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Abstract: Causation is a source of confusion in tort theory, as well as a flash point between consequentialist and deontological legal theorists. Consequentialists argue that causation is generally determined by the policy grounds for negligence, not by a technical analysis of the facts. Conversely, deontologists reject the view that policy motives determine causation findings. Causation has also generated different approaches within the consequentialist school. In this chapter I try to bring some order to the arguments on causation by isolating key elements of the cases and introducing a "causation tree" that highlights the role of information. A better model of causation may help to resolve the arguments between different schools of tort theory, and to reconcile conflicting models within the consequentialist school.

[*] William Fairfield Warren Distinguished Professor, Boston University, and Professor of Law, Boston University School of Law. For helpful comments I thank Jennifer Arlen. John Goldberg, Henry Smith, and the students in their private law workshop also provided helpful comments, especially Anneil Kollavi. I thank Nina Prevot and Matt Saldana for research assistance.

INTRODUCTION

Causation is a source of confusion in tort theory, as well as a flash point for the debate between consequentialist and deontological legal theorists.[1] Consequentialists argue that causation is generally determined by the policy grounds for negligence, not by a technical analysis of the facts.[2] Conversely, deontologists reject the view that policy motives determine causation findings.[3]

Causation has also generated different approaches within the consequentialist school. Some take an essentially forward-looking approach to formalizing causation analysis, finding causation analysis to be subsumed within the Hand Formula.[4] Another approach within the consequentialist school closely examines the incentive effects of causation in the presence of an uncertain application of the negligence test.[5] This approach makes use of the fact that the causation test is applied retrospectively, but it makes no attempt to reconcile itself with the forward-looking approach.

In this chapter I will try to bring some order to the arguments on causation.[6] My perspective is consequentialist, but the arguments here have implications for the deontological theorists as well. In particular, by isolating the key elements of the causation cases, and introducing a "causation tree" to aid analysis, I hope to identify important missing pieces in the

[1] Wright (1985a, 1985b). For a critique of the deontological approach, see Kelman (1987).

[2] Calabresi (1975), Malone (1956).

[3] Calabresi (1975), Malone (1956).

[4] Calabresi (1975), Landes and Posner (1983), Shavell (1980). The Hand Formula, articulated by Judge Learned Hand in United States v. Carroll Towing, 159 F.2d 169 (2d Cir. 1947), holds that an actor is negligent if he fails to take care when the burden of care (B) is less than the product of the probability of loss (P) and the severity of the loss (L) – i.e., $B < PL$.

[5] Grady (1983), Kahan (1989), Marks (1994).

[6] This chapter is a companion piece to Keith N. Hylton & Haizhen Lin (2013), which sets out a new model of causation analysis. This chapter discusses the literature on causation and identifies gaps in the analysis, laying the groundwork for the Hylton and Lin paper.

existing literature on causation. A better model of causation may help to resolve the arguments between different schools of tort theory, and to reconcile conflicting models within the consequentialist school.

This chapter is organized as follows. Part 2 discusses canonical causation cases, and identifies different notions of causation observed in the case law. Part 3 reviews the economic literature on causation. Part 4 presents a framework for causation analysis developed in Hylton & Lin (2013) that incorporates and extends preexisting economic approaches. Part 5 uses the framework of Part 4 to examine informational constraints binding on courts in causation cases. Part 6 concludes.

CLASSIFICATION OF CAUSATION CASES

Causation is a basic requirement of tort liability. Whether the victim has been injured by intentional or negligent conduct, the injurer will not be held liable unless a court finds that the injury, for which the victim sues, was caused by the injurer's conduct. In negligence lawsuits, causation is one of the basic elements that the plaintiff must demonstrate in order to prevail. Negligence consists of four components: duty, breach, causation, and damages. Although duty is typically not a difficult matter in most cases, the burden of proof rests with the plaintiff to establish each of these components in a negligence lawsuit. This means that if the facts are too uncertain for a court to be able to say, at the end of a trial, that it is more likely than not that the defendant's negligence caused the plaintiff's injury, the plaintiff's negligence lawsuit will fail.

The causation cases in tort law raise two distinct issues, *factual* and *proximate* causation, with factual causation usually associated with but-for causation and proximate causation usually associated with foreseeability. To be specific, factual causation, in a negligence lawsuit, is

determined by asking whether the injury would have happened even if the defendant had taken care.[7] Proximate causation is determined by asking whether the plaintiff's injury was foreseeable given the defendant's negligence.

It follows from these definitions that it is possible for the factual causation test to be satisfied without the proximate causation test being satisfied. For example, a negligent traffic maneuver by the defendant might delay the plaintiff, causing the plaintiff to arrive at a spot where lightning strikes. In this case, there is causation in the but-for sense—that is, the plaintiff's injury would not have happened if the defendant had not caused the plaintiff to be delayed—but not in the proximate or foreseeable sense. Proximate causation means there is a "probabilistic linkage" between the defendant's negligence and the plaintiff's injury, in that knowledge of the defendant's negligence would lead one to predict the plaintiff's injury.

This suggests that the cases can be sorted into a matrix:

	Proximate Causation	No Proximate Causation
But-For Causation	*A cases*	*B cases*
No But-For Causation	*C cases*	*D cases*

Start with the *A cases*, the first cell in the upper-left corner. In most cases that appear in court, there will be both factual (but-for) and proximate causation. For example, suppose the defendant's truck swerves in front of the plaintiff's car, causing the plaintiff to veer to the side of the road, as in *Marshall v. Nugent*.[8] Another oncoming driver sees the truck at the last minute, swerves to avoid hitting it, and runs directly into the plaintiff's car. The defendant truck driver's negligence is not only a but-for cause of the plaintiff's injury but also probabilistically linked to

[7] See generally Prosser (1971), 236–90.

