arising from a northern Alberta oil plant shut-down that has occurred after an eco-terrorist hacked into the plant's mainframe computer.¹ It is at this moment that she is struck by an autonomous delivery van. The van was travelling the wrong way down a one-way street because the city transportation department has not uploaded a temporary change to traffic direction to accommodate a condo developer. An algorithm built into the telephone service to warn the lawyer of oncoming traffic fails to alert her because the coding engineer saved money by writing the algorithm based on map data and vehicle presence, but not directional traffic flow. Who is at fault, and for what consequences?

Under a statutory reverse onus, the pedestrian's injury or death arose from the presumed negligence of the owner of the van.² That reasoning, however, would never provide a conclusive answer. Before one starts to consider the actual negligence of the parties, it is necessary to collapse our preconceptions of proximate cause. A reality in which one party's cybernetic device can harm another's from a remote location necessitates a jolt to the central nervous system of tort law. The answer to the question, "Who is my neighbour?" posed by Lord Atkin in *Donoghue v. Stevenson*³ as the original basis for a duty of care outside of contract, can now be any number of affected parties, anywhere. The question "Who?" no longer informs the legal determination of proximity or remoteness. Nor does the fact that property and events in cyberspace have no physical abode, a true impediment to the ability of Canadian courts to accept jurisdiction.⁴ If *everyone* — as opposed to *anyone* — is my neighbour (as

* Of the Ontario Bar. The author is grateful to Amanda Kreidié for her editorial assistance and Craig Allen for his actuarial support.

¹ In sequence, the plant's security breach was the original cause of both the shut-down and the pedestrian injury.

² Ontario *Highway Traffic Act*, R.S.O. 1990, c. H.8, s. 193(1).

³ *Donoghue v. Stevenson*, [1932] A.C. 562, [1932] All E.R. Rep. 1 (H.L.).

⁴ Jeremy De Beer and Tracey Doyle, "Dealing with Digital Property in Civil Litigation,"

illustrated by the indeterminate and foreseeable global harm resulting from a virus or other malware spread by the email server of a well-connected retail chain, Internet business, or service firm), foreseeable scope of harm is not helpful to the law.⁵ “*Did my neighbour cause me harm warranting compensation?*” becomes the more salient question. In cyberspace, the law must shift the task of limiting liability from scope of duty of care based on foreseeability to likelihood of harm based on reasonable prediction of cause.

Because tort law assigns responsibility for harm among strangers, it necessitates a general theory of causation in a way that other forms or causes of action do not. Conduct regulated by statute or contract usually entails a verbal formula for causation, using words such as “arising out of,” “caused by,” etc. In torts, however, causation exists in the unwritten legal ether. Canadian courts have tried to restrain the protean creature by rooting it in tangible consequences. The expansion of the phenomena of torts from material injuries of cyberspace will require a change in mindset. If courts try to apply to events on the information highway the principles of causation governing responsibility for pile-ups on the motorway, the inability to prove cause to a legal standard will render tort law irrelevant.

In 2017, both “reality” and “virtual reality” interact with each other causally. The pedestrian struck down while operating a smartphone to reach a colleague in another city is not interacting with the device any more than the confused three-year-old of the 20th century was told to “Talk to grandma” through a wired Bakelite receiver.⁶ The phrase “virtual reality” masks the fact that the digital world is in fact real. *Virtual* no longer means *almost* real. Nor does it mean an *alternate* reality or even an *augmentation* of reality. As will be stated later in this chapter, the notion that information is separate from the physical world is quickly becoming obsolete with the advent of quantum computing.

The interaction between information and conventional objects, such as self-driving vehicles, already requires jurists to upgrade their thinking. Such vehicles cannot be impaired by alcohol or fatigue, and within the logic of their algorithms they may well respond to a traffic situation precisely as intended. The typical wisdom that most of tort law will converge into product liability does not help where there is nothing wrong with the vehicle. It is the *interaction* of vehicles, commercial websites and other vessels of human activity, to which

in Archibald and Echlin, eds., *Annual Review of Civil Litigation* (Toronto: Carswell, 2016) 1 at 186-90.

⁵ The “neighbour” principle recognized potential victims from identifiable individuals even though their identities were not known in advance to the tortfeasor: e.g., the consumer of ginger-beer or those riding in and sharing the road with a defective automobile.

⁶ Three-year-old and telephone example performed in song by Laurie Anderson, “So Happy Birthday,” *United States Live* (New York: Warner Bros., 1984).

the law will have to turn when deciding whether a victim should be compensated by a perpetrator. In order to make legal determinations based on such interaction, jurists must discover the ways in which the digitally controlled world operates differently from the physical one, especially at the intersection between unintentional, intentional and designed phenomena.

Prediction of the past may appear novel or overly abstract to practicing tort lawyers who pride themselves on forensic or *ex post* logic: drawing or deducing conclusions from a mass of accident data collected after the fact. Casualty actuaries in the insurance industry have started to measure catastrophic losses counterfactually based on alternative pasts — the stuff of science fiction, perhaps, but now part of scientific fact. There is more to this *ex ante* approach than the upending of the deductive triangle that starts from a wide range of possibilities to identify a single, probable cause. Starting with the notion that disasters are caused by one or more predictable triggers, the real cause can be the failure to predict them and the actual cause might not be legally significant. The discussion of security breaches of those failing to prevent a terrorist act, for example, are highly relevant to some of the issues involving cyber breaches and hacking even if the hackers are usually beyond the reach of tort law. The past cannot be altered, but those tasked with identifying cause, fault and future risk mitigation must also consider the obvious trigger as a constant inevitability and the real causes as the failures in protecting the public from what might happen:

The past is what is was; but it is nevertheless instructive to ask questions about the past. One of the most insightful questions that was asked of 9/11, and might be asked of any disaster is this: *Why didn't this happen before?* Historical investigation may reveal that it did, or might have happened before with an estimated likelihood, but there was limited risk awareness and insufficient action taken to mitigate the potential loss.⁷

Litigation involving an event like 9/11 will be rare. However, many of the principles of predictive or *ex ante* causal analysis are pertinent to a wide range of damage-causing events in the Internet age, from crashes involving driverless cars to frozen pipes from malfunctioning smart thermostats, because of the centrality of information and its interaction within data networks. When systems intended to protect an asset, such as a sensor, cause a disaster instead of preventing it, cyber terrorism is now a viable trigger in addition to human or machine error.⁸ If Canadian courts do not allow the principle of causation to adapt to the world of information management and intentionality, there will be a legal vacuum ready for exploitation by those who would profit through unfair means without regard to the damage caused to individuals and institutions. This chapter will

⁷ G. Woo, “Counterfactual Disaster Risk Analysis,” unpublished: <<http://www.variancejournal.org/articlespress/articles/Counterfactual-Woo.pdf>> at 26.

⁸ Woo, *op. cit.* at 24-25.

demonstrate why Canadian courts must adapt the principles of causation in common-law and statutory torts, to accommodate the challenges of proof facing parties seeking judicial remedies for substantive breaches. In order to do so, the argument will follow this outline:

1. Identification of the elusiveness of cyber torts, from the duty and breach perspective, in making it difficult to apply causation principles based on tangible injuries.
2. The traditional common-law reluctance to recognize intangible effects of unlawful conduct, such as economic torts, will be a millstone around the neck of the law. The “but for” test of legal causation is not obsolete, but it must be freed from arbitrary *ex post* thinking in order to capture the interconnection of causal factors over time.
3. Legal causation is a matter of probability, but in the past. Therefore, the likelihood that one or more things led to an adverse result is not only deductive but also inductive, in that the evidence can provide a *prediction* of what happened, from the perspective of the facts *ex ante*. Increasingly, the common law will need the help of more sophisticated theories of causation such as that developed by the Bayesian school, if only for the reason that participants on the Internet increasingly interact *expecting* cause and effect to occur in accordance with such theories.
4. Failure to expand our conception of the causal element in tort law could result in injustices, and the inability of citizens to look to the courts for redress when they suffer harm due to breaches of duty and intentional or reckless acts committed in an information network. Without replacing the “but for” test, the courts must apply it in a way that actually determines whether one event led to another.

II. THE ELUSIVE CYBER-TORT

In 2017, there is little substantive law for tort lawyers to prepare themselves for the opening of the cyber tort floodgates. Law students learn of the English common law’s notable failure in the 19th century to give recognition to negligence’s categorical imperative in the context of an already frequent occurrence: an accident involving a faulty horse-drawn coach.⁹ In the case of the Internet, the fact that the courts have had little experience in trying cases involving losses and events occurring in cyberspace makes the task of exposition that much harder. For this reason, it may be helpful to describe some potential paradigms based on current events and anticipated litigation.

⁹ *Winterbottom v. Wright* (1842), 152 E.R. 402, 10 M. W. 109.

Paradigm 1: Security Breach

The typical cyber tort in the virtual world (as opposed to one resulting in tangible injury, such as a vehicle accident or a failure in medical equipment) is the leak of secure information from an *e-commerce* site or financial institution. In the 2013 case of *Lone Star National Bank v. Heartland Payment Systems*,¹⁰ a group of banks brought a negligence claim against a handler of confidential customer data for having failed to prevent a data breach resulting from a cyber-attack. Similar intrusions leading to the theft of credit card information have plagued major retail outlets. Perhaps the most celebrated intrusion resulted in the outing of would-be adulterers on the Ashley Madison dating website, giving rise to the potential blackmailing of countless participants. Recently, lawyers have started a class action in Ontario against a casino for a data breach alleging negligence in the protection of private employee, customer and vendor data.¹¹ The media report of the lawyer handling the casino law suit stated the class plaintiffs' position that the casino "rolled the dice" with the data "rather than invest in state-of-the-art security measures."

These are examples of a case in negligence against a custodian of private data, or by extension against a firm contracted by a custodian to provide cyber security services. Seen through the lens of traditional tort law causation principles, the most obvious analogy is bailment. The bank operating a secure safety deposit box service, for example, will be judged on the quality of the security of its vault. But causation depends on an analysis that differs conceptually from standard of care. If the safecrackers were able to take valuables out of the safety-deposit vault despite a given strength of security, this fact would not be conclusive of causation if the method used by the criminals would also have eluded a higher level of security. According to the traditional "but for" analysis, the fact that there was negligence is not sufficient to conclude liability. Rather, the plaintiff has to prove the harm could not have occurred without the negligent act or omission.

As the lore surrounding famous 20th-century criminal technicians such as Roy Saunders¹² demonstrated, the standard of care for the design of bank vaults was always a moving target, because the elite safecrackers strove to keep a step ahead. In theory, at least, the "but for" test of causation in tort law should not find a bank liable for having left its vault unlocked, if the thief was a Roy

¹⁰ *Lone Star National Bank v. Heartland Payment Systems*, 729 F.3d 421 (5th Cir., 2013).

¹¹ "Casino Rama cyberattack prompts \$50M class-action lawsuit," CBC News, November 11, 2016: <<http://www.cbc.ca/news/canada/toronto/casino-rama-cyberattack-prompts-50m-class-action-lawsuit-1.3848073>>; also see <<http://www.casinoraclassaction.com/>>.

¹² "The Jewel Heist that Changed Safecracking Forever," *USA Supply Source Blog*, November 18, 2013: <<http://www.blog.usasupplysource.com/2013/11/the-jewel-heist-that-changed-safecracking-forever/>>.

Saunders. As absurd as it may sound, the nexus in tort law between standard of care and causation would likely have formulated liability for the vault-owner if it failed to protect against criminal gangs employing “reasonably competent” safecrackers. The usefulness of the analogy to Internet hacking and other cyber security threats is that in the 21st century there are known threats against security firms and others that are less known or unknown.

The conceptual usefulness of bailment is limited by its physical and geographically fixed reality. In order to capture security without such fixed abode, perhaps a medical epidemic serves as a more relevant analogy. Being hacked, usually through various Trojan Horse methods such as self-installation of viruses and malware onto target computer network hosts, can be like contracting a tropical disease from a drink chilled with contaminated ice cubes. One might get sick even though one has received all the right shots before boarding the airplane. Consider, for example, a physician who advises a patient to get a particular vaccine formulation without first researching the different strengths of protection. Epidemic, therefore, meets ill-prepared visitor from Canada. *Computer* viruses have traditionally been small packets of malicious software code that “infect” websites and emails and spread with the reticular efficiency of a cold or influenza in an urban population. Biological viruses are small packets of genetic *information* whose main feature is the ability to mutate and alter the cellular metabolism of life forms. The functional similarity is therefore more than metaphorical and linguistic.

In the case of a data breach, the epidemiological paradigm breaks down because of the element of intentionality. The degree of intention and sophistication used by the perpetrators would, at first blush, confound the tort law principle of causation known as *novus actus interveniens*. In other words, the defendant cannot be held liable for harm caused by an act committed by someone who is not a party to the relationship between the plaintiff and the defendant. The new and intervening act can eliminate liability in tort because the third party’s act, and not the defendant’s negligence, is deemed to be the actual cause of the injury.¹³ Unlike viruses, where the harmful agents are indiscriminate packets of information that infect servers and computers on the Internet, a hacker is a *new* intervenor in the equation, thus satisfying the doctrinal *novus* requirement of the exculpatory intervening cause.

If the analysis were to end there, the result of holding no security consultants legally responsible for hacker attacks would be highly unsatisfactory, because concurrent contractual and tort liability in professional services combines both general and specific expectations of competence. For example, Canadian tort law imposes liability on police forces for failing to prevent harm from a known

¹³ *Hill v. Hamilton-Wentworth Regional Police Services Board*, [2007] 3 S.C.R. 129 (S.C.C.) at 181 [S.C.R.].

and at-large criminal.¹⁴ The application of liability for lapse of security or protection is not as simple as including known threats and excluding unknown threats. In situations where commercial and political entities “living” in cyberspace are likely to be targeted, the existence of threats is often only one factor. Another factor could be the sophistication of the pool of perpetrators. Hackers, like the bank robbers of old, are likely to defy low to middle-range security but are unlikely to go after soft targets where the gains do not outweigh the risk of capture. Unlike most common biological viral infections, many security breaches can be traced back to their source. When considering causation in some settings, such as security breaches of home workers or outsourced agencies, the sleuth must look beyond the computers and physical locations. A securities lawyer working on a confidential draft prospectus for a stock in advance of a public offering could be hacked over an open network in a coffee shop by an industrial spy. Attributing fault in such instances requires a combination of negligence and causation principles. The lawyer is likely the proximate culprit. However, if the law firm’s remote access system were encrypted, the cause would not have been the lawyer but the installer of the encryption.

