7-30-2020

Incentivized Torts: An Empirical Analysis

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NORTHWESTERN LAW REVIEW (forthcoming 2021)

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J. Shahar Dillbary, Cherie Metcalf, and Brock Stoddard∗

ABSTRACT

Courts and scholars assume that group causation theories (e.g., concerted action) deter wrongdoers. This article empirically tests, and rejects, this assumption, using a series of incentivized laboratory experiments. Contrary to common belief, data from over 200 subjects shows that group liability can *encourage* tortious behavior and incentivize individuals to act with as many tortfeasors as possible. Surprisingly, we find that subjects can be just as likely to commit a tort under a liability regime as they would be when facing no tort liability. Group liability can also incentivize a tort by making subjects perceive it as fairer to victims and society. These findings are consistent across a series of robustness checks, including both regression analysis and non-parametric tests.

We also test courts' and scholarly insistence that the but-for test fails in cases subject to group causation. We use a novel experimental design that allows us to test whether, and to what extent, each individual's decision to engage in a tortious activity is influenced by the decisions of others. Upending conventional belief, we find strong evidence that the but-for test operates in group causation settings (e.g. concurrent causes). Moreover, in our experiments, subjects' reliance on but-for causation produced the very tort that group liability attempted to discourage.

A major function of liability in torts, criminal law and other areas of the law is to deter actors from engaging in socially undesireable activities. The same is said about doctrines that result in group liability. Our empirical results challenge this basic logic.

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I. INTRODUCTION

This article undertakes to test two assertions that courts and scholars accept and rely on—perhaps because of their intuitive appeal—but which lack empirical support.

The first claim is that group liability *deters* tortious behavior. Courts impose such liability using theories such as concerted action, substantial factor, and alternative liability.[1] For example, based on a belief in its ability to

[1] Under concerted action theory a number of parties can be held liable if they acted tortiously pursuant to an agreement "or to accomplish a particular result." RESTATEMENT (SECOND) OF TORTS § 876 cmt. a (AM. LAW INST. 1979). Even absent an agreement, a group of careless actors may be held liable under the substantial factor doctrine if their independent careless behaviors concurred and each substantially contributed to the victim's harm. RESTATEMENT (SECOND) OF TORTS § 432(2) (AM. LAW INST. 1965). Alternative liability allows courts to hold liable careless parties who did not injure the victim if the identity of the injurer is unknown. RESTATEMENT

discourage antisocial behavior,[2] courts hold liable all participants to a drag race, including non-injuring drivers and spectators.[3] Similarly, courts have imposed liability on all actors who carelessly set fires, although each fire alone could have destroyed the victim's property.[4] They have also imposed liability on a group of hunters even when it was clear that one of them did not injure the victim.[5] The logic of these cases extends beyond their particular facts to many settings involving multiple actors.[6]

Leading scholars also justify the application of group liability on *theoretical* grounds. For example, Shavell and Posner explain that, absent group causation theories like alternative liability and concerted action, "the incentive of the injurers to avoid harming" others would be "inappropriately weaken[ed]."[7] Similarly, Grady, Levmore, and Levinson laud the ability of "collective sanctions" to deter group members from engaging in wrongdoing.[8]

(SECOND) OF TORTS § 433B) (AM. LAW INST. 1965). *See also infra* notes 3–6, 17-19 and accompanying text.

[2] David A. Fischer, *Products Liability—An Analysis of Market Share Liability*, 34 VAND. L. REV. 1623, 1629, 1633 (1981) (noting that in cases like Summers, "each defendant's conduct was unquestionably of an antisocial nature" and arguing that the law "seeks to . . . discourage socially undesirable activity").

[3] RESTATEMENT (SECOND) OF TORTS § 876 cmt. c, illus. 2, cmt. d, illus. 4 (AM. LAW INST. 1979); RESTATEMENT (THIRD) OF TORTS: APPORTIONMENT OF LIAB. § 15 cmt. a, illus. 1 (AM. LAW INST. 2000); Abel v. Eli Lilly & Co., 343 N.W.2d 164, 176 n.19 (Mich. 1984), *superseded by statute*, Mich. Comp. Laws § 600.6304, *as recognized in* Napier v. Osmose, Inc., 399 F. Supp. 2d 811 (W.D. Mich. 2005) (explaining that concerted action "seems to have developed to deter hazardous group behavior").

[4] Anderson v. Minneapolis, St. Paul & Sault Ste. Marie Ry. Co., 179 N.W. 45, 49 (Minn. 1920); RESTATEMENT (SECOND) OF TORTS § 432(2) (AM. LAW INST. 1965) (applying the substantial factor test); RESTATEMENT (THIRD) OF TORTS: LIAB. FOR PHYSICAL & EMOTIONAL HARM § 27 cmt. d (AM. LAW INST. 2010) ("Imposing liability in such a circumstance serves the policy of deterrence"); DAN B. DOBBS, THE LAW OF TORTS § 171, at 414 (2000) (referring to the two fire hypo as the "classic example"); W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS § 42, at 278 (5th ed. 1984) [hereinafter PROSSER AND KEETON].

[5] Summers v. Tice, 199 P.2d 1, 1–2 (Cal. 1948); Steven Shavell, *An Analysis of Causation and the Scope of Liability in the Law of Torts*, 9 J. LEGAL STUD. 463, 494 (1980) (justifying the imposing of group liability in *Summers* and noting that to "do otherwise would inappropriately weaken the incentive of the injurers to avoid harm"); Fischer, *supra* note 2, at 1629, 1633.

[6] *See e.g.*, DOBBS, *supra* note 4 § 175, at 427 (discussing the alternative liability doctrine and noting that "the practical effect of the rule is to impose . . . liability upon each defendant in the *numerous cases* in which one defendant cannot show that the other defendant was the cause . . ." (emphasis added)).