[8] 222 F.2d 604 (1st Cir. 1955).

the injury. If the defendant truck driver had not turned in front of the plaintiff, the plaintiff would not have had to swerve to the side of the road, and the accident would not have occurred. Moreover, it is probable that a negligent move by a truck driver that forces one car to move to the side of the road, causing the truck to block the road, could lead to another accident.

Now consider *B cases*, the category in which but-for causation is present but there is no proximate causation. This time, the truck swerves in front of the plaintiff's car, causing the plaintiff to swerve to the side of the road. The plaintiff is delayed in his travel as a result of the confusion. When the plaintiff reaches an intersection three blocks from the incident, a bolt of lightning hits him. Now there is clearly but-for causation in the sense that the plaintiff would not have been hit with lightning if he had not been delayed. But there is no probabilistic linkage; there is no reason to predict a lightning strike following the defendant's negligence.

For the remaining cells in the table, it will help to distinguish two senses of proximate causation. One is *general proximate causation*, which occurs when a failure to take care leads generally to a foreseeable set of incidents. For example, speeding can be a type of negligence, depending on the setting that leads generally to traffic accidents. Failure to equip a boat with lifebuoys can be a type of negligence that leads generally to drowning incidents. The other type of probabilistic causation is *specific proximate causation*, which is based on the set of facts in a particular case. Although speeding may lead generally to a greater risk of accidents, the particular type of speeding in a particular case may have no probabilistic connection at all to the accident that occurs.

Consider the *D cases*, the bottom-right cell. Suppose the defendant builds a fence surrounding cricket grounds that is unreasonably low, as alleged in *Stone v. Bolton*.[9] That is a

[9] [1950] 1 K.B. 201.

type of negligence that leads generally to injuries caused by cricket balls being hit over the fence. But suppose the ball in a particular instance is hit so high over the fence that it would have easily cleared a fence set at the reasonable height. Although there would be general proximate causation in this scenario, there would be no specific proximate causation. If a ball were hit over the fence so high that it would have cleared a fence at the reasonable height, the but-for test is not satisfied because the accident would have happened anyway; there would be no specific proximate causation, although there would be general proximate causation.

Consider another hypothetical related to the category of "no but-for causation and no proximate causation" (*D cases*). Suppose the defendant swerves his truck in front of the plaintiff, causing him to veer to the side, which delays his trip. The plaintiff, recognizing that he may be delayed, speeds up to a point where he is no longer late. At that point, he is struck by lightning. The defendant's negligence is not a but-for cause of the injury; the accident would have happened even if the defendant had not been negligent. Neither is it probabilistically linked in the general sense; a negligent move that delays the victim does not lead generally to lightning strikes. Lastly, the defendant's negligence is not probabilistically linked in the specific sense; the particular negligence described does not enhance the probability of the plaintiff being the victim of a lightning strike.

Another case in the bottom-right cell is *Perkins v. Tex. & New Orleans Ry. Co*.[10] The defendant railroad's negligence consisted of driving 15 miles an hour above the speed limit. However, the facts established that even if the train had been operated at the speed limit, the plaintiff would not have had time to evade the train. In this case, there is no but-for causation; the accident would have happened even if the train had been operated at the speed limit. There is

[10] 147 So. 2d 646 (La. 1962).

proximate causation in the general sense (speeding tends to lead to accidents) but not in the specific sense (this particular case of speeding, i.e., the excess over the speed limit, did not affect the probability of the accident).

The *C cases* category, the bottom-left cell, is designed to capture cases in which there is no but-for causation, but there is proximate causation. It appears at first glance to be difficult to find examples in which there is no but-for causation but there is specific proximate causation. In many settings in which the accident would have happened even if the defendant had not been negligent, it will also appear that the defendant's negligence did not increase the probability of the accident in the particular case. However, some examples of specific proximate causation coupled with the absence of but-for causation can be found in cases involving uncertainty over factual causation. Suppose, for example, a doctor performs surgery on a patient. The patient would die, in the absence of negligence, with a probability of 30 percent, and negligence increases the probability of death to 40 percent. One could argue that the doctor's negligence is not a but-for cause of the patient's death, since the death very likely would have occurred (in three out four instances of death coupled with negligence) even if the doctor had not been negligent. The type of negligence under consideration satisfies the general proximate causation requirement, and arguably satisfies the specific proximate causation requirement since the negligence significantly increases the likelihood of death.

In this chapter I will focus on factual causation. However, the arguments I will develop below can be applied easily to proximate causation analysis.[11]

CAUSATION ANALYSES: REVIEW OF LITERATURE

[11] See Hylton & Lin (2013).

The consequentialist literature in this area consists of two major strands. The first I will label the Shavell-Landes-Posner strand.[12] The second I will label the Grady-Kahan-Marks strand.[13]

The Shavell-Landes-Posner strand suggests that causation analysis has little to offer that is independent of the Hand Formula analysis of negligence. The argument concludes that in almost any case in which a court would hold that the defendant is not negligent based on factual causation, the Hand Formula analysis reveals that the defendant is not negligent.