Causation is not a static examination of reasonable precautions but a dynamic comparison of outcomes. By illustration, if there were three levels of cyber protection in ascending order of strength and cost, Gold, Silver and Bronze, most tort lawyers would question the use of the Bronze level of service when more effective options were available. Let us assume Bronze security was designed to thwart 70 percent of known hacking techniques, Silver 80 percent and Gold 90 percent respectively, and that the industry standard for this type of database was Silver. Breach of the standard of care, therefore, is assumed. The question then turns to the likelihood, based on a 51 percent standard, that the use of Bronze caused the data breach.

A common law court applying the usual *ex post* causation analysis could hold the defendant liable because Bronze turned out to be ineffective, and the burden of risk would be shouldered by the party choosing the lower standard of protection. However, this “increased risk” approach to causation is only applicable (a) where it is impossible to say which of two negligent causes caused the injury, or (b) where the defendant’s negligence has deprived the plaintiff of the ability to prove what he would have done had the defendant not committed a negligent act or omission.¹⁵ Instead, the ordinary “but for” test for causation would require the court to dismiss the claim on the basis that the plaintiff has failed to prove that a decrease of 10 percent in the level of protection caused the

¹⁴ *Doe v. Metropolitan Toronto (Municipality) Commissioners of Police* (1990), 74 O.R. (2d) 225, 72 D.L.R. (4th) 580 (Div. Ct.), leave to appeal refused 1991 CarswellOnt 1009 (C.A.).

¹⁵ *Resurface Corp. v. Hanke*, [2007] 1 S.C.R. 333 (S.C.C.) at paras. 27-28.

breach. After all, the 80 percent for Silver is comparable to a state of no protection, not comparable to the Bronze level of service. An effective 10 percent increase in the odds of an attack being successful from 20 percent to 30 percent does not mean the attack would not have been successful if the odds were 20 percent and not 30 percent.

The simple probabilistic approach considers the source of the harm in terms of frequency. It does this by positing the pool of threats as random if not equal. Instead, if courts were to consider the pool as comprised of an unknown but estimable number of intentional malefactors of varying skill and resources, causation would depend more upon the intentionality of the threat and the efficacy of the protection. This is not a standard of care analysis where the event of the breach is measured against the reasonable anticipation of a certain type of cyber-attack. Rather, it is an *ex ante* approach to causation which compares the methods used to compromise the data custodian's security against the types of protection employed. The cause of the hacker's successful intrusion must be seen in terms of the materiality of the choice between Bronze and Silver. This means eliminating the lower levels or tiers of threats comprising much of the protection afforded by Bronze. If 50 percent of all threats in the pool represent historical threats, the likelihood that the custodian would be attacked must be seen in terms of the 20 percent of live threats covered by Bronze versus the 30 percent covered by Silver. Bronze would be seen as providing 2/3 of the protection of Silver. This, however, does not mean a 1/3 probability of an attack by a hacker in the active pool but rather a 2/3 probability that a hacker incapable of defeating Silver will attack Bronze. What is missing from the analysis so far is any consideration of the Gold service. It was supposed to be even more secure than Silver.

If everyone protected their equipment using state-of-the-art techniques, nothing would ever be compromised and only elite saboteurs would ever succeed. A pool of 10 percent of hackers capable of defeating Silver but not Gold will gravitate toward attacking installations with Silver. Like moths to the flame (or bank robbers) attackers will likely target more difficult installations because of the perception that more secure sites protect more valuable or sensitive information, or because the challenge is more life-affirming. The very existence of Silver-level installations means those at the top of the hacker food chain will prefer to devote energy going after Silver and leaving Bronze alone. (The evidence for this counterintuitive phenomenon is the decades-long free pass granted by the malicious hacker community to computers sold by Apple,¹⁶ whose operating systems lack active malware protection programming.) The

¹⁶ "Apple Computers Are Getting Hit With This Virus for the First Time," *Time*, March 7, 2016: <<http://time.com/4249413/apple-mac-ransomware-hack/>>.

vulnerability of Silver installations to hackers thwarted by the Gold service will thus protect Bronze, from a purely frequentist perspective.

Paradigm 2: Accidents in a Remote-Controlled World

The substantive sources of liability are not, however, static. In fact, the so-called “Internet of things,” where everyday objects depend ever more on a connection to data in the “cloud”¹⁷ as an alternative to on-board information, torts occurring in the “virtual” world of information networks can increasingly have impacts on the physical or tangible world. A very simple example is the remotely-controlled home HVAC system.¹⁸ A family vacationing over the Christmas holidays may rely on such a device to control the temperature in their home in Canada, to prevent the water pipes, ordinarily situated within the insulated portion of exterior walls of a residential building, from freezing. The family could come home to a flooded house if the system malfunctions during a manufacturer’s firmware update. The sequence of causation is probably fairly simple, except for the timing of the firmware update and the nature of the network error. These two factors will pose difficulty for the plaintiff or subrogating insurer in maintaining the chain of causation.

The “Internet of things” will impact tort law most when the “things” are automobiles. Cars that “drive themselves” are thought to shift the paradigm of automobile litigation from driver-against-driver to product liability. The main danger now appears to be the behavior, not of the self-driving car, but the reaction of human drivers to its presence.¹⁹ When one considers the enormous forensic²⁰ costs incidental to the prosecution of a product liability suit, law suits are likely to be limited to catastrophic cases. Causation will become much more important because the inferences of circumstantial evidence based on “obvious” or “common sense” conclusions cannot be legally sustainable where, as in most mass-marketed technology, a simple device or user interface masks a spider-web

¹⁷ The cloud is an artful metonym for a secure suburban warehouse full of computer servers leased out in volumes of trillions of packets of information. Connections to such resources by fibre-optic networks allows “things” like automated thermostats to perform countless calculations per second, without a massive on-board computer installed in the wall.

¹⁸ Heating, venting and air-conditioning (HVAC).

¹⁹ “Uber suspends self-driving car program after Arizona crash,” CNBC.com, March 26, 2016: <<http://www.cnbc.com/2017/03/26/uber-self-driving-car-arizona-crash-suspended.html>> .

²⁰ “Forensic,” in common use, generally means the application of scientific investigation to assist in the resolution of legal problems. In this chapter, the word “forensic” also denotes the *ex post* scientific investigation of past events, to find out “what happened” in the reverse order in which they occurred. The advantage of forensic methods is that they collect as much circumstantial data as possible from, e.g., a crime scene. The limitation of the forensic method is that by cataloguing possible connections a real cause might be discounted or hidden. The classic example is the catalyst or *agent provocateur*.

of circuits and millions of packets of information per second. *Res ipsa loquitur*, already relegated in Canada to the hopper of non-doctrinal legal shorthand for “what happened here was obvious,” will indeed be allowed finally to rest in peace.²¹ The popular belief of a transformation from driver negligence to product liability is already causing personal lines automobile insurance markets to cede to general insurance products.²²

For legal-causal analysis, attempts to compartmentalize the driverless car accident into the product liability paradigm will be more wrong than right. A crash between automobiles, one or both or a multiple of which include driverless cars, is not the same as an overheated kettle or leaky natural gas appliance. Each autonomous vehicle represents a fundamental change in the legal human-machine relationship from owner-operator to owner-passenger. If a technological products and services company such as Google were to sell an autonomous vehicle to a population, Google would not only be a manufacturer but also a private operator of a transportation system. The information network controlling and regulating the speed and direction of the vehicles would have to be considered a version of, say, the Vancouver Translink transportation authority operating a network of autonomous passenger trains. The major differences would, however, be the existence of hundreds of thousands of vehicles in any given vicinity, and the interaction of vehicles on the Google network with, say, those on networks operated by rivals such as Microsoft, Apple, Amazon or even Blackberry, as well as owners of legacy gasoline vehicles operated by onboard human drivers. Driverless cars will not be trains or slot cars. Indeed, to follow the service analogy to its logical conclusion, a truly safe car should deploy air bags and other safety measures before risk of impact, in the same way an observant butler might catch a water glass before it tips over.

Today, the primary source of liability for accidents involving autonomous vehicles is tort law. In both instances, the duty of care is on the driver as the person whose control over the steering, accelerating and braking played a part in the cause of the collision. Highway regulation has imposed vicarious responsibility on the owner even if the owner is not the driver, except where the driver did not have the owner’s consent.²³ Where none of the occupants of the vehicle are in control, the cause of the accident could be the way the car moves or stops in relation to mapped locations, traffic conditions, and other vehicles. If the manufacturer becomes the driver-operator of the vehicle, it will not suffice to say the car was safe. The manufacturer could then be responsible for the behaviour of the car. This shift in their responsibility for the potential causes of accidents has prompted some manufacturers to consider retaining

²¹ *Fontaine v. British Columbia (Official Administrator)*, [1998] 1 S.C.R. 424 (S.C.C.) at para. 26.

²² Defense Research Institute, *For the Defense*, Vol. 58 No. 5 (2016), at p. 20.

²³ E.g. *Highway Traffic Act*, R.S.O. 1990, c H.8, s. 192.

ownership of the autonomous vehicles. Such a move would require a manufacturer's business plan to take on a pure service model. In anticipation of this legal shift, California's Department of Motor Vehicles currently prohibits ownership of autonomous vehicles by anyone other than a manufacturer, research institution or museum.²⁴ A draft regulation has been circulated to permit leasing of autonomous vehicles by manufacturers, thus maintaining a level of control by manufacturers over the vehicles' upkeep.²⁵ The future of driverless vehicles could follow this model, but a more competitive market would likely entail personally-owned vehicles relying on navigation networks operated by a patchwork of private-public partnerships.

Autonomous vehicles are not exceptional to the tort law in the electronic age. Rather, they represent a tangible interface between the Internet and the hazardous machine. Calling these vehicles autonomous is a misnomer because cars with human drivers are already autonomous from each other. Driverless vehicles are controlled by a network of wireless electronic data networks and are therefore not autonomous. Municipal and governmental agencies bear the responsibility for ensuring that manufacturers' mapping data match the civil infrastructure, including traffic control measures. This does not only encompass permanent structures like newly reclaimed public roads in housing developments. A burst water main in the middle of the night which requires a temporary traffic diversion will need to be communicated to all known driverless vehicle manufacturers, or else the cars could plow into the road maintenance workers. This could be achieved by erecting temporary data transmitters to which the vehicles respond. However, if the public works staff does not erect the transmitters, their workers and the travelling public will be endangered. The potential causes of accidents can thus be subject to changes in data sets and fixed machine actors in "real time," i.e. the interaction of electronic and human networks.

The potential for most or all conventional automobiles being replaced by driverless models gives rise to the necessity of tort law to meet the causation challenges of this new reality. Tort law's resistance to intangible or multifactorial causes could lead to its obsolescence. Standard-form contracts of adhesion, or statutes and regulation, will not obviate the need for jurists to consider causation and the legal standards for awarding compensation for motor vehicle accidents. As Ontario's hybrid tort/no-fault accident benefits system has proven, the fact that a specific test for causation is prescribed by contract has not eliminated the need for a claimant to establish that injuries were caused by a motor vehicle accident as defined by the wording of the accident-benefits regulation.²⁶

²⁴ 13 CCR 3.7 § 227.50.

²⁵ Mollander, J. A. and Wiener, Y. A., "Driverless Vehicles and the Effect on Insurance," *For the Defence*, Vol. 58 No. 5 (Chicago: Defence Research Institute, 2016), at 20.

Paradigm 3: Economic Torts Come of Age (or Don't)

A variant of tort law that seems at home in cyberspace is unfair competition. Most forms of unfair competition are now a form of intellectual property law, such as copyright and trade mark infringement. These forms of property rights are regulated and enforced by statute. Property is conceptually an economic concept, determined by the control and enjoyment of things (“*choses*”). In English law, intellectual property law originated at the intersection of the laws regulating Crown monopolies and economic torts such as passing off (the law protecting traders from unfair competition from others employing similarly sounding business to poach goodwill). The intersection between property law and torts is also a critical one because property law defines the legal boundaries that the laws of trespass, negligence and nuisance actually enforce.

Cyber assets such as websites, databases and secure networks are property, and how the law protects them from damage or appropriation determines their viability and value as property.²⁷ The similarity between intellectual property and some forms of torts committed by information network participants is the intangible nature of the subject matter. Consider a paid campaign intended to divert Internet traffic for a newly launched product to false or misleading product reviews. From fake product reviews to the dissemination of false information regarding political candidates, the assault on truth online is already a recognized social media “viral” disease. Although the “fake news” scandal of the 2016 American presidential elections found its origins in locations distant from the reach of common-law courts, North American Internet conglomerates have reportedly taken measures to stop the income stream to the publishers.²⁸ Companies such as Google and Facebook face exposure to legal liability, including class action exposure, as the Internet advertising brokers for defamatory or otherwise tortious Internet content. Liability for hosting or brokering such content can fall into existing categories of economic torts, such as unlawful interference with economic relations. That tort provides a civil remedy (in the form of damages) in three-party situations where the defendant commits an unlawful act against a third party in order to cause economic harm to the plaintiff. Canadian courts limit the availability of a remedy in instances where the unlawful acts would give rise to civil liability to the third party, or would do so if the third party suffered loss from the acts.²⁹

²⁶ E.g., *Economical Mutual Insurance Company v. Caughy* (2015), 51 C.C.L.I. (5th) 111 (S.C.J.), affirmed 2016 CarswellOnt 4358 (C.A.).

²⁷ De Beer and Doyle, *op. cit.*, at 172-75.

²⁸ A. Higgins et al., “Inside a Fake News Sausage Factory: ‘This Is All About Income,’” *New York Times*, November 25, 2016: <http://www.nytimes.com/2016/11/25/world/europe/fake-news-donald-trump-hillary-clinton-georgia.html?_r=0> .

²⁹ *A.I. Enterprises Ltd. v. Bram Enterprises Ltd.*, [2014] 1 S.C.R. 177 (S.C.C.) at 186 and 215 [S.C.R.] (at paras. 5 and 74).

The threshold for the requirement of actionable harm to the third party in this situation — potential customers driven away from the plaintiff's site or being lured away to the defendant's site — would have to be based on the theory that the third party was *deprived* of the freedom or opportunity to contract with the plaintiff. Such deprivation cannot be an intellectual property breach because of the absence of property. Rather, it is an impairment of freedom in the way a leg injury could prevent a victim from walking. The facts therefore call for a tort analysis instead of one involving a property breach.