Using the distinction I introduced above between general probabilistic linkage and specific probabilistic linkage, there are cases in which the defendant may appear to be negligent based on a general analysis, but when one examines the case in terms of the specific probabilistic linkage, it appears that the defendant was not negligent. Consider, for example, *Perkins*: the train was operated at a rate in excess of the speed limit, but the plaintiff would not have had time to evade the train even if it had been operated at the speed limit. In terms of general probabilistic linkage, operating a train above the speed limit is conduct that increases the likelihood of an accident. However, in terms of the specific linkage, the excessive speed had no effect on the likelihood of the particular accident that happened.

The Shavell-Landes-Posner argument reduces to the following: in cases where there is general proximate causation but not specific proximate causation, the correct conclusion is that the defendant is not negligent. The additional precaution required to avoid a negligence finding would not affect the probability of an accident under the actual conditions—i.e., additional care would have been unproductive. Given this, there is no economic case for requiring additional care.

[12] *See* Landes & Posner (1983), and Shavell (1980).
[13] *See* Grady (1983), Kahan (1989), and Marks (1994).

The Grady-Kahan-Marks argument focuses on the incentives affected by the factual causation test in tort law. According to Grady-Kahan-Marks, the causation test removes a discontinuity in the relationship between the level of care and liability, and consequently nudges incentives for care closer to optimality in settings where there is uncertainty surrounding the application of the negligence test.

The Grady-Kahan-Marks argument, first developed by Mark Grady, is best explained by the cricket fence hypothetical explored by Marcel Kahan. In the cricket hypothetical, the ball sails over the fence at a height that would have still led to the same accident (an injury from being hit by a cricket ball) even if the fence had been set at the reasonable height. Since the accident would have happened even if the fence had been set at the reasonable height, the factual causation test of tort law would not be satisfied by the plaintiff's claim.

The Grady-Kahan-Marks analysis shows how the factual causation test affects incentives for care, in comparison to a negligence test that does not take factual causation into account. For example, suppose factual causation is not taken into account. Let the reasonable fence height be ten feet, and consider the cricket ground owner's liability when the fence is at ten feet. In this case the cricket ground owner would not be held liable, because the fence is at the reasonable height.

Now suppose the owner lowers the fence by one inch to nine feet 11 inches, now one inch below the reasonable level. If factual causation is not taken into account, the owner becomes liable for all cricket balls that fly over the fence, irrespective of the height at which the ball clears. If factual causation is taken into account, the owner becomes liable only for cricket balls that pass between ten feet and nine feet 11 inches. So, when the factual causation test is taken into account, the owner's liability increases continuously from zero as he lowers the fence

from the ten-foot level. When the factual causation test is not taken into account, the owner's liability jumps discontinuously as soon as he lowers the fence from the ten-foot level.

As this analysis suggests, the factual causation test can impact incentives for care, if there is uncertainty surrounding the application of the negligence test. In particular, suppose the court makes mistakes in assessing negligence, and the mistakes are more likely as one gets closer to the reasonable fence height. Realizing this, an owner would consider the likelihood of liability if his fence were mistakenly found to be above or below the reasonable height. The factual causation test has a powerful effect in this scenario. Suppose the court does not take factual causation into account. If the owner's fence is mistakenly found to be slightly above the reasonable height, the owner's liability is zero. If his fence is erroneously found to be slightly below the reasonable height, his liability jumps substantially. If, in contrast, the court does take the factual causation test into account, then a finding that the owner's fence is slightly below the reasonable height leads to a very small increase in liability above the zero level.

Given the asymmetric effect of judicial errors in assessing liability, the potential defendant will err on the side of excessive precaution in a regime in which courts do not take factual causation into account in assessing negligence. In contrast, the tendency to over-comply with the negligence standard will not be observed in a regime in which the factual causation test is applied.

The Grady-Kahan-Marks analysis, as emphasized in Grady's original presentation, suggests a positive theory of the causation doctrine. The causation test appears at first glance to serve no obvious function other than to permit some defendants to escape liability, and some courts have suggested that they would refuse to apply it.[14] But the Grady analysis shows that the

[14] *See, e.g.*, Stone v. Bolton, *infra*, fn 9.

causation test plays a role in regulating precaution in the presence of a negligence test that may be applied with error by courts. The factual causation test leads potential defendants to choose care levels that are closer to the reasonable care level than would be observed in the absence of the factual causation test.

It would appear to follow from Grady's theory that in settings where the cost of over-compliance with the negligence standard is small, or substantially less than the cost of any under-compliance that might result under the factual causation test, courts should not be concerned with rigorously applying the factual causation test. On the other hand, where the cost of over-compliance is large relative to the cost of under-compliance, Grady's theory suggests that courts would be more likely to apply the factual causation test.

For example, suppose the victim is accidentally pushed from a ten-story building and plummets toward the ground. As the victim is falling, the injurer negligently fires his rifle and kills the victim before he hits the ground. On factual causation grounds it would appear that the injurer should not be held liable for the victim's death; he would have been killed by the impact with the ground even if the injurer had not negligently shot him. But courts have been reluctant to apply the but-for test to cases of this sort, probably because the social cost of under-compliance is greater than the social cost of over-compliance.

Instead of the but-for test in cases of concurrent negligence, courts have applied the substantial factor test originating in *Anderson v. Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.*[15] and in *Kingston v. Chicago & N.W. Ry. Co.*[16] In both cases two negligently created fires join and destroy property. The courts abandoned the but-for test and replaced it with a substantial factor test for causation in these cases. Application of the but-for test would result in neither

[15] 179 N.W. 45 (Minn. 1920).
[16] 211 N.W. 913 (Wis. 1927).

tortfeasor being held liable, which would dilute incentives for care in the concurrent caretaking scenario.[17] The under-compliance cost resulting from application of the factual causation test to these cases would be much greater than the possible over-compliance cost resulting from refusing to apply the factual causation test.

Stephen Marks introduces an important difference in the Grady-Kahan analysis. Marks finds that, even under the assumptions of Grady and Kahan, the factual causation test still leads to excessive care when there is uncertainty regarding the application of the negligence test. The reason for this is that the Grady and Kahan analysis is built around an example whose fundamental structure is consistent with the cricket fence hypothetical. In that hypothetical, the probability of an injury is zero when the injurer takes care (i.e., keeps the fence at the reasonable height) and the ball is hit at a level that is below the fence height. To generalize, when the contingency that makes care effective occurs, the probability of an injury is zero in the Grady-Kahan-Marks analysis. But this is not generally true. In many cases, the probability of an injury will still be positive when the injurer takes care and when the contingency that makes care effective occurs.

Consider, for example, *Perkins*. The injurer would take care in that case by reducing the speed of the train to the level required by law. The intervention that makes care effective would consist of the victim being able quickly to get off the train tracks. But even if this were so in *Perkins*, a train moving at the speed limit still imposes some risk of harm. One cannot conclude that the probability of an injury is zero simply because a train, or a car, is moving at the legal speed limit. The residual risk when potential injurers take care remains positive and significant in this scenario.

[17] Landes and Posner (1983, 125).

Because the residual risk remains positive even when people take care in the *Perkins* scenario, there remains a discontinuous jump in liability under the negligence test. The negligence test does not subtract off from the damage award an estimate of the damages that would result even if the injurer took care, and because of this, there is an unavoidable discontinuity in incentives created by the test.

In spite of this unavoidable discontinuity, the Grady-Kahan-Marks point largely remains. The discontinuity is less severe—or the size of the jump lessens as a result of the causation test. Because of this, the causation test reduces the tendency toward socially excessive precaution when there is uncertainty surrounding the application of the negligence test. Moreover, in the special case represented by the cricket hypothetical, the causation test removes the discontinuity entirely.

ASSESSING ALTERNATIVE APPROACHES TO CAUSATION AND INCENTIVES

Given the contrast between the Shavell-Landes-Posner and the Grady-Kahan-Marks analyses of factual causation, the obvious question is which theory provides the best or most useful analysis of the causation problem in tort law. The two theories ought to be reconciled. One holds that causation is largely a distraction, once one has taken a careful approach to the negligence assessment according to the Hand Formula. The other holds that causation doctrine plays an important role in understanding incentives created by negligence law. Obviously, the two propositions are not mutually exclusive; but the question remains whether the two theories can be reconciled.

Under the framework adopted in the previous section, the causation cases can be described according to three general features: whether there is causation in the but-for sense,

whether there is a *general* probabilistic linkage (general proximate cause) between the defendant's negligence and the plaintiff's injury, and whether there is a *specific* probabilistic linkage (specific proximate cause) between the defendant's negligence and the plaintiff's injury. In the class of causation problems analyzed by Grady and Kahan, there is no causation in the but-for sense, and no specific probabilistic linkage, but there is a general probabilistic linkage. The general probabilistic linkage exists in the cricket ball case because a fence set below the reasonable level is likely to be associated with injuries caused by balls flying over the fence. There is no specific probabilistic linkage because the ball flies at such a height that the injury would have happened even if the owner of the grounds had set the fence at the reasonable height. And, for the same reason, there is no but-for causation in the cricket case.

The cricket hypothetical is a special case of a more general class of causation problems. In general, causation is an issue even in cases in which all three causation features are operative: the but-for test could be satisfied, there could be a general probabilistic linkage, and there could be a specific probabilistic linkage. The cricket hypothetical arises as a special case where the specific probabilistic linkage shrinks to zero.

Consider an example that illustrates the more general factual causation problem, *N.Y. Cent. R.R. v. Grimstad*.[18] In *Grimstad*, the defendant was sued for negligence for failing to equip a barge with lifebuoys, after the plaintiff's decedent, a barge captain, fell into the water and drowned. The plaintiff lost on factual causation grounds. The court noted that even if the boat had been equipped with lifebuoys, there was no guarantee that anyone would have been able to grab the lifebuoy, throw it sufficiently close to the captain to be useful, and for the captain to grab it securely, all in time to prevent the drowning. *Grimstad* is a case in which it is unclear *a*

[18] 264 F. 334 (2d Cir. 1920).

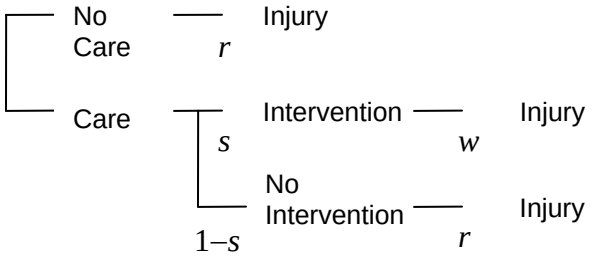
priori whether the but-for causation test is satisfied, or whether there is a specific probabilistic linkage between the defendant's negligence and the victim's loss.

The factual structure of *Grimstad* can be set out as a causation tree, as shown in Figure 4.1.[19] The "care" path represents the scenario in which the defendant has equipped the boat with lifebuoys; the "no care" path assumes the defendant has failed to equip the boat with lifebuoys. In *Grimstad*, equipping the boat with lifebuoys was not enough by itself to reduce the probability of a drowning. The effect of equipping the boat depended on the likelihood of successful intervention—in fact, on a chain of successful interventions.