The novelty of the paradigm in the Internet setting can give rise to confusion as to whether the interference with Internet traffic is deterrence or luring away. Consider the decisions of the Federal Court of Canada trial and appellate divisions in *Red Label Vacations Inc. (redtag.ca) v. 411 Travel Buys Limited (411travelbuys.ca)*.³⁰ These courts declined to hold that the use of an industrial competitor's trade marks in the hidden metadata did not constitute infringement of intellectual property rights such as trade mark or copyright.³¹ The lack of inherent jurisdiction to consider common-law torts such as passing off, as well as the more limited scope of subject matter in passing-off cases, constrained the Federal Court from conducting a separate and significant analysis under tort law. In the case of intellectual property infringement, causation is not a factor because the breach of a proprietary right calls for a remedy whether or not there is actual harm.

Red Label, in which the defendant's contractor had negligently used the plaintiff's trade marks in the metadata until the practice was discovered, appears to have been a missed opportunity to consider, under a tort law lens, the causal effect of the use of metadata in diverting *e-commerce* traffic from one website to another. The speed and volume of Internet commerce could mean that, if found to be tortious, behaviour that deprives another business of custom or advertising revenue might result in multi-million dollar losses, even if the wrongful activity is corrected within hours or days. Perhaps the boundary the courts drew in the *Red Label* decision between lawful and unlawful behaviour occurred in the absence of a physical or virtual trespass on the plaintiff's equipment, i.e. web-hosting servers owned or rented by the plaintiff. The diversion of business from

³⁰ *Red Label Vacations Inc. (redtag.ca) v. 411 Travel Buys Limited (411travelbuys.ca)*, 2015 FC 18 (F.C.), affirmed 2015 FCA 290 (F.C.A.). *Disclaimer*: Counsel for the plaintiff in this case is an associate of the law firm Gilbertson Davis LLP, where the author is a partner.

³¹ While this would have been correct if the litigants were dealing in goods, because s. 4(1) of the *Trade-marks Act*, R.S.C. 1985, c T-13, requires visible use of the trade mark, the case concerned trade marks for services. Under s. 4(2), "A trade-mark is deemed to be used in association with services if it is used or displayed in the performance or advertising of those services." The lack of contextual interpretation of the opposition of "used" against "displayed" and the presumption that they mean different things, means the *Red Label* decisions may not be the final word on the subject.

the plaintiff's website would be lawful, as opposed to behaviour such as an attack or hack that prevents or slows down *e-commerce* traffic to the plaintiff's site.

The Court in *Red Label* did not assess damages. In declining to do so, it sidestepped the issue of causation altogether. In *e-commerce*, customers seeking unique goods and services can locate a supplier on the other side of the globe almost instantly. More specifically, sophisticated suppliers can, by tracking potential market participants through their Internet protocol (IP) addresses or store accounts, predict the likelihood of a future purchase through search patterns on sites such as Google. The algorithms required to perform such predictive tasks are simply accelerated forms of predictive psychology in more conventional settings. An interruption of service for an *e-commerce* entity can therefore be significant, even for a short period of time. Perhaps the *de minimis* rule will ensure that few law suits are brought for momentary interruptions. The effect of a lengthy website disruption on a mass-market vendor will also present few difficulties for a court — where the common law encounters problems of evidence and proof of causation is the protean middle. For example, an Internet service provider (ISP) might suffer a disruption for a few minutes during an advertising event such as the Super Bowl. The task of measuring the actual effect could actually be rather complex, as viewers interested in the game might get up from their sofas, while others sit down just for the ads. From a causation perspective, however, no court can ignore the need to determine what and who caused the outage in order to determine responsibility for the economic loss to the broadcaster or advertisers.

Legal causation based on observed physical behaviour does not adequately address the justice of economic torts. Economics is an essentially predictive or inductive discipline, in which the scientist gathers data from past behaviour and attempts to determine outcomes based on past patterns and current circumstances. This is not a singularly *ex post* exercise because the premise is that conditions and behaviour will change and so require the economist to challenge the validity of any hypothesis. Cause and effect in *e-commerce* axiomatically ought to be informed by economic methods. Often the apparent subjectivity of economics stems from the observed behaviour of a market, which involves at least two parties to a transaction and therefore multiple variables.

A relevant example of this learning curve for jurists that is relevant to information technology is the so-called Pareto Principle, whereby a majority of effects are triggered by a minority of causes. This concept is named after Italian engineer and economist Vilfredo Pareto (1848-1923), whose study of macroeconomics found that it was possible to increase the wealth of individuals in a group without harming others, but only up to a certain point. That point was dubbed, "Pareto efficiency." Once achieved, an individual's increase in wealth will have to come at the expense of another. Incidental to this

theory was Pareto's observation that, at the turn of the 20th century, 80 percent of the land in Italy was owned by 20 percent of the population. From the premise that the wealthy have more economic power than the poor, this led to the rule of thumb that 80 percent of changes in the world are caused by 20 percent of the people. Microsoft has found that 80 percent of customer problems such as Windows system crashes are caused by 20 percent of software errors ("bugs").³² This type of logic may seem counter-intuitive until one considers that in most controlled environments, unstable or rogue elements will be scarce but powerful. The small number of the most difficult problems is determined by the strength and ability of the environment to remedy or resolve more anodyne ones.

Common-law reluctance to provide remedies for pure economic loss stems from a premise that outcomes for market participants are not the consequences of moral choices. This premise ignores the fact that in every supply-demand curve in microeconomics, or in every guns-and-butter choice at the macro level, the act of increasing or decreasing the inputs is a choice creating winners and losers. Pareto showed that, overall, one party's loss and another's gain are causally connected. Jurists must examine whether the outcomes stem from purely economic conditions or unfair market conduct. As with most scientific principles, the Pareto Principle is not a rule but a pattern that helps to make sense of a large number of independent events or transactions. At the macro-economic level, a cautious causal exposition of "econo-physics" appears in the work of French economist J. P. Bouchaud on the 2008 world financial crisis. Bouchaud observed that economists consider the behaviour of human market participants as if they were bound by elegant and rigid laws, whereas physicists are used to jettisoning theories once reality disproves them. For economists, causation is more of a self-contained system than the material world observed by physicists.³³ In his encore presentation, Bouchaud explained how the power and intention of markets have piqued the interest of physicists who have observed similar phenomena in the inanimate material world:

In the case of financial markets, physicists have been immediately intrigued by a number of phenomena described by power-laws. For example, the distribution of price changes, of company sizes, of individual wealth all have a power-law tail, to a large extent universal. The activity and volatility of markets have a power-law correlation in time, reflecting their intermittent nature, obvious to the naked eye: quiescent periods are intertwined with bursts of activity, on all time scales. Power-laws leave most economists unruffled (isn't it, after all, just another fitting function?), but immediately

³² Rooney, Paula (October 3, 2002), *Microsoft's CEO: 80—20 Rule Applies To Bugs, Not Just Features*, *ChannelWeb* : <<http://www.crn.com/news/security/18821726/microsofts-ceo-80-20-rule-applies-to-bugs-not-just-features.htm>> .

³³ J. P. Bouchaud, "Economics needs a scientific revolution," 455 *Nature* 1181 (30 October 2008).

send physicists imagination churning. The reason is that many complex physical systems display very similar intermittent dynamics: velocity fluctuations in turbulent flows, avalanche dynamics in random magnets under a slowly varying external field, teetering progression of cracks in a slowly strained disordered material, etc.³⁴

Both economists and physicists strive to acknowledge the results of experiments only if they are repeatable. In the data collected by the investigator of a “disaster,” an event that appears to have no causal order from an *ex post* view can be readily explained and verified from an *ex ante* approach.

This contrast can be illustrated by considering the mixing of two types of coloured balls in a children’s play enclosure. One child stands behind a pile of green balls, the second one behind yellow balls. We “know” that after the several minutes of throwing the balls at each other, the balls will be evenly distributed in the room. This “knowledge” is actually a prediction — or a reliable *ex ante* opinion of causation. We are likely to find that the evenness is not a result of randomness but rather probabilistic intentionality.³⁵ Because the intention is there, there is no randomness about it. Without the direction to try to throw the balls against each other, each child will be required to choose the direction of each throw, and the hidden bias against hitting the other ball or the other child would likely result in less randomness in the distribution. If the chance of imperfect impacts is reduced to zero, however, in theory the balls of one colour will never escape their original half of the room. (If the children were reconvened annually and all became star baseball pitchers, they are likely to achieve a high degree of bounce-back for some time, because of the heuristic nature of the exercise.)

This example demonstrates that patterns in market behaviour in Internet commercial transactions cannot be described as random, but rather varying manifestations of intentionality within a range between failure and success. From the vantage point of an unsophisticated commercial website operator (if there is such an entity), customers browse or log on randomly. If that were true, there could be no certainty that anyone would visit the site ever again to buy products or services. Alternatively, there would be no incentive to spend on marketing if websites attracted customers with predetermined frequency.

³⁴ J. P. Bouchaud, “The (Unfortunate) Complexity of the Economy,” *Physics World*, April 2009, 28-32.

³⁵ The collision of two balls can have three apparently random trajectories, but in fact they are two failures and a success: deflection to one side, deflection to the other side, and bounce back to origin. If the children were exceptional, they could throw the balls precisely in a manner that their balls bounce back to them every time. The colours could, in a room of future Cy Young award winners, remain separate between the imaginary centre line. Their inability to keep this up, although apparently random, is in fact a distribution of two failed negotiations for every one direct hit.

E-commerce does not operate randomly any more than the traditional exchange economy. It operates as a consequence of hits and misses within a heuristic matrix of search results based on the successful searches of all global participants. As in the case of the coloured balls, the effects of unlawful competition cannot be determined by applying the ordinary retrospective counterfactual analysis. The difference, especially as humanity approaches use of quantum computing, is that the heuristic ability of the Internet will achieve high levels of direct ‘hits’ much more quickly than the ball-throwing children. Interference with SEO, in which companies invest heavily, would be actionable provided lawyers and courts understood how directly the interference led to the damage.

Tort law’s bias against the judicial reification of economic grievances already seems backward. The Supreme Court of Canada almost proudly states, “tort law has traditionally accorded less protection to purely economic interests than to physical integrity and property rights.”³⁶ It should now be prepared to recognize this bias as stemming, not from the justice of the paradigm, but rather from the courts’ reluctance to grasp how events in the paradigm occur. The next section will deliver the hypothesis that tort law’s struggles with the intermediate uncertainties of causation in the biological world, i.e. injuries resulting from medical treatments, can help jurists develop a truly general theory of causation, ready for the coming century.

III. EXPANDING CAUSATION FROM THE TANGIBLE TO THE INTANGIBLE

1. Tort Law’s Physicality a Function of 20th-Century Technology, not of Tort Law Itself

The difficulties in legal causation tend to start where high school science ends, because high school is the last time most jurists studied the subject. The “but for” test is simple enough to apply in most two-party cases. (Were it not for the defendant’s automobile rear-ending the plaintiff’s, the plaintiff would not have suffered the neck injury.) As soon as a third potential cause is in play, defendants cling fast to the doctrinal application of the *sine qua non* principle while plaintiffs turn to fallback positions such as the “material contribution” test, where all that is required is a substantial influence on the harmful result. The most recent Supreme Court of Canada iterations³⁷ of the “but for” test for causation in tort law continued the so-called “common sense” or “robust and

³⁶ *A.I. Enterprises Ltd. v. Bram Enterprises Ltd.*, [2014] 1 S.C.R. 177 (S.C.C.) at 195 [S.C.R.].

³⁷ *Clements v. Clements*, [2012] 2 S.C.R. 181 (S.C.C.) at paras. 6-16; and *Benhaim v. St-Germain*, 2016 SCC 48 (S.C.C.) at paras. 54-55.

pragmatic” approach to causation entrenched in Canadian tort law by *Snell v. Farrell*:

I am of the opinion that the dissatisfaction with the traditional approach to causation stems to a large extent from its too rigid application by the courts in many cases. Causation need not be determined by scientific precision. It is, as stated by Lord Salmon in *Alphacell Ltd. v. Woodward*, [1972] 2 All E.R. 475, at p. 490:

. . . essentially a practical question of fact which can best be answered by ordinary common sense rather than abstract metaphysical theory.³⁸

The “robust and pragmatic” approach in *Snell* was not a retreat from the “but for” test, but an example of its application to an inference-drawing exercise “using ordinary logic and reasoning as in other contexts.”³⁹ The rejection of scientific precision in *Snell* in favour of more “ordinary” fact-finding arose from the evidentiary challenges of medical negligence cases. The difficulty encountered by patients in proving iatrogenic causation has occasionally led to calls for reversal of the burden of proof. Doctors and other health professionals have greater first-hand access to the patient’s condition and chart information at the time of the adverse health outcome, compared to the patient. The Court in *Snell* was clearly afraid of opening the floodgates to medical negligence suits by a reversal of the burden of proof of causation. However, if one described the above reasoning in *Snell* as a nod to the “unscientific,” the Court might consider such an implication as unintended.

Apart from the avoidance of endless debates or overly lengthy trials, one has to question what purpose robustness and pragmatism serve in helping a court draw an inference about one party’s conduct leading to another’s injury. The fact that the court comes back to the *Snell* articulation of the “but for” test whenever it faces a tough set of facts actually shows that the judicial exercise of fact-finding in causation is not limited to inference-drawing. Rather, robustness and pragmatism are virtues valued in forward-minded decision-makers, such as company directors or politicians. This is inherently *ex ante* reasoning. Probability is not an element of gaps in forensic evidence but rather a method of working with the uncertainty of consequences. Thus, when one focuses on the use of words importing robustness, pragmatism or common sense, and shies away from the implicitly “delicate” or “impractical” empiricism of scientists, one can see that the *Snell* expression of causation betrays a categorical need for both forward and retrospective vantage points. After all, causation in law is not merely descriptive.

The justification for awarding compensation includes an ethical component. For this reason, the distinction between forensic probability and practical probability emerges as the key to formulating the “but for” principle in a way

³⁸ *Snell v. Farrell*, [1990] 2 S.C.R. 311 (S.C.C.) at 328 [S.C.R.].