In *Grimstad*, and cases with similar fact structures, the probabilities associated with each branch on the causation tree are as shown in Figure 1. If the defendant does not take care (by failing to equip the barge with lifebuoys), then the probability of a drowning is r. If the defendant takes care under the legal standard (equips the barge with lifebuoys), then the probability of a drowning depends on the probability of an intervention (s); for example, whether the victim can swim to the lifebuoy. If an intervention occurs, then the conditional probability of injury (drowning) given the intervention is w, where $w < r$. If an intervention does not occur, the conditional probability of injury given the absence of intervention is simply the same probability of injury if there had been a breach (r). The probability of an injury given that the defendant takes care is therefore $sw + (1–s)r$.

[19] The model presented informally in this part is based on Hylton & Lin (2013).

Figure 1: Causation Event Diagram



A general probabilistic linkage would be observed if the average probability of injury given precaution is significantly less than the probability of injury given no precaution. General probabilistic linkage between the defendant's failure to take care and the plaintiff's injury is assumed to exist in this case, because a failure to take care increases the probability that the plaintiff will be injured from $sw + (1–s)r$ to r (where $sw + (1–s)r < r$ by assumption).

In order to capture within this model the difference between general and specific probabilistic linkages, I will assume that there is a range of possible intervention probabilities in different settings. When an accident occurs, it is accompanied by a specific realization drawn from the range of possible intervention probabilities. To simplify, assume there are two possible levels for the intervention probability: s_o and s_1, with corresponding probabilities p_o and p_1. In other words, there are two settings in which intervention may occur, and those settings appear with frequencies p_o and p_1. If intervention setting p_o is realized, then the probability of an intervention occurring in that setting is s_o. Under this assumption, the general expected intervention probability is $E(s) = p_o s_o + p_1 s_1$, and the expected probability of injury given that the defendant takes care is

$$E(s)w + (1 - E(s))r \ .$$

Suppose the amount of the loss (the damages claim) if the victim drowns is represented by *D*. If the defendant fails to take care, the expected loss is *rD*. If the defendant takes care, then for any given realization s_i of the intervention probability, the expected loss is equal to $(s_i w + (1 - s_i)r)D$. If the burden of complying with the negligence standard (equipping with lifebuoys) is *B*, then the defendant would be negligent, given a realization s_i of the intervention probability, if he failed to equip the boat when

$$B < (r - (s_i w + (1 - s_i)r)D \ .$$

The left-hand side of this inequality is the burden of precaution and the right hand side is the incremental loss avoided by precaution. As the probability of intervention gets smaller, the less likely it is that the incremental loss avoided is greater than the burden of precaution; hence the less likely it is that the defendant is negligent. If the likelihood of intervention is zero, for example, the defendant clearly would not be negligent in failing to equip the boat with lifebuoys. As long as the probability of intervention is positive, the incremental loss avoided by precaution (right-hand side of the inequality) will be positive; but there is no guarantee that it will be greater than the burden of precaution.

The factual causation problem in cases like *Grimstad* requires the court to determine, in light of the facts, whether the probability of intervention is so small that the incremental loss avoided by precaution is equally small, or obviously less than the burden of precaution. The finding is interesting largely because it seems to contradict an assessment based only on the general probabilistic linkage. In the specific case, the incremental loss avoided may be found to

be less than the burden of precaution, while on a general assessment the incremental loss avoided might be greater than the burden of precaution.

The structure of the general causation scenario exemplified by *Grimstad* can therefore be described as follows:

$$B > (r - (s_o w + (1 - s_o) r) D$$

$$B < [r - (E(s) w + (1 - E(s)) r)] D$$

where s_o is the case-specific intervention probability.

In order to clarify this description of structure, consider the following numerical example. Suppose there are two probabilities of intervention: s_o = ¼ and s_1 = ¾. The low-intervention probability corresponds to the instances in which the captain of the barge is alone, or on the barge with only his wife. The high-intervention probability corresponds to instances in which the captain is on the barge with other experienced sailors. The likelihood of a successful intervention is low when the captain is alone, and high when the captain is surrounded by other sailors. Associated with these intervention scenarios are frequencies. The frequency with which the low-intervention probability scenario occurs is p_o = ¼ and the frequency with which the high-intervention probability scenario occurs is p_1 = ¾.

One important feature of this structural description is that the frequencies with which the high-intervention and low-intervention probability scenarios occurs may be known by the captain and the barge owner, but may be unavailable to a court. The court may be unable, therefore, to determine whether additional safety precautions will have a substantial effect on the likelihood of injury on an *ex ante* basis.

Given the assumptions of this numerical example, the expected probability of injury given that the defendant (barge owner) takes care (installs lifebuoys) is equal to (¼)(¼) + (¾)(¾)

= 5/8. Assume the cost of taking care is $40 and that the injury is $160. Assume, in addition, that w = ¼ and r = ¾. Comparing the burden of taking care to the *ex ante* benefit (in terms of losses avoided):

$$\$40 < \left(\frac{3}{4} - \left[\left(\frac{5}{8}\right)\left(\frac{1}{4}\right) + \left(\frac{3}{8}\right)\left(\frac{3}{4}\right)\right]\right)\$160$$

which is equivalent to $40 < $50. Thus, taking care (installing lifebuoys) is socially desirable on an *ex ante* basis. Suppose, however, that the accident occurs in a low-intervention probability state—for example, when the captain is alone on the barge, or there with only his wife. The court observes the facts of the case and that the intervention probability is only ¼ in the case that comes before it. When the court analyzes the defendant's negligence, it compares the burden of taking care to its estimate of losses avoided, given the observed intervention probability. The court's estimate of losses avoided is:

$$\left(\frac{3}{4} - \left[\left(\frac{1}{4}\right)\left(\frac{1}{4}\right) + \left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\right]\right)\$160 = \$20$$

and since this is less than the cost of taking care, $40, the court concludes that the defendant could not be negligent.

The causation problem analyzed by Grady and Kahan can be treated as a special case within this framework. Consider the cricket hypothetical. The height at which the ball sails over the fence determines the realized (specific) intervention probability. If the ball flies over the "reasonable height" for the fence, then the fact that the fence was at the reasonable height would have no effect on the probability of an injury. Thus, if ten feet is the reasonable height, the event "ball flies over fence at height greater than ten feet" implies that the intervention probability is equal to zero. The precaution of having a fence at the reasonable height reduces the probability

of an injury only in the intervening event of a ball flying at a height no greater than ten feet. Put another way, there is no specific probability linkage given the event that the ball flies at a height greater than ten feet. The general probability linkage is established by the fact that at the reasonable fence height (ten feet) any additional increase in height would require a burden that is greater than the incremental losses avoided, based on expectations.

In this framework, the Shavell-Landes-Posner model of causation and the Grady-Kahan-Marks analysis are easily reconciled in terms of the levels of *ex ante* and *ex post* information on intervention probabilities. In the Grady-Kahan-Marks analysis, there is a reasonable fence height, based on averages or statistical expectations. If the defendant fails to meet the reasonable height, he is negligent, based on an *ex ante* assessment. However, if the ball flies over the fence at a height that exceeds the reasonable fence height, the court will excuse the defendant on causation grounds (after observing the realized probability of intervention). In the Shavell-Landes-Posner analysis, there is a reasonable fence height, again based on an ex ante assessment of averages. If the defendant fails to meet the reasonable fence height, he is still not negligent if the ball flies over the fence at a height that is greater than the reasonable fence height. The explanation is that the reasonable precaution, if taken, would not have altered the likelihood of the accident. These are two different ways of describing the same phenomenon. Courts typically adopt the first description, but the second is equivalent in its implications.

EX ANTE VERSUS EX POST APPROACH

So far I have described causation analysis as requiring a differentiation between a general probabilistic linkage and a specific probabilistic linkage. This approach is consistent with the cases, but it is still inadequate to capture all that is going on in the causation cases.

The important feature that is missing in the preceding discussion is a consideration of the information available to the parties in the *ex ante* (before the accident) and *ex post* (after the accident) time periods. General probabilistic linkage refers to the *ex ante* period in which care must be taken before the specific probability of intervention has been revealed. Specific probabilistic linkage refers to the *ex post* period after the specific probability of intervention has been revealed.

For example, return to *Grimstad*. In the *ex ante* period, the barge owner (or some agent of his) has to decide whether to install lifebuoys. He must make the decision without knowing the specific probability of intervention that will be realized. Hence, the barge owner must choose a level of care knowing only the distribution of the future intervention probability. Social welfare would be optimized if he took care (installed lifebuoys) whenever doing so reduces the sum of accident and accident avoidance costs *ex ante*.[20]

What does it mean for the barge owner to know the distribution of the intervention probability? It means that the barge owner has sufficient information to make a reasonably accurate guess about the likelihood of a successful rescue (successful intervention) in the accident setting. That is a function of the amount of time the barge workers (sailors) will be around others who can carry out a rescue competently. If the barge captain is unlikely ever to be on the barge alone without competent support, the barge owner would predict that the distribution of the intervention probability is skewed toward one. On the other hand, if the captain is likely to spend a lot of time on the barge alone, or with only his wife (as was the case in *Grimstad* when the accident occurred), then the intervention probability distribution will be

[20] In more technical terms, when inequality (2) holds.

skewed toward zero. If these scenarios happen with roughly equal frequency, then the intervention probability may have a uniform or symmetric distribution.

The court is unlikely to be in a position to make this assessment. Specifically, the court is unlikely, even after all of the evidence is presented at trial, to know the *ex ante* distribution of the intervention likelihood. To have such information would require the court to replicate the experience-based knowledge of the barge owner. Since knowing the distribution of the intervention probability is essential to estimate the expected losses to be avoided by taking care, and the court does not know the distribution, the court would be unable to determine negligence in an accurate manner.[21]

The problem of information in this setting is a common one in negligence law. The knowledge of the court consists of that possessed by the judge and the jury. The judge and jury observe sufficient evidence to make an *ex post* assessment of negligence. But the information required to make an *ex ante* assessment of negligence is often privately held by one or more of the parties in litigation, and incapable of being verified by the court. In some cases, specifically those in which courts are at a substantial informational advantage relative to the defendant, a custom defense could provide an optimal standard for determining negligence, since custom would presumably reflect the information possessed by the actors within the industry.

As an illustration, return to *Grimstad*. The court is unlikely to have enough information to determine whether failing to install lifebuoys is negligent, because in order to do so in an economically accurate way, the court would need information on the distribution of the probability of a successful intervention (i.e., a rescue performed by throwing a lifebuoy accurately and in time), which is a function of the frequency with which the barge captain is

[21] In more technical terms, the court is unlikely to be able to use the formula in (2) to determine negligence in an *ex ante* evaluation using the Hand Formula.

surrounded by experienced sailors. One possible solution to this problem is for the court to require the parties to generate information on the distribution of the intervention probability. But this may not be sufficient to put the court in the same position as industry actors. The information generated in court would be presented by partisans, and the court therefore would have to discount presentations from each side of the dispute.