³⁹ *Benhaim, supra*, at para. 55.

that integrates the ethical perspective of the tortfeasor in legal causation. The English courts have long considered the word “responsibility” in their tort apportionment legislation as fault-based on causation, whereas the Canadian courts have interpreted the word “fault” as requiring apportionment on the basis of moral fault.⁴⁰ The English approach is more just from an economic perspective, because defendants are responsible for apportionments based on the actual contribution to harm, and not on the degree of offence to community standards. However, the most just role of robustness and pragmatism in attributing liability likely lies somewhere between the Canadian and English approaches to apportionment. Causation does not attract liability without a breach of the standard. Therefore, a unified approach to legal causation would entail an expression of the legal elements of upholding standards and deterring harmful behaviour. The need to recognize the *legal* in legal causation becomes all the more acute when torts committed in the electronic ether lack the physicality of an impaired driver or an uncleared sidewalk. Canadian tort law cases in conventional fields of human activity have been in decline for years. One only has to examine the raw statistics of road accidents to see how safe streets will one day be the “new normal,” even before driverless cars overtake human-driven ones.⁴¹ If conventional torts become as infrequent as homicides — still frequent enough to maintain boutiques of higher-end criminal lawyers — will cyberspace be the relatively victim-free utopia, unregulated by common-law duties and standards of care?

Those who consider the Internet as a domain incapable of court regulation may have forgotten that, prior to the advent of congested automobile travel, vehicular highways were mostly unregulated. The birth of modern tort law can be traced back to the retreat from the harsh principle in *Winterbottom v. Wright*,⁴² in which the Court refused to offer a party injured in a road accident a remedy in damages in the absence of a contract. At that time, the notion of a general duty of care was considered an intrusion on the freedom of contract.

⁴⁰ *Heller v. Martens* (2002), 213 D.L.R. (4th) 124 (C.A.), interpreting provincial apportionment legislation referring to degree of “fault.” The English courts, in considering the more causal term “responsibility,” applied a test based on degree of causation: Akazaki, “1% Liability in Tort: Fact or Fiction?” 30 *Advoc. Q.* 104 (2005), at 106.

⁴¹ The most significant bellwether statistics come from the Transport Canada reports of the continuing decline in injury-causing automobile collisions: in 1992, 3,073 with fatalities and 169,640 with injuries; in 2011, 1,834 with fatalities and 121,159 with injuries. Similar statistics regarding the number of automobile accident victims: in 1992, 3,501 fatal, 25,521 serious (i.e. admitted to ER) and 249,823 total injuries; in 2011, 2006 fatal, 10,443 serious and 166,725 total. Source: *Canadian Motor Vehicle Traffic Collision Statistics 2011* (Ottawa : Transport Canada, 2013), Internet: <https://www.tc.gc.ca/media/documents/roadsafety/TrafficCollisionStatistics_2011.pdf> .

⁴² *Winterbottom v. Wright* (1842), 152 E.R. 402, 10 M. W. 109.

Donoghue v. Stevenson, the foundation of the English law of negligence and product liability, was the famous “snail in a bottle” case in which a plaintiff was permitted to bring a negligence suit against a manufacturer of ginger beer despite the absence of a contract. The plaintiff had fallen ill after having consumed ginger beer containing a decomposed snail. The facts and circumstances of the case seem to be very material-oriented only because of the state of human development at the time. The *ratio* of the case was actually transformational because it expanded the traditional categorical imperative from person-to-person interaction in small communities to activities within the anonymous stream of commerce. Legal causation was losing parochial boundaries.

Lord Atkin’s speech in *Donoghue* drew on the 1914 New York Court of Appeals’ decision of Justice Cardozo in *MacPherson v. Buick Motor Co.*, in basing the duty of care on the consumer’s inability to inspect products for defects. In *MacPherson*, the fact that the automobile’s wheels were painted impaired the consumer’s ability to examine it for workmanship and so gave cause to impose liability on the automobile manufacturer for effectively concealing the defect. Previously, the contractual doctrine of *caveat emptor* required the purchaser to inspect an article such as “a pitchfork, a golf club, an axe-helve, or an oar for a boat” for soundness.⁴³ Duty emerged not so much from proximity but rather from the concealment of cause, and from denying the retailer the capacity to perform an intermediate inspection between the manufacturer and the end-user. Causation, more than morality or fairness, forced the law to consider our duties to one another in the absence of a contract or statute. The more crowded our streets became and the more mass-produced our food and beverages, the less the common law was able to sustain a lawless utopia. Tort law faces a similar crisis moment as humanity marches into cyberspace.

2. Unseen Phenomena: Taxonomy of Non-Physical Objects in Cyberspace

At the time the House of Lords released the latches to the proverbial floodgates in 1932, few could imagine how dominant tort law would become in the civil caseload of common-law courts. The lesson of a retrospective view is that the experiential nature of the common law defies attempts to forecast the subject matter of tort claims.⁴⁴ The social nature of the Internet in facilitating instantaneous interactions has led to the invocation of defamation, the most social of torts. The 2005 edition of this book was prescient in the publication of

⁴³ *Donoghue v. Stevenson*, [1932] A.C. 562, [1932] All E.R. Rep. 1 (H.L.) at 598-599 [A.C.], referring to *MacPherson v. Buick Motor Co.*, 160 A.D. 55, 145 N.Y.S. 462 (3d Dept., 1914) at 58-59 [A.D.].

⁴⁴ In contrast to the Civilian approach, based on legislative codes.

a chapter by Elizabeth Judge on the emergence of “cyber-libel” as a subset of Canadian tort law.⁴⁵ 2017 is not too early to consider Judge’s perspective as a reflection of “turn-of-the-century” thinking. Judge viewed cyber torts from the perspective of existing law and identified defamation as the natural breeding ground for litigation because, at that time, cyberspace (“Web 1.0”) was solely a means of communication. Her chapter concentrated on three modes of digital communication: messages posted to public websites, anonymous messages to Internet chat groups and emails distributed to parties other than the victim of the defamation. She looked further ahead to the development of new causes of action, such as breach of Internet privacy, violation of online norms and misuse of computer equipment.

Since Judge’s prognostication, the online world has moved beyond the interactive platform of “Web 2.0” to full remote control, surveillance and monitoring of physical and economic events: communication not only of messages, but also of cause and effect. In an exhibitionist, “post-truth” and social-media obsessed world, concepts such as personal reputation and privacy have been subsumed into a wider state of precarious commercial and personal outcomes. This is a world in which parties accept the terms and conditions of everything from the acceptance of “cookies” (small computer programs altering the user’s software in order to facilitate the “look and feel” of websites) to filing tax declarations, as contracts of adhesion no one ever reads.

The inadequacy of contracts in allocating the risks of a dangerous world on the consumer of information products will undoubtedly lead to the development of law based on normative values — tort law. Rustag and Koenig have argued for the establishment of a tort of negligent enablement of cybercrime to address the inability of courts to hold software developers to account for selling products that are vulnerable to attack by hackers, virus programmers and identity thieves. The software industry, they say, blames criminals for intrusions and careless users who fail to implement cyber security.⁴⁶ Insurance coverage, an important element of any legal compensation regime, is a murky subject because the conventional thinking of information as intangible makes it hard to treat data breaches as “property damage.” Tortious damage to the storage media such as chip sets and magnetic tapes is clearly covered by the insurance policy wording of “tangible property” but the information stored on them is not.⁴⁷ Corruption of data in storage media may render a computer system non-functional despite the absence of damage to material.

⁴⁵ Elizabeth F. Judge, “Cybertorts in Canada: Trends and Themes in Cyber-Libel and Other Online Torts” in Todd Archibald & Michael G. Cochrane, eds., *Annual Review of Civil Litigation* (Toronto: Carswell, 2005) 149 at 157.

⁴⁶ Rustad, M.L. and Koenig, T.H., “The Tort of Negligent Enablement of Cybercrime,” 20 *Berkeley Tech. L.J.* 1553 (2005), at 1559.

⁴⁷ Cooley, J.W., “New Challenges for Consumers and Businesses in the Cyber-Frontier:

The actual scientific basis for this distinction between tangible and intangible property reflects an early to mid-20th-century state of popular knowledge in which matter and energy are separate phenomena from a pragmatic perspective. In 2016, Prime Minister Trudeau became the unlikely catalyst for the introduction of quantum computing into the vernacular. Despite criticism that Trudeau's explanation was flawed,⁴⁸ he raised mainstream consciousness of an area of research and development that builds on the 1960's work of IBM physicist Rolf Landauer. Landauer showed that *all* information is actually physical and capable of manipulation at the atomic level.⁴⁹ The conventional computers sitting on lawyers' and judges' desks give the appearance of being mere conduits for information transported by electrical or optical data (data processing). The computer, however, actually represents the interaction of electricity and light with physical switches in the way switchboard operators once ran telephone lines.

The quantum computer, based on the ontological paradox of Schrodinger's cat being simultaneously alive and dead,⁵⁰ operates on the potential for atoms in super-cooled suspension to simultaneously carry both 0 and 1 values of data ("qubits") at the same time. The quantum computer dispels the appearance of a separation between data and the computer. The computer and the network in which it operates *are* the data, at the subatomic level. Humans only supply design and higher-level intentionality. Courts must develop an understanding of 21st-century science in order to rule on disputes arising from harm occurring in computer networks. The obsolete and artificial characterization of data as intangible phenomena, and therefore incapable of physical proximity between alleged tortfeasors and tort victim, has served as a juridical check on fear that events in "real life" caused by events in cyberspace might lead to indeterminate legal liability and endless law suits:

Without a proximate cause limitation, Internet security breaches could create boundless liability. At some point, a cause of an Internet security breach is so remote that it would be unfair to impose liability. If terrorists had exploited a security hole in software to construct illicit communication channels to coordinate the attacks on New York City and Washington D.C., the security hole theoretically could be deemed a cause-in-fact of the billions of dollars in damages that occurred on

E-Contracts, E-Torts, and E-Dispute Resolution," 13 *Loy. Consumer L. Rev.* 102 (2001), at 107-08, and note 30.

⁴⁸ "Actually, Justin Trudeau doesn't get quantum computing," *Washington Post*: < https://www.washingtonpost.com/posteverything/wp/2016/04/18/actually-justin-trudeau-doesnt-get-quantum-computing/?utm_term=.e5c591692902 > .

⁴⁹ Online: < https://en.wikipedia.org/wiki/Landauer's_principle > . Also see T. Dittrich, "'The concept of information in physics': an interdisciplinary topical lecture," *European Journal of Physics*, Volume 36, Number 1, 2014: < <http://iopscience.iop.org/article/10.1088/0143-0807/36/1/015010> > .

⁵⁰ Online: < https://en.wikipedia.org/wiki/Schr%C3%B6dinger's_cat > .

September 11, 2001. A court would be unlikely to determine the insecure software a proximate cause of the thousands of deaths and destruction even if the security hole was a cause-in-fact of the attacks.⁵¹

It is when logic or non-material (*immaterial*) elements bring about intangible harm that the law finds itself lacking. The flow of information is the counterfactual inquiry in its purest form: what was the consequence of a line or several million lines of computer code, and would the harm have occurred if these lines of code were not designed, sold or sent? And what was the harm, to begin with? Once the law understands that cyberspace is as physical as land or water, it can no longer dismiss the necessity to regulate activity on the basis that it does not *matter*.

Cyberspace does matter, but it does not have to follow the expected patterns of behaviour. Outside defamation, the so-called “floodgates” argument has kept a tight check on the scope of tort law. Canadian courts have long expressed a sometimes irrational fear that they must not make it too easy to sue, to keep out hordes of justice-seekers. Occasionally, the courts invite the public into the jurisprudential mechanical room, and we see causation is the linchpin to the gate operator’s wheel:

The traditional approach to causation has come under attack in a number of cases in which there is concern that due to the complexities of proof, the probable victim of tortious conduct will be deprived of relief. This concern is strongest in circumstances in which, on the basis of some percentage of statistical probability, the plaintiff is the likely victim of the combined tortious conduct of a number of defendants, but cannot prove causation against a specific defendant or defendants on the basis of particularized evidence in accordance with traditional principles.⁵²

3. Freeing the “But For” Principle from Ex -Post Exclusivity

The Supreme Court of Canada has for decades eschewed intellectual treatment of the phenomenon of one thing leading to another, with legal consequences. Witness the Chief Justice of Canada’s approach to the subject in *Resurfice Corp. v. Hanke*, expressed with a modicum of intellectual disdain:

Much judicial and academic ink has been spilled over the proper test for causation in cases of negligence. It is neither necessary nor helpful to catalogue the various debates. It suffices at this juncture to simply assert the general principles that emerge from the cases.⁵³

In that instance, the Court considered injuries to a Zamboni operator in an explosion caused by his confusing a hot water tank with a gasoline tank. The Court stated that the law should resist the temptation to resolve difficult cases

⁵¹ Rustad, M.L. and Koenig, T.H., *op. cit.*, at 1603.

⁵² *Snell v. Farrell*, [1990] 2 S.C.R. 311 (S.C.C.) at 320 [S.C.R.].

⁵³ *Resurfice Corp. v. Hanke*, [2007] 1 S.C.R. 333 (S.C.C.) at para. 20.

by reversing the burden of proof. The only real exceptions to this rule were the following:

- (a) the injury was caused by one of a multiple of negligent parties, such as two hunters firing negligently into the woods, injuring another hunter;⁵⁴ and
- (b) informed consent cases, where it is impossible to be certain that a person would have allowed something to be done, had the risks been fully explained.

The weakness of the perennial debate between the “but for” and “material contribution” tests is the static or categorical nature of the causal analysis as a “chain.” In order to satisfy the logic of the “but for” analysis, the defendant’s act or omission is a necessary link in the chain. Material contribution, on the other hand, involves a lower threshold of proof because it tolerates a substantial possibility that the harm could have occurred even if the defendant’s impugned conduct did not occur. British Columbia trial courts appear to represent a persistent pocket of resistance to the Supreme Court of Canada’s restriction of the “material contribution” test to rare exceptions.⁵⁵ The *Resurfice* Court categorically limited the “material contribution” exception to the “but for” test to an exception rather than a rival principle:

First, it must be impossible for the plaintiff to prove that the defendant’s negligence caused the plaintiff’s injury using the “but for” test. The impossibility must be due to factors that are outside of the plaintiff’s control; for example, current limits of scientific knowledge. Second, it must be clear that the defendant breached a duty of care owed to the plaintiff, thereby exposing the plaintiff to an unreasonable risk of injury, and the plaintiff must have suffered that form of injury. In other words, the plaintiff’s injury must fall within the ambit of the risk created by the defendant’s breach. In those exceptional cases where these two requirements are satisfied, liability may be imposed, even though the “but for” test is not satisfied, because it would offend basic notions of fairness and justice to deny liability by applying a “but for” approach.⁵⁶

The Supreme Court has also rejected the reversal of the burden of proof of causation in instances where the defendant’s negligence is egregious or obvious. Instead, the Court has accepted a measured loosening of the burden of proof of the “but for” test in circumstances where the defendant’s negligence obliterated

⁵⁴ *Cook v. Lewis*, [1951] S.C.R. 830 (S.C.C.). The logic, of course breaks down by increasing the number of hunters to three, thus raising the probability of *not* being the cause to 67%, as explained in Richard Wright, “Proving Causation: Probability versus Belief,” *Perspectives on Causation*, Ch. 10, R. Goldberg, ed. (Hart Publishing, 2011: < <https://ssrn.com/abstract=1918474> > at 212.