In the absence of full information on the *ex ante* optimal standard of care, the court can assess negligence using a backward-looking or *ex post* approach. The *ex post* method requires the court to use information revealed by the accident to estimate the actual probability of intervention *ex post*, and to determine negligence on the basis of that information. This is equivalent to an *ex post* negligence evaluation using the specific intervention probability revealed in the accident event,[22] and it is what the court did in *Grimstad*. The court noted that the potential rescuer was the barge captain's wife, and that there was no evidence to suggest that she would have known where to find the lifebuoys and been able to throw one with sufficient speed and accuracy to prevent the captain from drowning. Given the information revealed by the accident, the court determined that causation was purely speculative, and that there was insufficient evidence to support a finding of negligence.

The *ex post* approach to negligence probably captures the reasoning of courts in the vast majority of causation cases. This is obviously so in cases such as *Grimstad*, but it appears to be true also of the more technical but-for causation cases such as the cricket fence hypothetical discussed earlier. In these cases, the court determines negligence by examining what happened in the accident. *Ex post*, it knows the actual probability of intervention. If it finds that the revealed probability of intervention is too low to support a finding of negligence on the basis of an *ex post*

[22] See equation (1).

assessment, it is likely to conclude that the evidence of causation, or of negligence, is purely speculative. If it finds that the probability of intervention as revealed is close to zero, it can conclude in the same manner. The but-for causation test, which involves determining whether the revealed probability of intervention is close to zero, is essentially subsumed in the *ex post* negligence assessment. The but-for causation test is a sufficient condition for finding an absence of negligence.

The general acceptance of the substantial factor test is, most likely, a reflection of the tendency of courts to adopt an *ex post* evaluation of negligence in settings where the *ex ante* determination of negligence is either administratively burdensome or has been precluded by the existence of a statute that settles the negligence determination. The substantial factor test requires the court to determine whether the defendant's negligence was a substantial factor in bringing about the plaintiff's injury.[23] The test invites courts to apply an *ex post* assessment of negligence rather than search for a reliably correct answer to the but-for causation question. The substantial factor analysis is far more consistent with the court's analysis in *Grimstad* than is the but-for test.

I have not argued that it is never possible for a court to accurately apply the but-for causation analysis. For a court to do so, it would first have to have an accurate assessment of negligence on an *ex ante* basis; after obtaining this assessment it would then apply the but-for test. In a simple case, such as the cricket fence hypothetical, it may be possible for a court to have sufficient information to determine the reasonable fence height *ex ante*. At the *ex post* stage, it might be relatively easy for a court to determine whether the cricket ball flew over the fence at such a height that it would have easily cleared a fence of reasonable height. But it should be clear that this example represents a special case that will not be replicated in structure in much

[23] *See* RESTATEMENT (SECOND) OF TORTS § 431 (1965).

of the case law. The uncertainties surrounding the evaluations of *ex ante* negligence and *ex post* causation are often too great for such an ideal application of formal standards and tests.

Indeed, even in the cricket fence hypothetical it is likely that in most such scenarios it would be difficult to determine whether the cricket ball flew over the fence at a height that would have easily cleared a fence set at the reasonable height. To make such a determination, one would have to accurately determine the trajectory, or the entire arc, of the cricket ball, and compare the trajectory with the (invisible) line at which the ball would pass over (or run into) the reasonable height fence. In scenarios where the ball is popped straight up and lands on the other side of the fence, the determination could be made roughly without difficulty. But outside this case, most ball-over-fence cases will involve uncertainty over the trajectory question.

Given the informational bind in which courts are often likely to find themselves, they are left with three options: (1) applying an *ex post* negligence standard, (2) applying a strict liability rule, or (3) trying to determine the *ex ante* negligence standard based on incomplete information.

The law on strict liability sets out a clear policy basis for its application, first set out generally in *Rylands v. Fletcher*.[24] Many of the uncertain factual causation cases cannot meet the requirements for strict liability described in *Rylands*. The option of applying a strict liability rule is effectively foreclosed in many cases by the doctrinal constraints of *Rylands*.

The third option, determining the *ex ante* negligence standard, is difficult, subject to gaming by litigants on whom the court relies for information, and discouraged by evidence norms. The realized intervention probability is objectively verifiable and therefore acceptable evidence. The average intervention probability required to construct an *ex ante* negligence standard is not objectively verifiable, and would require estimation and conjecture.

[24] Flecther v. Rylands, L.R. 1 Ex. 265 (1866) (Blackburn opinion).

The causation cases are generally consistent with the *ex post* negligence standard as a method of conducting causation analysis. First, it is obvious that negligence is being determined by an *ex post* analysis. In every case that comes before a court, the accident has happened already, so the court is determining negligence using information on the revealed probability of an intervention. Second, the courts are unlikely in many cases to have enough information to make a reasonably accurate estimate of the losses to be avoided by taking care—an estimate that would require knowledge of the distribution of the probability of intervention. Given these two generally observed features of litigation, viewing causation analysis as subsumed within an *ex post* assessment of negligence seems entirely appropriate.

The cases are also consistent with the *ex post* negligence approach. *Grimstad* is an obvious example. The court made no attempt to determine negligence on an *ex ante* basis. The evidence in *Grimstad* did not point clearly to an answer on the causation issue. The court could not say with certainty that a successful rescue would not have occurred under the facts of the case if the defendant had equipped the boat with lifebuoys. All the court could say was that the evidence did not suggest that a successful rescue was likely to occur if the boat had been properly equipped, and that negligence, in the specific event, was a matter of speculation. This is in essence an *ex post* negligence evaluation.