⁵⁵ E.g., *Churath v. Cheema*, 2016 BCSC 2303 (S.C.) at para. 7; and *La Porte v. Earl*, 2016 BCSC 2298 (S.C.) at para. 49, referring to a “substantial connection” test.

⁵⁶ *Resurfice, supra*, at para. 25.

the plaintiff's ability to tender evidence of causation.⁵⁷ The rejection of attempts to relax significantly or reverse the burden of proof of causation is a civil law version Blackstone's 1765 formula, that "It is better that ten guilty persons escape than that one innocent suffer."

The Supreme Court's failure to see that the impetus to loosen the "but for" analysis, either in favour of a burden reversal or a "material contribution" test, is in fact the same intellectual current that sparked the origin of tort law in *Donoghue* and *MacPherson*: the role of the defendant as obliterator of the proof of causation.

Some of the confusion about the "but for" test arises from the employment of two words that are, separately, almost meaningless. The need to avoid language with indeterminate meanings was identified by Langille in his study of the influence of Wittgenstein on legal theory. Courts must avoid wording legal principles in ways that encourage manipulation of ambiguities. Otherwise, courts become law-makers instead of law-appliers.⁵⁸ "But for" is a phrase containing two articulations. "But" is a word of disassociation, even though the purpose of the legal test is the *positive* burden of showing an association between cause and effect. In this context, it probably means "were it not," or "barring." "For" is a word importing purpose, similar to the Latin word "pro" meaning service to a particular thing (a cause). Put "but" and "for" together and one gleans the meaning that a cause and an effect, to be connected legally, have to exclude the probability of the event occurring *without* the defendant's conduct.⁵⁹

Recognition of the word, "but" as a dissociative word in a legal test to determine *association*⁶⁰ reveals how the burden of proof actually entails a double negative. It is the plaintiff's burden to prove the defendant's negligence caused the injury. The court then requires the plaintiff to prove the harm would not have occurred, absent the negligence. The requirement to eliminate other causes is one means of expressing the attributive justice element of legal causation, i.e. whether the defendant's role in bringing about the harm deserves a judicial remedy. The requirement to eliminate other causes is inherently more possible in a chain reaction, and improbable in a multi-participant event. What most common-law jurists believe the phrase "but for" means is causation as a continuous chain of events in which the court must imagine whether the harm would have occurred if the suspected cause is removed from the course of events.

⁵⁷ *Benhaim v. St-Germain*, 2016 SCC 48 (S.C.C.) at paras. 63-67.

⁵⁸ Langille, B., "Revolution Without Foundation: The Grammar of Scepticism and Law," 33 McGill L. J. 451 1987-1988 at p. 457.

⁵⁹ In the spirit of Wittgenstein's concept of Sprachspiel (word-game, the relationship between words and the real world), "but for" purposively tries to capture legal causation via a hypothetical back door.

⁶⁰ Attribution, the purpose of tests for legal causation, being a more defined form of association.

The inherently deductive nature of this approach involves a rear-view belief in the ability or inability of the other circumstances to produce the same result.

Resurfice has left us to consider how the same court would articulate the causation principle if an injury were to occur in a network of man-machine interactions, such as a team of hospital nurses looking after medical instruments in a cardiac ward from a remote station. If the station operators are not nurses but a set of subjective computer algorithms, we can still have cases of human-cybernetic interaction leading to serious and fatal accidents. The question, “Is Mr. Jones in room 800 suffering a heart attack?” could actually be less helpful than the question, “Is Mr. Jones in room 800 expected to suffer a heart attack, if no one tends to his drip line in the next 20 minutes?” The latter question, and associated programming, adds a layer of prediction and real-time change to the causal analysis of the adverse event. This 20th-century technology could then be upgraded to a system in which the monitoring station not only updates its analysis of Mr. Jones’ medical data but also learns about Mr. Jones’ heart function at an individual level, based on heuristic circuits. If the system extended the 20-minute question to 40 minutes based on Mr. Jones’ data and chart history and a policy decision to direct medical personnel to more urgent cases, what would the legal consequences be if Mr. Jones suffered a heart attack during the 30th minute?⁶¹ Mr. Jones’s lawyer would argue the machine’s decision to extend the interval of human monitoring caused the heart attack. The hospital’s lawyer could be expected to defend on the basis that so many factors could lead to a heart attack that the plaintiff cannot discharge the burden of proof based on the “but for” analysis.

In fact, the computer’s behaviour is not different from that of a staff doctor or senior nurse in charge of juggling resources on a cardiac ward. The change of interval might not be to save on staffing costs but rather to account in real time for the fact that there might be a Ms. Smith in another room whose priority of care has just elevated from a 40-minute interval to a 20-minute one, in relation to Mr. Jones. The real answer could then be that the hospital can only adapt to real-time progress-monitoring of patients and can only respond responsibly to other cases whose urgency increases. Mr. Jones could introduce evidence that the machine could have been programmed to link to the hospital’s on-call system to increase resources to deal with Ms. Smith’s condition, without reducing the monitoring interval for Mr. Jones. This illustrates a case in which the use of an *ex ante* view proves the *ex post* analysis is simply insufficient to do

⁶¹ Observing that natural beings can be subject to logarithmic, as opposed to linear conditions. E.g., in measuring life expectancy, the older one is, the older one is expected to be before one dies. If a trauma victim survives certain thresholds after an accident, the more likely the victim will live instead of perish. The medical analogy is applicable to cyber torts because the reticular nature of information and social networks make the likelihood of damage greater after each level of the spread of a problem.

justice to the problem. The *ex ante* view yields the cause as the machine's calculated risk. The court will need to decide whether the cause was carelessness or exercise of judgment. The causal analysis does not have a "right answer" in the sense of a mathematical problem. Rather, it takes the form of multiple concurrent dilemmas.

Legal causation's need for an attributive methodology makes an *ex post* formulation of the "but for" test easier for the trier of fact. However, the above cardiac ward example proves the concurrent need for an attributive logic that relies on a view of how the event occurred from the time of the alleged tort. Our search for a more balanced articulation of the "but for" test for use in multifactorial interactions between thinking machines and human activity, requires that we draw insight from the law's consideration of a similar interaction between medicine and humans.

4. Functional Analogy to Causation in Medical Negligence Cases

Medical negligence cases are actually the closest analogue to cyber torts for two important reasons. First, the systems of the body, down to processes at the cellular and even molecular level, operate much like information systems involving multiple participants. Second, the counterfactual dynamic of causation in medical cases, especially those involving informed consent to treatment, involves elements of intentionality: a "what if" decision-making process on the part of the plaintiff patient, and an overriding discretionary role of the medical doctor in limiting freedom of choice in favour of what is best for the patient or for public health. Both of these elements of causation in medical cases place front and centre the *ex ante* influence of information in having brought about a potentially harmful event such as an adverse drug reaction, an unsuccessful surgery or an unattended infection. The interaction between a complex and frequently counterintuitive physical phenomenon (the human body) and interventions based on information (treatments), requires both a sense of what *happened* and what was *thought to be happening* to do justice to the parties' dispute.

Activity in cyberspace follows a logic that is more sophisticated than ordinary cause and effect. Predictive and adaptive theories of events, such as Bayesian logic (introduced later in this chapter), can help attribute events to their consequences as part of the basic judicial function of finding out what happened and what should be done about it. The legal fixation on the linear *ex post* temporality of the "but for" principle of causation cannot readily apply to a fatal crash between two driverless vehicles, each with a different map update or proprietary algorithm for interpreting traffic conditions. The indeterminate permutations of known and unknown data held in a large number of connected and yet autonomous⁶² vehicles are even greater than cases involving the

compromise of a fetus during pregnancy and/or delivery.⁶³ Whereas a purely *ex post* forensic approach might cause a court to give too much weight to outcome, an *ex ante* approach starting from the vantage point of the principal parties might allow the court to imagine how the event occurred: not so much deducing the past from an indeterminate set of variables, but predicting it from a limited set of antecedent vantage points. Legal causation, one must not forget, is a principle of justice.

Causation and burdens of proof are inextricable. In the absence of certainty or a closed experiment, the material relationship between two objects or forces in the real world deals with one's confidence in the existence of a linear relationship between cause and effect. "Causation," according to our Supreme Court's formulation in *Snell*, "is an expression of the relationship that must be found to exist between the tortious act of the wrongdoer and the injury to the victim in order to justify compensation of the latter out of the pocket of the former."⁶⁴ The legal test for causation has tended to abhor the apparent rigour of scientific standards of proof.⁶⁵ In an effort to harmonize the legal process' ability to rely on scientific facts with the way the scientific community accepts reliability, courts have developed a standard for the methodology of interpreting primary data. The landmark U.S. Supreme Court decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* concerned the interpretation of a procedural rule containing the words "scientific knowledge." However, it sparked a movement to shore up the gatekeeper role of the courts in admitting evidence of facts interpreted by scientific experts.⁶⁶

Despite the dichotomy between legal and scientific burdens of proof of causation, both are in fact driven by purpose. In the face of an incurable communicable disease, an epidemiologist may be happy to try out a vaccine shown to be 51 percent effective (the same as the legal standard of proof), but a structural engineer would not permit an ingredient to be mixed with concrete that could lead to the collapse of one in a thousand buildings (0.001 percent). The family of a patient succumbing to a terminal viral condition might rightly feel justified in suing a doctor for having failed to recommend a vaccine with 50 percent or less likelihood of efficacy. The doctor's defence lawyer might argue that the failure to prescribe did not cause the condition. Departures from this dichotomy, such as the loss-of-chance doctrine, have not taken hold in

⁶² Connected to each other via the Internet, but autonomous from each other physically in separate vehicles.

⁶³ As described in *Marchand v. The Public General Hospital Society of Chatham* (2000), 51 O.R. (3d) 97 (C.A.), leave to appeal refused 2001 CarswellOnt 3412 (S.C.C.).

⁶⁴ *Snell v. Farrell*, [1990] 2 S.C.R. 311 (S.C.C.) at 326 [S.C.R.].

⁶⁵ *Snell, ibid.* at 330 (100%), and Barnes, D. W., "Too Many Probabilities: Statistical Evidence of Tort Causation," 64 *Law & Contemp. Probs.* 191 (Autumn 2001), at 191 (95%).

⁶⁶ *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) at 590-593 [U.S.].

Canada.⁶⁷ The result would not be in doubt, if the tort involved consent to treatment (as opposed to failure to treat) because the combination of *ex post* and *ex ante* elements is based on an objective standard applied to causation at the moment of consent.⁶⁸

Whereas the proof or evidence of causation lives within the facts, the purpose lives within the mind of the person posing the question. The standard of proof is of no practical value in law if not paired with a standard of belief. If the doctrine of informed consent compensated based on a significant risk of adverse outcome of less than 50 percent, then justice should consider the fairness of denying compensation where the breach of duty deprived the plaintiff of a similar chance of avoiding an adverse outcome. The use of the *ex ante* hypothesis actually counterweighs a necessary fallacy of the *ex post* causal analysis, in that the survival percentage is based on a ratio of two outcome sub-cohorts, alive and dead, from which the subject was excluded.

This type of prospective logic will undoubtedly be necessary in cases such as accidents among self-driving cars. The forensic *ex post* thinking among experts who were employed to pick over the fragments of evidence could lead to a shift in our understanding of such accidents away from driver error to product liability.⁶⁹ This reflects an antiquated way of viewing the technology. The manufacturer of the driverless car has not so much transformed the car as it has replaced the driver. A chauffeur is not a product, but rather a *service*. If the onboard route map is out of date, there is nothing wrong with the car. There may have, rather, been something wrong with the map provider, or with the municipality. The “defect” has less in common with the traditional defective car than it has with a tired or inattentive driver.

Predictions that “owners may also face liability for failing to maintain and upgrade the computer components in their vehicles,” include the possibility that “an operating system is no longer supported by the manufacturer.”⁷⁰ The choice between “but for” over “material contribution” must be made because of the inherent unfairness of finding liability where non-tortious surrounding circumstances could have caused the injury in the absence of the defendant’s tort. The “but for” analysis tends to be satisfactory when a plaintiff is trying to prove something happened in the physical world, such as a missed diagnosis where sickness, aggravation or death ensued. The “but for” principle struggles to help judges determine negative events that did *not* occur, such as a lost e-commerce customer due to unfair competition or a server shutdown. This *what if* analysis is more the bailiwick of counterfactual analysis, and critically, part of

⁶⁷ *Laferrière v. Lawson*, [1991] 1 S.C.R. 541 (S.C.C.) at 608 [S.C.R.].

⁶⁸ *Reibl v. Hughes*, [1980] 2 S.C.R. 880 (S.C.C.) at 899 [S.C.R.].

⁶⁹ “Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles,” 2013 *U. Ill. J.L. Tech. & Pol’y* 247 (2013) at 258-277.

⁷⁰ Mollander, J. A. and Wiener, Y. A., *supra* note 25, p. 16, at 19.

the future jurist's tool kit for dealing with adverse events taking place in, or as a result of, the transmission and manipulation of data.

The very concept of "but for" imports a concept of probability because it is "but for" the negligence etc. the consequence would not have occurred. "Would not" is an inherently probabilistic phrase. The judicial task of "balancing" probabilities between an event causing another or not is by its nature a static weighing exercise. In order to grasp the logic of predicting the past as a causal exercise, the trier of fact needs to take the mental camera to the point of origin and point it forward.

5. Overcoming the Legal Fixation with the Ex-Post Forensic Perspective

To the generations currently sitting on Canadian trial courts, the lack of verifiable factual sources makes discussions involving the Internet uncomfortable. Jurists are familiar with witness testimony, traditionally based on what one can see, hear, touch, smell or feel. North American courts have adopted the *Daubert* criteria for evaluating scientific evidence and its anchor in the acceptance of the expert's methods by those who work in the field.⁷¹ The drawback of this cautious approach is that it resigns itself to being behind the state of the art and being limited to the comfort level of judges. In times of exponential technological advancement, this can mean the law falls behind the rest of human knowledge and endeavour.

Judicial attempts to compensate or to end up frustrating justice-seekers by reducing causal formulae to quasi-Delphic platitudes such as the Supreme Court's statement in *Snell* that causation is a "relationship" between the tort and the injury justifying compensation. The words say nothing about the nature of that relationship. The Latin equivalent of "but for," *sine qua non*, explains that the harm to the plaintiff would not have occurred without the wrongful act or omission of the defendant. The limitations of this concept can be readily illustrated by the small wrong that causes a large loss in circumstances where other causes are patently more hazardous but also non-tortious. The common law tries to control the unfairness of such cases through principles such as remoteness⁷² and foreseeability.⁷³ To reach the capacity for nuanced articulation of "just causes," jurists must work with the *Snell* relationship between the wrong and the harm from different special and temporal perspectives. Remoteness and foreseeability are still principal factors in limiting the scope of the law's reach. The difference now is that these factors

⁷¹ *R. v. Abbey*, 2009 ONCA 624, 97 O.R. (3d) 330 (C.A.) at paras. 117-120, leave to appeal refused 2010 CarswellOnt 4827 (S.C.C.).

⁷² *Overseas Tankship (UK) Ltd. v. Morts Dock and Engineering Co Ltd.*, [1961] A.C. 388, [1961] 1 All E.R. 404 (New South Wales P.C.).

⁷³ *Palsgraf v. Long Island Railroad Co.*, 162 N.E. 99, 248 N.Y. 339 (1928).

need to be examined as if they occurred in a film editing suite: by rewinding, replaying and stopping the action.

If the courts seem ham-fisted by relatively simple conundrums of causation arising from the mid-20th-century product design of a Zamboni, what will they do with cases involving 21st-century artificial intelligence (AI)? Even early versions of AI, such as learning home thermostats connected to the Internet, are poised to cause accidents for which consequences may be justiciable. If such a device, designed by California engineers, were to misjudge the Canadian winter and cause a resident's water pipes to freeze, the ensuing product liability action brought by a subrogating insurer for flood damage would require more than "*res ipsa loquitur*," now abolished in Canadian law.⁷⁴ Proof of causation would necessarily require examination of the learning patterns of the devices, any associated Internet-based service, and how they interact with the end-user resident. This example illustrates how courts will need to get over the novelty of machines having an *ex ante* perspective that can be examined, in terms of learning the way humans do. If they do not, they will be incapable of trying the merits of even simple product liability cases.

The most prescient commentary on the concept of machinery capable of learning, self-improving and — important from a tort perspective — making mistakes, was Alan Turing. Turing, in his revolutionary essay on computers, stated:

An important feature of a learning machine is that its teacher will often be very largely ignorant of quite what is going on inside, although he may still be able to some extent to predict his pupil's behavior. This should apply most strongly to the later education of a machine arising from a child machine of well-tried design (or programme). This is in clear contrast with normal procedure when using a machine to do computations one's object is then to have a clear mental picture of the state of the machine at each moment in the computation. This object can only be achieved with a struggle. The view that "the machine can only do what we know how to order it to do," appears strange in face of this.⁷⁵

Robotic arms used in car assembly plants can possess a sense of touch necessary to fit parts together. This means they can also be trained to learn from pain and rewards. The fact that machines already make decisions and perform autonomous tasks that affect human lives and property means the law must learn increasingly to treat the causal aspects of adverse events involving machines in the same way it dealt with the discretionary, deliberate or even the careless acts or omissions of humans.

⁷⁴ *Fontaine v. British Columbia (Official Administrator)* (1997), [1998] 1 S.C.R. 424 (S.C.C.) at 435 [S.C.R.].

⁷⁵ A. M. Turing, "Computing Machinery and Intelligence," *Mind*, N.S., Vol. 59, No. 236 (Oct., 1950) pp. 433-460, at 458.

The knowledge deficit of the common law in developing a clearer understanding of the role of consequence in legal causation appears to stem from a blind spot in legal training that excludes causation from law or the examination of the justice of a dispute. According to Hart and Honoré, lawyers try to push too many questions through the single “but for” funnel:

How can an omission to act or a persistent state of being be considered the cause of anything? What do we mean when we say that one person caused another to act by providing him with a reason for acting (a relationship the authors characterize as an “interpersonal transaction”)? How has one caused harm when he has provided another with an opportunity for inflicting it? What is meant by causing loss by depriving another of a chance of economic gain? The significant point is that although these questions are all properly thought of as involving causal concepts, the concepts that are involved have distinct characteristics and cannot necessarily be subsumed under a single, all embracing notion of causation.⁷⁶

This statement betrays the limitations of a judiciary accustomed to thinking about civil common-law remedies as a set of categories and formulae or legal “tests.” The consequence appears to be that the Canadian Common Law is poorly equipped to deal with causation for legal conflicts online.

In 2013, the National Judicial Institute of Canada published its *Science Manual for Canadian Judges*,⁷⁷ based on the American counterpart, *Reference Manual on Scientific Evidence* (now in its third edition).⁷⁸ These publications not only address the need for judicial education and standardization of knowledge, but they also introduce some of the basic concepts of the philosophy of science that inform contemporary human activity. So far, the only evidence that Canadian judges are even aware of the Canadian *Manual* are references by Todd Archibald, the editor of this book, in the 2014 and 2015 editions of this *Annual Review*⁷⁹ and two Canadian judgments.⁸⁰ That means the Canadian judiciary has all but ignored *the* bench book for scientific evidence.

As in the case of any survey treatment, the *Manual* is expository of certain threads of thought, and its highlighting of certain thinkers exposes a mild bias toward the adoption of Thomas Bayes (1701-61), an 18th-century English statistician, philosopher and Presbyterian minister. Bayes’ theory of causation, largely overlooked by the legal tradition, is in fact a potential source of assistance because it, like the judicial role, examined the likelihood that one

⁷⁶ Mansfield, J.H., “Hart and Honoré, *Causation and the Law* — A Comment,” 17 Vand. L. Rev. 487 (1963-1964) at 488; also *q.v.* Hart and Honoré, *Causation and the Law*, 2nd Ed. (New York : Oxford University Press, 1959, 1985), at 109-28.

⁷⁷ National Judicial Institute, *Science Manual for Canadian Judges* (Ottawa, 2013).

⁷⁸ Federal Judicial Center, *Reference Manual on Scientific Evidence*, 3rd Ed. (Washington, D.C., 2011).

⁷⁹ Archibald et al., *Annual Review of Civil Litigation*, 2014 at fn. 11, and 2015 at fn. 29.

⁸⁰ *R. v. Maple Lodge Farms*, 2013 CarswellOnt 13887 (C.J.) at para. 42; and *R. v. McLaughlin*, 2014 ONSC 6537 (S.C.J.) at para. 87.

thing led to another based on one's belief in such consequences. Although there is only one reference in the *Manual* to another philosopher of science, David Hume (1771-76), Hume's unseen hand is also very present in the book.⁸¹ Bayes, as we will see, added to this body of thought by defining the limits of Hume's naturalism and skepticism, and by illustrating how humans require the answer to certain questions that cannot be answered by simply aggregating observed data.⁸²

Hume's descriptive approach to the natural world and Bayes' approach based on belief are not opposed. The *Manual* is careful not to suggest judges should prefer one over the other, but rather to require judges to be aware that the two methods of interpreting scientific data can lead to divergent results. The authors refer to one significant observation by Hume, known as the "is-ought problem," to illustrate how scientific experts frequently employ arbitrary (and therefore subjective) standards and criteria in the interpretation of objective data. Instead of saying a particular set of recorded data "ought" to indicate a particular fact, scientists often state that a fact *is*, without disclosing that a range of errors is factored into the conclusion. The Humean "is-ought problem" actually brings Hume closer to Bayes by acknowledging that scientists employ a belief-based methodology, even though they may not care to admit it. Despite Hume's status as a foundational thinker about causation, the law has largely ignored him while struggling to understand this central concept of attributing consequence to parties from whom the injured seek compensation in tort. The only reference to Hume in Canadian law appears in a scholarly Newfoundland trial court decision, *Petro-Canada v. Canada-Newfoundland Offshore Petroleum Board*,⁸³ involving rights to an offshore petroleum discovery.

The *Manual* is somewhat of a touchstone for this exploration of the adaptability of legal causation according to the "but for" principle, because (a) it is required reading for the Canadian judiciary and (b) two appendices of Chapter 2 planted a new tree of knowledge on the judicial landscape. Those appendices painstakingly outline the difference between descriptive and scientific causal hypotheses, and between "frequentist" and Bayesian probability in drawing conclusions from observed data.⁸⁴ The practical utility of recognizing these different, and not necessarily competing, approaches

⁸¹ *Science Manual for Canadian Judges*, p. 102. In the context of the European Enlightenment, the anti-spiritual aspect of Hume's writings proved more provocative and enduring than Bayes' preoccupation with how things happened, whether or not a deity had a hand in the consequences. Nevertheless, causation was actually central to Hume's teachings against the Church.

⁸² John Earman, "Bayes, Hume, Price and Miracles," *Proceedings of the British Academy*, 113, (2002) at 99-109.

⁸³ *Petro-Canada v. Canada-Newfoundland Offshore Petroleum Board*, 1995 CarswellNfld 126 (T.D.) at para. 53.

⁸⁴ *Science Manual*, *supra* at 119 and 129.

formed the discussion of “ascertainment bias” in the DNA identification of criminal offenders. Although the discussion concerns attribution or identification, as opposed to consequence, it is worthwhile reading the *Manual’s* DNA example because identification is a form of legal consequence based on both linear and reticular sorting processes. The example can be adapted to explain the judicial task of determining causation, as an attribution of liability for a consequence of an earlier act or omission. Once the court enters the mindset of attribution (the *legal* part of legal causation), it is better equipped to exercise its fact-finding powers beyond the vague understanding that it is an inquiry into the relationship between the wrongful conduct and the plaintiff’s harm.

The example in the *Manual* is a DNA sample collected from a crime scene, and the police practice of comparing it to a database of known offenders. Once the investigator takes several further steps to verify the accuracy of the match, a suspect could be charged. The frequentist or deductive commentator would say this process is not as reliable as one where the investigators first identify the suspect through non-DNA circumstantial evidence, and thereafter compare the DNA sample to the suspect’s. The challenge facing the law by translating a 51 percent frequentist approach is the effective denial of the 49 percent of real world cases that have a different result. The Supreme Court has recently held, rightly if somewhat simplistically, that statistics about the frequency of a particular event do not prove that the event occurred in any particular instance.⁸⁵ The reason for the criticism of the method of comparing the crime scene DNA with the offender database is that the greater the number of known-offender samples one trawls in order to find a match, the greater the likelihood that someone’s sample, not necessarily the perpetrator’s, will match.⁸⁶

The utility of the Bayesian approach to causation lies in the intentionality of the triage. What makes ascertainment bias a potential liability helps the law consider the likelihood of behaviour modification in the human, machine-assisted human, or machine responses to a tortfeasor’s act or omission. In the earlier example of an Internet security company, the victim’s process of choosing protection options was as much a factor as the intentional behaviour of hackers looking for opportunities to breach security. Causation in that scenario

⁸⁵ *Benhaim v. StGermain*, 2016 SCC 48 (S.C.C.) at para. 74.

⁸⁶ By way of analogy, the manual says the likelihood of finding someone with the identical name as oneself is greater in a telephone directory from a large city compared to that of a small village. Ascertainment bias — the motive to confirm what one has found — emerges as a logical vulnerability when computing power has increased the availability of DNA sampling as a triage tool. In contrast, the Bayesian approach would consider the larger sampling of DNA samples eliminated from the search to indicate the reliability of the match during the identification stage. Further discussion as to the merits of one method over the other in the forensic identification field is beyond the scope of this chapter.

involved a reconstruction of what would have happened, had the victim received different advice or purchased a higher level of protection. The victim cannot know of the specific threat, and so any retrospective search for a cause is suspect because the knowledge of the harm or breach will look backwards in time and explore possible causes of which the defendant's breach of duty of care might be one.

In the retrospective approach, the victim's belief in what the future held in store (including factors within his control) are, at best, part of the circumstantial evidence. A Bayesian approach starts with an *ex ante* perspective and considers the probability of an outcome using current knowledge as an objective measure of one's belief in a result.⁸⁷ When establishing the course of events in a substantially logic-driven past reality, an approach that relies on contemporaneous knowledge of judicial facts helps identification of what would have happened, but for the tort, than an approach that retrospectively associates types of facts with classes of outcomes. Being seen at the scene of an accident is not the same as having caused it to occur. The difference between presence and consequence was the central argument in the 2016 decision of the Ontario Superior Court in *Wise v. Abbott Laboratories*.⁸⁸ The Court held that statistical confirmation of increased adverse reactions to a drug was evidence that the drug should have been dispensed with a stronger warning. However, the Court declined to hold that the adverse reactions generally occur as a result of the drug.

Where the relationships are more general, in line with tort law's neighbour principle, the logic of the events leading causally to the harmful incident is less closed and more difficult for the court to follow. One such analogue is found in the relationship between a government security service and an individual. In the *Jane Doe* case, the Court sustained a pleading. The allegation was that the municipal police service failed to warn the plaintiff, a victim of a serial sexual predator, that they had been investigating the activities of the assailant in the victim's neighbourhood.⁸⁹ Apart from applying the generous rules regarding the scope of pleadings, the Ontario Divisional Court applied this rationale:

This leaves the question of causation. How can it be proved that if the police had discharged their private law duty of care to the plaintiff, she would not have been assaulted?

In my opinion, it is open to the plaintiff to show that had she been warned, she could have taken steps to prevent the attacker from entering her apartment. Alternatively, she could have moved, stayed with a friend or had someone stay with her. Many

⁸⁷ *Science Manual*, p. 129.

⁸⁸ *Wise v. Abbott Laboratories, Limited*, 2016 ONSC 7275 (S.C.J.) at paras. 370-372.