There are other cases in the same mold. In *Rouleau v. Blotner*,[25] the plaintiff sued the defendant for negligence in failing to signal with his car blinker before turning his truck across oncoming traffic. However, the evidence indicated that the plaintiff's driver was looking at the stretch of road immediately before his car at the time when he should have been looking for a turn signal, which is why the plaintiff's driver did not see the truck until it was too late. In

[25] 152 A. 916 (N.H. 1931).

Rouleau, just as in *Grimstad*, the evidence was not clear enough to say with certainty that the accident would have happened even if the plaintiff had taken care. However, the evidence did not suggest the opposite, either: that the accident would not have occurred if the defendant had switched his turn signal on. It was a matter of speculation whether the accident would or would not have happened.

Some cases speak in relatively clear terms about causation even though the evidence is not so clear. In *City of Piqua v. Morris*,[26] the court concluded confidently that the plaintiff's loss (due to a flood) would have occurred even if the defendant had taken the requested precautions (clearing debris from wickets to allow water to pass). But a close read of the case reveals that the evidence was ambiguous. The court concluded that it would not have mattered if the defendant (City of Piqua) had taken precautions because the flood was so large that the wickets could not have carried away the water even if they had been cleared of debris, and consequently the plaintiff's property loss was almost entirely attributable to the unusual rainfall that occurred. The facts support the conclusion that the evidence on causation was ambiguous at best.

There are some cases that are distinguishable from the *ex post* negligence approach because the facts indicate with near certainty that the accident would have happened even if the requested precaution had been taken. Many of them involve accidents on roads, or on railroad tracks. If a car is being driven at a speed of 60 miles per hour, and a non-negligent rate is 55 miles per hour, it is easy for a court to calculate the additional time that an actor would have to avoid a collision if his speed had been shifted down to 55. If the additional time is trivial—such as one second—then a court is in a good position to assert that the accident would have happened

[26] 120 N.E. 300 (Ohio 1918).

anyway. Of course, even here the court is making a statement about the quality of the evidence, not a statement about certainty.

Given that courts are applying an *ex post* assessment of negligence in many if not all of the causation cases, the next question is why courts apply such an assessment instead of attempting to get enough information to conduct an *ex ante* Hand Formula analysis. I have already referred to two possible explanations: the prohibitive cost of acquiring the information necessary to conduct an *ex ante* assessment and the constraints placed on courts by evidence norms. Two other possible reasons are the existence of statutory standards of care and the behavioral tendencies of decision-makers under uncertainty.

The existence of a statutory standard of care that is breached forces the court to distinguish negligence from causation, and the court is more or less compelled to find negligence for the breach. However, the court examines causation separately. As a result, many of the cases involving statutory breaches involve findings of negligence coupled with findings of no causation. The separate causation test plays an important role in allowing the court to apply an *ex post* negligence test after concluding that the statutory breach answers the *ex ante* negligence question.

The remaining possible explanation for why courts apply the *ex post* negligence test is behavioral.[27] Social scientists have identified a behavioral pattern favoring wagers that have estimable probabilities to those that do not—that is, an aversion to ambiguity. The same bias may be present in courts. The *ex post* assessment of negligence involves working with probability estimates that are observable or calculable based on information in a particular case. The *ex ante* assessment of negligence means trying to discover information on probability

[27] *See* Hylton and Lin (2013).

distributions that may not be completely available to courts. The behavioral preferences revealed by ambiguity aversion may be at work within the minds of judges; they prefer to conduct an assessment of negligence working with information at hand rather than working with probabilities that are unknown. This is simply reflecting an aversion to assessing negligence in a setting of "unknown unknowns."

All of this is not to say that courts never estimate optimal care standards from an *ex ante* perspective. As a procedural matter, all negligence and causation determinations are made *ex post* and use information revealed by the accident. Where the accident technology is so simple that courts can easily estimate the optimal care standard from an *ex ante* perspective, courts would presumably recognize the superiority of doing so.

CONCLUSION

There is much more to be said about causation analysis than I have ventured here. Philosophically-oriented writers have devoted a great deal of attention to the logical bases for attributions of causation.[28] I have not discussed these questions in this chapter. However, my arguments have implications for the corrective justice torts theorists. To the extent informational constraints bind the courts, the decisions on causation may simply reflect the best that courts can do under the constraints. They do not necessarily reflect an inclination to avoid policy-based assessments of negligence, even if that were possible. With limited information, and compelled by circumstances to conduct an *ex post* evaluation of negligence, courts have adopted the language of causation analysis as a substitute to a policy-grounded analysis of negligence. A

[28] *See, e.g.*, Wright (1985a). For a useful overview of theoretical approaches to causation, see Rizzo (1987), Cooter (1987).

court that issues of finding of “no causation”, is saying in effect that it does not have enough information to support a finding of negligence.

Instead of focusing on the arguments between consequentialist and deontological schools of tort theory, I have focused on modeling the basic structure of causation disputes. The literature on the incentive effects of the causation test has been based on models that are incomplete as descriptions of the causation problem in tort cases. The corrective justice theorists have not modeled the causation problem, but their discussions have assumed that information constraints do not bind courts. I have only outlined here a more comprehensive framework for analyzing causation based on differentiating *ex ante* and *ex post* analyses of negligence.

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