⁸⁹ *Doe v. Metropolitan Toronto (Municipality) Commissioners of Police* (1990), 74 O.R. (2d) 225 (Div. Ct.), leave to appeal refused 1991 CarswellOnt 1009 (C.A.).

options would have been available to her, all of which she was denied as a result of the failure to warn.

Where the alleged deprivation of choice is the effect of the tortious act or omission, the forensic exercise then turns to the likelihood of the lost choices in making a difference, and the law must examine each counterfactual or hypothetical choice from a past vantage point. It must look prospectively at the likelihood that (a) the plaintiff would have modified her behaviour and (b) that the modification could have protected her from the malefactor. In *Jane Doe*, the law should not find that the failure to warn women in the neighbourhood *simpliciter* would have prevented the sexual assault. To meet the “but for” test, the victim would have to demonstrate that she would have acted on such warning by moving out, buying extra locks for the balcony door, etc. She would have had to prove that she would not have exhibited the common behaviour of people to do nothing in the face of public service announcements.

In the cybersecurity paradigm, the intentionality of causation, in both general and specific duties to protect the plaintiff, is the factor which makes it insufficient to prove that the intruder entered the secure network because the protection was sold at one level instead of another. Most discussions of Bayesian causation, especially in academic treatments, suffer from being incredibly dense and often use complicated symbolic formulae and equations. In order to introduce this advanced field of counterfactual theory to the public, popular science and philosophy have introduced illustrations through mind-puzzles such as the “Monty Hall Problem.”⁹⁰ The name of this puzzle refers to the host of a popular 20th-century television game show *Let’s Make a Deal* in which participants are forced to make decisions based on prizes hidden behind sliding doors.

Told in advance that behind one of three doors is a car, and behind two others a goat, the contestant has a one-in-three chance of winning the car. The contestant starts by choosing a door. Mr. Hall asks whether the contestant is sure about the choice. Will it be advantageous to keep choosing, or settle for a fixed amount of cash offered as the deal? As the game proceeds, Mr. Hall opens one of the other doors, revealing a goat. The pure frequentist will say the odds have not changed from one in three. A pragmatic frequentist might then say it is now a coin-toss: one in two. The Bayesian, however, would point out that neither of these approaches is accurate: rather, it is advantageous for the contestant to switch to the other door because it has a two-in-three chance of revealing the car. What confounds the frequentist approach is that, in order to

⁹⁰ See F. D. Flam, “The Odds, Continually Updated,” *The New York Times*, Sept. 29, 2014: <<http://www.nytimes.com/2014/09/30/science/the-odds-continually-updated.html>> .

make the game good television, Mr. Hall knows the prizes behind each door and must choose to open one of the two doors hiding a goat. The likelihood that the two non-chosen doors both conceal goats is the same as the original probability: one in three. The revelation of a goat behind one of the unchosen doors means the likelihood that the car is behind the other unchosen door is two-in-three. The wise choice is to switch to the remaining closed door.

The host's revelation of a goat door raises the likelihood of the remaining unchosen door concealing the car by 100 percent, from $1/3$ to $2/3$. Another way to look at this is that the opening odds were $2/3$ against the choice made. The goat behind the opened door now allows the contestant to turn these odds around by requiring only one choice to pick the $2/3$ advantage. This logic applies to the likelihood of making the right choice because the factor in play is the dynamic state of knowledge of the contestant. When Mr. Hall opens a door and reveals a goat, this could be a causal event, or it could not be. In theory, to a perfectly logical and contemplative person, the revelation of the goat should cause the contestant to switch doors. The actual outcome does not matter from a causal perspective, except that Mr. Hall caused the contestant to change his or her mind. In a pressured, time-limited situation, Mr. Hall's action might not have prompted the change. This process has proven that the event initiated by Mr. Hall would have caused the contestant to recognize the better choice of door.

If the concept seems foreign to the after-the-fact forensic analysis of tort law, consider the instances where the very question of fault comes down to the reasonable or rational person making the right choice from three or more options. The foregoing illustration demonstrates how a court might better view the relationships among events occurring in a world of algorithms. In such a world, computers and networks are employed in activities dependent on probabilities and approximations, and not just simple logical sequences. The idea of probability constantly being updated is vital because it is not enough to examine the likelihood of a potential cause and effect, combined with intervening factors in a static way. Analogies such as the Monty Hall principle help add a predictive element looking prospectively from the negligent event, as opposed to looking at it purely in hindsight. Much of the judicial treatment of causation deals with the probability of past events occurring due to the presence of a harmful influence (or the lack of a beneficial one), in cases attributed to the defendant's breach of a duty of care. The *belief* in the causal effect of putative cause *c* resulting in effect *e*, in accordance with a basic "but for" analysis, can be confounded by a frequentist approach due to the lack of confirmation in data. However, if one were to count or rule out the effects of other factors based on a dynamic basis, the same data set can be better interpreted based on the fairness of a belief that one thing led to another.

This concept was applied recently in an Ontario trial decision, affirmed by the Ontario Court of Appeal, regarding whether the failure to deliver a hormone treatment to a pregnant mother caused cerebral palsy in the infant. In *Goodman v. Viljoen*, at para. 128, Walters J. said this about causation in the context of deciding whether a failure to administer a risk-reducing treatment caused an adverse result according to the “but for” test:

In order to determine the probability that the risk of [Cerebral Palsy] is reduced, one must use the Bayesian method which uses a different definition of probability. It is an expression of the degree of belief about the unknown.⁹¹

In accepting the trial judge’s reasoning, Feldman J.A., speaking for the majority, stated:

In my view, the trial judge made no error by accepting Dr. Perlman’s evidence in her consideration of this issue. Dr. Perlman gave his opinion in this case based not only on the Cochrane analysis of 48 cases, but also on his knowledge of the earlier 2004 study and analysis, his knowledge of animal studies showing a relationship between ACS and CP, his expertise and experience, as well as the biological plausibility approach and the Bayesian probability analysis by Dr. Willan. The biological plausibility approach in particular addresses the likelihood that steroids have a maturational effect on all membranes including the brain membranes whose disruption leads to PVL.⁹²

The Bayesian approach has also been seen in the workers’ compensation setting where this scientific method has been applied in diagnosis of industrial diseases and as a medico-legal aid to determining entitlement to benefits for workplace injuries.⁹³

In employing an *ex ante* approach in the belief of consequence as a complement to the *ex post* examination of how the plaintiff’s harm occurred, it is nevertheless important not to intermix their application. An *ex ante* belief-based inquiry of consequence cannot be used to reverse-engineer a task of identification, particularly where the sample is too small to justify a reliable belief. This logical pitfall was illustrated in the following paradox:

For example, if there were three defendants, each equally likely to have been the cause of the plaintiff’s injury, each defendant can ‘prove’ that she was not the cause, since there is a 67 per cent probability that she was not the cause, which leads to the paradoxical result that it can be ‘proven’ that none of the defendants was the cause, even though we know that one of them was the cause.⁹⁴

⁹¹ *Goodman v. Viljoen*, 2011 ONSC 821 (S.C.J.) at para. 128, affirmed 2012 ONCA 896 (C.A.), leave to appeal refused 2013 CarswellOnt 9420 (S.C.C.).

⁹² *Goodman v. Viljoen*, 2012 ONCA 896 (C.A.) at para. 130, leave to appeal refused 2013 CarswellOnt 9420 (S.C.C.).

⁹³ *Decision No. 95/09I*, 2015 ONWSIAT 2113 (W.S.I.A.T.).

⁹⁴ Richard W. Wright, *supra* note 54 at 212.

If the courts were to consider some cyber torts as incapable of proof because of the existence of too many independent factors, it is possible to envisage the Internet as largely unregulated by the law of torts. However, the one substance that is not lacking in cyberspace is information (data), as well as information about information (*meta-data*). For example, the widespread use of post-purchase satisfaction surveys makes it entirely possible for online commercial decisions made by a large number of people to be tracked with sufficient accuracy to say, for example, that 19 times out of 20, a particular “fake news” report caused purchasers *en masse* to return a product they came to believe contained a hazardous defect.

The *ex ante* causal analysis through belief-based perception of the unravelling of past events is not restricted to events having physical manifestations. In the case of *e-commerce* transactions, the link between electronic trade libel and other forms of unlawful competition and actual loss of sales is difficult to measure using currently available resources. This state of affairs will not long endure. Significant market actors such as Google Inc. have already commissioned studies by causal theorists about the tracking of causal relationships among events occurring online. That company’s stake in developing knowledge of these relationships derives the central value of its multi-billion dollar business in paid search-engine advertising on the Internet: the ability to prove that words, images, videos or even certain news stories on websites led to people’s buying decisions. The fact that Google Inc., widely considered the dominant participant in the Internet, has so many eggs in the Bayesian causation basket, will mean that, to some extent, much of reality itself on Planet Earth will be informed by behaviour hard-wired to a Bayesian or a variation of Bayesian *ex ante* cause-and-effect thinking. For its customers and partners in the Internet marketing business, Google’s Bayesian mission includes distribution of an online service called Causal Impact, described as follows:

The package aims to address this difficulty using a structural Bayesian time-series model to estimate how the response metric might have evolved after the intervention if the intervention had not occurred.⁹⁵

The Google site hosting this service cites an academic study it commissioned to study the effect of interventions in cyberspace on participant behaviour.⁹⁶ In one example, the authors found that a paid advertising campaign dramatically increased the number of clicks to an *e-commerce* site, proving that the intervention of a paid campaign did not merely shift future clicks into the present or “cannibalize” search results that would have led to clicks in the absence of the campaign.⁹⁷ The study described, among others, an experiment

⁹⁵ Online: < <http://google.github.io/CausalImpact/> > .

⁹⁶ K.H. Brodersen, et al., “Inferring Causal Impact Using Bayesian Structural Time-Series Models,” *The Annals of Applied Statistics*, 2015: Vol. 9, No. 1, 247-74.

modelling the effect of a paid online campaign on commercial traffic to a website operated by a client of Google. The company provides unpaid advertising through its ordinary search engine, and so from a strict causal perspective, the question arises whether a paid advertising campaign or an unpaid search result led to a change in valuable traffic. In the conclusions, the authors described this challenge in the following way:

The principal problem in observational studies is endogeneity: the possibility that the observed outcome might not be the result of the treatment but of other omitted, endogenous variables.⁹⁸

The ability to prove the effect — or the absence — of a triggering event in the face of active alternative causes depends entirely on the effort and sophistication of the party claiming the advantage of this type of evidence. To an advertiser and Internet service company such as Google, the value of this type of information is obvious. The authors had the prescience, however, to foresee other applications to the causal methodology:

Overall, we expect inferences on the causal impact of designed market interventions to play an increasingly prominent role in providing quantitative accounts of return on investment. . . . This is because marketing resources, specifically, can only be allocated to whichever campaign elements jointly provide the greatest return on ad spend (ROAS) if we understand the causal effects of spend on sales, product adoption or user engagement. At the same time, our approach could be used for many other applications involving causal inference. Examples include problems found in economics, epidemiology, biology or the political and social sciences.⁹⁹

That a company with such global influence on behaviour is using the *ex ante* perspective of causation as an integral part of its own business model, suggests jurists would be foolish not to consider the function of events and consequences in the Google ecosystem. Compensation is the remedy offered by tort law, but the relationship between the wrong and the injury cannot be limited to a post-mortem examination of an event. Tort law imposes liability on drivers who rear-end others' vehicles because of the *expected* damage to others' property and bodily health. It is not, as some lawyers and judges approach causation in tort law, a purely deductive exercise in assembling physically related circumstantial evidence and imposing retrospective moral judgment. Without an *ex ante* perspective, causation in tort law risks arbitrariness and unfairness.

To resume an example stated earlier in this chapter, a paid campaign intended to divert Internet traffic for a newly-launched product to false or misleading

⁹⁷ Brodersen, *op. cit.*, at 265.

⁹⁸ *Ibid.* at 271.

⁹⁹ *Ibid.* To Google's list of examples, one could add "traffic control". Even our current traffic management technology depends entirely on *ex ante* predictions of vehicular speed, volume and highway geometry.

product reviews appears to be *prima facie* tortious, either as an unlawful interference with commercial relations or perhaps a new category of substantive tort. By starting from an *ex ante* position and considering the causal relationship from the intentionality of the perpetrator, or the competing business that hired the perpetrator, it is much easier to see the probity of data showing the effects of the harmful behaviour. If the defendant intended to divert business away from the plaintiff by unlawful means, it is easier to justify a judicial remedy when the plaintiff can demonstrate its Internet business suffered a decline. In such instances, the Bayesian principle that fact-subsequent factors will affect choices, including intentional factors, can persuasively prove that the wrongful behaviour caused the product launch to fail. In contrast, a more traditional approach to economic causation might start with the doctrinal prediction that advertising is a market-neutral externality or that people seeking the alleged tort victim's product will eventually find it in a standard search. From an *ex post* perspective, the same data might be interpreted in a way that the unlawful behaviour and the result were coincidental and not causally related.

In Hart and Honoré, we find the distinction between “explanatory” and “attributive,”¹⁰⁰ with the former describing the circumstances of the event, and the latter ascribing policy-driven value judgments about the role of particular actors. In theory, all relevant factors have a causal role in bringing about a result. The law is more interested in the consequences of a wrongful act or omission, and the place to judge the consequence is the time of occurrence, not the time of the judicial trial. For this reason, a burglary did not so much result from, but rather was occasioned by, the negligence of a neighbour who, having agreed to lock up the house, subsequently forgot. It was the burglar who caused the burglary. However, the “but for” analysis attributes fault and cause based on the attributive, consequential inquiry.¹⁰¹

IV. NO CAUSATION? NO CAUSE OF ACTION? NO CONSEQUENCES.

1. Making Courts More Sensitive to Causality

The Supreme Court needs to prepare itself for tort cases arising from events occurring partly or wholly due to the interaction with or among knowledge-based machines. In order to do so, it must first dispel the premise that “but for” only means the imaginary task of *removing* the suspected cause from the historical data and determining whether the harm could still have occurred. In a real-world condition where $a + b + c \rightarrow e$, and c is presumed cause and e actual

¹⁰⁰ Mansfield, *op. cit.*, at 489.

¹⁰¹ W. H. Dray, “Causal Judgment in Attributive and Explanatory Contexts,” *Law and Contemporary Problems*, 49:93 (1986) at 13 and at 22.

effect, c is a cause iff¹⁰² $a + b + c$. This mathematical representation of the “but for” test for legal causation can be misleading because the interaction of “ $a + b + c$ ” is no more static than our known physical universe can exist without time and three dimensions. The question for the jurist is whether to accept c as the cause where a or b or both cannot be ascertained (as opposed to being absent), and despite the lack of known other causes of e , $a + b + c$ represent the known ingredients of e . Courts tend to accept c as the cause of e even without the other ingredients, unless the absence of one or both of the others can be proven. We cloak this in the words “robust and pragmatic” or “common sense.” In fact, this represents a values decision based on the anecdotal or collective experience of the trier of fact.

The sample paradigms of cyber torts in this chapter illustrate how the law’s justification for restoring the plaintiff to pre-harm conditions at the defendant’s expense must take into account the intentionality of some or all of the participants in the commission of the tort. In order to do justice to the parties, compensation must represent the harm actually caused rather than harm caused by other factors. The task of identifying such harm is likely to become more difficult, as the behaviour of computer networks outgrows traceable verbal commands and enters a more heuristic stage of technology where machines learn by making mistakes and exercise discretion, as humans do. It is entirely possible for the courts to misconstrue technological flux and reject evidence of causation as “unsettled science,” similar to the conflation of admissibility of scientific expert evidence with proof of facts. In the case of the latter, courts would be wise not to consider scientific evidence admissible under the *Daubert* rules as a requirement to accept it as binding. All expert evidence remains subject to the “ultimate issue” rule that courts, and not experts, are accountable for deciding factual disputes.¹⁰³ Similarly, judges should not mistake the uncertainty of an *ex ante* attribution of causal fault with the criteria in the *Daubert* evidentiary gatekeeper role against admissibility of unsettled science.¹⁰⁴ Rather, the courts must consider the predictive faculty of the *ex ante* methodology as a fact-finding and choice-narrowing aid.¹⁰⁵

¹⁰² *iff* = *if and only if*.

¹⁰³ *Reference Manual For Judges*, at 20-21.

¹⁰⁴ *Science Manual for Judges*, at 171.

¹⁰⁵ Following the use of the Bayesian approach to DNA evidence, it makes practical sense for law enforcement agencies to seek matches for crime scene samples from the data already obtained from known criminals, even though there is an ascertainment bias based on the premise that offenders are repeat offenders. If the alternative is to work with a largely theoretical pool of genetic markers, the uncertainties of statistical sampling oppose the judicial preference for making findings of fact based on real data and not hypotheses. Thus, a court seeing events in cyberspace from a purely forensic *ex post* perspective might consider ‘the World-Wide Web’ as being too reticular and complicated to follow the input and output of commands and data for purpose of

Our courts are capable of finding that the legal cause of a building explosion was not a gas leak, even though the leak was the only identified source of volatile gas.¹⁰⁶ Indeed, in *Westco Storage*, the Manitoba Court of Appeal overturned a trial judge who simply deduced that the leak was the only possible source of explosive material. Usually, the assumption is that the “mixture of gases” explodes. In fact, at the molecular level an explosion is a rapid series of exothermal reactions from one molecule to another, resulting in an expansion of the outer wall of the fire greater than the strength of the enclosure to withstand the force. The proof of this is that there will be no explosion if the container is stronger than the explosive capacity of the gas (e.g. an old-fashioned bank vault) or if the container is too weak (e.g. if the mixture is ignited inside a soap bubble). The chain of chemical reaction is faithfully repeatable, but still relies on negotiations (chemical reactions) at the molecular level. Nevertheless, the inter-individual and collective behaviors of gas molecules within a building explosion are not dissimilar to the behaviour of market participants in a financial crisis such as the one in 2008.¹⁰⁷ The difficult decision we must make in the 21st century is whether to allow a similar process to apply to cyber torts, where the presence of co-efficient causal elements is not only prevalent but also inherently defies proof in a court of law. The presence of so many unknowns would foil the current formulation of the “but for” test for causation because the counterfactual analysis requires so many unknowns. If Canadian courts were to shut the door on cyber tort claims because of this failing, as they seem to have done, they would facilitate behaviour law-abiding participants in the digital economy would consider unfair or unlawful.

2. Just History Repeating: Updating the Formulation of “But For”

Tort law must constantly undergo a relevance check in order to serve the underlying policy of settling civil grievances. The history of workplace injury compensation demonstrates an area of law reform where employment law, the law of Master and Servant, contained procedural impediments that meant few employers were sued despite data of many injuries and deaths.¹⁰⁸ In the early 1970’s, there was a significant impetus toward reforming the law of torts because

meeting the rigours of the ‘but for’ causation formula. The same court, enabled by authority to narrow the range of outcomes from time references anchored in the tortfeasor’s wrongful act or omission, can more readily satisfy itself of the existence (or not) of a substantial relationship of fault between the defendant’s tort and the plaintiff’s harm.

¹⁰⁶ *Westco Storage Ltd. v. Inter-City Gas Utilities Ltd.*, 1989 CarswellMan 161, [1989] 4 W.W.R. 289, 59 Man. R. (2d) 37, [1989] M.J. No. 206 (C.A.), leave to appeal refused (1989), 102 N.R. 400 (note) (S.C.C.).

¹⁰⁷ A. Kononovicius and V. Daniunas, “Agent-Based and Macroscopic Modeling of the Complex Socio-Economic Systems,” ISSN 2029-7564 (online) *Sociallines Technologijos Social Technologies*, 2013, 3(1) at 85-103.

of a widely-held belief that the common-law causes of action in tort were impairing the function of the law itself. At that time, the concern was less about access to justice than it was an intellectual concern that the proliferation of rules and legal tests made it hard for members of the public and their lawyers to predict the outcome of law suits. Indirectly, however, that concern also translated into a belief that the courts were turning away legitimate claims and not fulfilling their role of general deterrence against wrongful behaviour. One target of such concern at the time was the law of occupier negligence:

If any part of our occupier's law is least justified, and most intellectually disreputable, it is the complete exoneration of a sometimes very careless defendant because a plaintiff, for reasons of practical or economic necessity, must expose himself to open risks, and is injured despite the most careful means of self-preservation.¹⁰⁹

The 1972 report of the Ontario Law Reform Commission (OLRC) on Occupier's Liability expressed general dissatisfaction with the way the Ontario courts were dealing with a common cause of accidental injury.¹¹⁰ The OLRC report itself was rather opaque in terms of the research informing these conclusions, and the research appears to piggy-back onto law reform initiatives in Scotland, England and Wales. The 1980 passage of the *Occupiers' Liability Act*, R.S.O. 1990, c. O.2, eliminated the common-law categories and established a more easily understood general system of liability for tort in premises liability.¹¹¹ At the risk of sounding overly simplistic, the effect of the statutory reform was not to create a new form of liability but rather to rationalize the legal requirements for proof of liability in line with the general theory of liability in tort. If the perception among some was that the legislature had opened the floodgates, it would have been more accurate to say the courts had previously kept the gates too water-tight.

The gatekeeper role of the "but for" test might be viewed with the aid of a variation on the same metaphor: a gate locked with a cryptic password. In frustration over the metaphysics required to apply the test *ex post* to many situations involving a constellation of forensic data, courts have applied amorphous concepts such as "robustness" and "pragmatism." The negatively-phrased requirement that the plaintiff has "to prove on a balance of probabilities that, but for the defendant's negligent conduct, the plaintiff would not have been injured,"¹¹² is not the same as saying the defendant's

¹⁰⁸ Anjan Chaklader, "History of Workers' Compensation in B.C.," *The Royal Commission on Workers' Compensation in B.C.* (1998) at 8.

¹⁰⁹ Paul C. Weiler, "Groping Towards A Canadian Tort Law: The Role of the Supreme Court of Canada," 21 *U.Toronto L.J.* 267 (1971) at 304.

¹¹⁰ Ontario Law Reform Commission, *Report on Occupiers' Liability*, 1972, at 6.

¹¹¹ Ryan Murray and Bianca Thomas, "Slips, Trips and Falls: Avoiding the Pitfalls of Occupiers' Liability Claims — Key Components and Interpretation of the Occupiers' Liability Act," paper for Ontario Bar Association seminar (April 19, 2014) at 1.

conduct caused the plaintiff's harm. As stated earlier, the Supreme Court has expressed the actual tort law causation requirement in negative terms in order to anchor the reach of tort law in a process of elimination attributing responsibility for the plaintiff's injury. To appreciate the legal need for the "but for" test to exhibit the qualities imprecisely described as "robustness," "pragmatism" or "common sense" — attributes of *ex ante* doing, rather than observing — the key can be found in the expression of probability that also lies at the heart of the judicial need for pragmatism. The desire for a blunt instrument is born out of a valid frustration with the inherently amoral or atomized nature of the forensic process, at odds with the court's function of rendering judgment.

The deductive exercise of identifying logical connections between the data in the evidence ensures that there is a true connection between the imputed cause and the harmful effect. This association is insufficient, however, to evaluate the extent to which it brought about the harm. Reliance on it alone significantly risks "guilt by association." The only way to find liability — a moral judgment on the association — is to combine this association with analysis of the event prospectively from a past point of origin. One can then see whether the defendant not only had some connection to the plaintiff's injury but also played a sufficient part in bringing about the harm to motivate the court to award compensation. In order to incorporate this *ex ante* perspective into the "but for" test, the court might consider a wording of the test such as this:

1. *In order to prove legal causation, the plaintiff must (still) prove on a balance of probabilities (b/p) that the defendant's conduct caused the plaintiff's harm.*
2. *In performing the balance of probabilities of legal causation (b/p), the court should make findings of fact based on two likelihoods:*
 - a) *The first likelihood¹¹³ connects the defendant's conduct to the plaintiff's harm by examining the result and circumstances at the time of the loss, and by considering whether the defendant's act or omission necessarily brought about the harm.¹¹⁴ This judicial exercise does not require certainty but a finding of fact based on simple likelihood.¹¹⁵ The first likelihood is insufficient to justify liability, until the court finds causation based on the second likelihood.¹¹⁶*

¹¹² *Benhaim v. St-Germain*, 2016 SCC 48 (S.C.C.) at para. 46.

¹¹³ Causation in an associative sense, analogous to placing the suspect at the "scene of the crime".

¹¹⁴ An active expression of the usually passive or negatively-voiced wording of the 'but for' or *sine qua non* concept.

¹¹⁵ This inquiry differs from the "material contribution" test in that the plaintiff would not satisfy the test if the harm likely would have occurred even if the defendant had played no part.

¹¹⁶ The capacity of the exclusive deductive or *ex post* application of the "but for" test to

- b) *The second likelihood limits the potential for an unfairly mechanical application of the “but for” logic, by considering the likelihood, as events occurred, of the alleged tort leading to the injury. In a jury trial, the instruction from the bench should ask the panel to consider whether there is sufficient evidence to believe a defendant’s wrongful conduct would cause the injury.*

This second question of likelihood tempers hindsight bias and thus imports the element of fairness into the causal analysis. It serves to adjust tort law to the emergent reality that geographic and even logical proximity are insufficient factual limitations on the scope of duty of care. Where everyone else is potentially one’s “neighbour” and foreseeability is indeterminate, a common-law court would be reluctant to impose a duty owed to the planet. Where a defendant such as an Internet service owes a duty of care to millions, it is not enough to *associate* the defendant’s conduct in hindsight with an injury suffered by those outside the direct customer (contractual) base, without proof of likelihood that a tort such as inadequate network security would cause the harm.¹¹⁷

To return to the example of the municipal worker’s failure to upload a temporary road diversion to a driverless vehicle navigation system, the municipality could be held liable for having caused the collision between the driverless delivery van and the jaywalking lawyer because both elements of the accident are predictable. It could also be provable that the lawyer would likely avoid being run over, if she is not expected to take the telephone call while hurrying to the law firm meeting. Under the strict application of the “but for” test, and the *ex post* first part of the proposed reformulation, the telephone company’s software contractor also *causes* the injury by failing to implement an alarm based on traffic flow instead of uploaded maps and vehicle presence. If other North-American telephone carriers use all three methods to design the alarm, the contractor is likely negligent for failing to deploy a software design taking traffic flow into account. The court’s task in determining liability for the negligent coding, however, will still depend on the *ex ante* ability to predict the risk. If it is proven that the traffic flow algorithm is deployed by other telecoms to measure speed and no one had ever been in an accident due to temporary traffic redirection, it becomes harder to adjudicate that the negligence caused the

bring about an unfair result — the source of judicial appeal to pragmatism — is evident in the expression, “Hindsight is 20/20.” Instead of pragmatism, by nature a compromise and not a more sensitive search for truth, what is required is balance by an inductive or predictive vantage point, *viz.* the inquiry expressed in 2(b).

¹¹⁷ As illustrated by the reasoning in *Wise*, fn. 88 *supra*, that *ex post* statistical confirmation of increased adverse reactions to a drug (by implication, lowered incidence of reactions for those who did not take the drug) did not prove that adverse reactions generally occurred as a result of the drug.

harm so as to justify imposing liability. If, however, the evidence shows that other telecoms required the traffic flow coding in anticipation of faulty traffic maps, the *ex ante* analysis becomes helpful in finding the contractor legally caused the pedestrian injury. While this may appear similar to a foreseeability analysis for duty of care (duty of care is inherently *ex ante*), the duty of care is defined not by foresight of the injury to the lawyer but rather the duty of care owed to all users of the road.

Each of the two probability inquiries, 2(a) and (b), is binary in that it requires a yes or no answer. It is important to observe that a verbal formulation of a test does not equate to a *formula*. While obviously a double “yes” would result in a legal finding that the defendant caused the plaintiff’s harm, but the questions are logically different. 2(a) is a weighing exercise conducted in hindsight and symbolized by the scales of justice. 2(b), on the other hand, does not involve a preponderance of pro or con evidence but, rather, evidence supporting a reasonable belief that the conduct would bring about the harm.

The proposed update to the “but for” test would leave it unchanged in practice for “simple” torts involving bodily injuries and tangible property damage. While the first part could stand alone to serve this purpose, the desirability of a unified legal test would allow the b/p data matrix of the second part to provide guidance in more difficult cases such as adverse medical events or injuries involving pre-existing conditions. The updated formulation provides a logical template for weighing the balance of probabilities that wrongful conduct such as inadequate cyber security, Internet-based physical plant security or cloud-based navigation actually brought about a data breach, industrial accident or autonomous motor vehicle collision. The judicial task of finding a defendant liable to a plaintiff for having caused harm will remain technically challenging and intricate. For this task, the common law needs a finer tool, not a blunter one.