[7] Shavell, *supra* note 5, at 494; RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 212 (Vickin Been et al. eds., 9th ed. 2014) (explaining that deterrence would be reduced without such theories); STEVEN SHAVELL, ECONOMIC ANALYSIS OF ACCIDENT LAW 108, 164–67 (1987) (discussing the economics of causation and the use of liability to induce "optimal behavior").

[8] Mark F. Grady, *Res Ipsa Loquitur and Compliance Error*, 142 U. PA. L. REV. 887, 913 (1994) (explaining that "defendants would have too little incentive to use precaution" without a theory such as res ipsa loquitur); Saul Levmore, *Gomorrah to* Ybarra *and More: Overextraction and the Puzzle of Immoderate Group Liability*, 81 VA. L. REV. 1561, 1563–64 (1995) (discussing res ipsa and justifying overextraction that may enhance deterrence); Daryl Levinson, *Collective Sanctions*,

This article undertakes to test the theoretical assertion that group liability deters actors. Courts and scholars accept and rely on this assertion—perhaps because of its intuitive appeal—despite the lack of empirical support. The article also tests the claim that the but-for test fails when group liability applies. Courts and scholars alike insist that "a literal and simple version of the but-for test" will exempt from liability the spectators in the drag race, the actors who carelessly set the fires, and the hunters in *Summers*.[9] The claim is that none of these actors are necessary and thus cannot be a "but for" cause of the harm.[10]

Despite their widespread acceptance, the two claims—that group liability deters and that the but-for test fails in such settings—have never been tested. To date, they are based on conjecture and belief.

This article empirically test these claims, using a novel series of incentivized laboratory experiments. Similar to other concurrent-cause cases,[11] in our experiments, each subject can alone cause the victim's harm. To ensure the robustness of our results, we used *two* framings: a context-free (or "neutral") frame and a contextualized variant—a vignette involving polluting factories.[12] In each framing, four out of every five subjects chose independently and simultaneously between a harmless activity with low payoffs and a tortious activity that promised higher gains. The payoffs of the fifth subject—the victim—were reduced to zero if at least one of the other four subjects chose the tortious activity.

Those who chose the tortious activity were subject to one of two liability regimes. In the no liability regime, behaving tortiously came at no (monetary) cost to the tortfeasor. Accordingly, each subject had a dominant strategy to behave tortiously. Under the liability regime, the tortfeasors had to fully compensate the victim in equal shares. Because the expected liability of each tortfeasor was diluted as more joined the activity, the payoffs *depended* on the decisions of others. Specifically, acting tortiously alone or with another promised a loss. By contrast, when acting together with two or more tortfeasors the expected liability of each was diluted to the point each could expect a gain. Importantly, subjects had to decide whether to join the tortious activity without knowing what others would choose. Our novel experimental design allowed us to observe each

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56 STAN. L. REV. 345, 350 (2003) (justifying the application of res ipsa on the grounds that it can "effectively deter wrongdoing").

[9] DOBBS, *supra* note 4, § 171, at 414 (2000) (taking the traditional view that "[w]hen each of two or more causes would be sufficient, standing alone, to cause the plaintiff's harm, a literal and simple version of the but-for test holds that neither defendant's act is a cause of the harm" and noting that "[t]he classic example is the case of two fires being swept by winds towards the plaintiff's property"); PROSSER AND KEETON, *supra* note 4, § 42, at 278.

[10] In other words, the claim is that the injury would have occurred regardless of such actors. *See e.g.*, Boim v. Holy Land Found. for Relief & Dev., 549 F.3d 685, 695, 697 (7th Cir. 2008) (explaining that "[i]n all these cases the requirement of proving [actual] causation is relaxed . . . because otherwise there would be a wrong and an injury but no remedy").

[11] *See supra* note 4 and accompanying text.

[12] The contextualized vignette is described in Example 1 in Part II.A. See also Part III.B. (discussing the experimental design).

subject's preferences. For example, we were able to observe whether a subject's willingness to act tortiously was conditional upon others doing the same; and whether, despite not knowing others' decisions, she is nevertheless willing to take a leap of faith and act tortiously.[13]

Contrary to common belief, data from over 200 subjects shows that group liability can *encourage* tortious behaviors. In our experiments, the majority of subjects preferred to act tortiously but only if joined by others. Moreover, their willingness to engage in the tortious activities increased with the number of tortfeasors. In the neutrally-framed experiment with liability, very few subjects were willing to act alone or with only one additional actor. However, conditional upon two other subjects joining the tortious activity—when the activity became profitable—the proportions of subjects willing to act *increased* to 92%, and conditional on three others acting, it reached 96%. In other words, despite the imposition of liability, almost everyone was willing to engage in the tortious activity provided a large enough number of actors would do the same. The result in the contextualized framing (i.e., the polluting factories setting) followed the same pattern. Moreover, we find that in certain situations subjects were more willing to act tortiously under a liability regime compared to no liability. The proportion of subjects willing to act conditional on two or three other subjects acting was higher under the liability regime compared to the no liability regime.

Subjects' unconditional decisions were also surprising. Although most subjects preferred to act tortiously only as part of a group, the vast majority decided to behave tortiously *unconditionally*. They did so despite the fact that they could *not* communicate with each other. This suggests that subjects not only were encouraged to behave tortiously, but they also acted as if they believed that others would also be enticed by the imposition of group liability.

Upending conventional belief, the data also provide overwhelming evidence supporting the claim that the but-for test can be operable in group causation theories like substantial factor. In all of the liability sessions, regardless of framing, subjects were unwilling to engage in the tortious activity but-for at least two other subjects doing the same.

In our experiments, group liability seems to impact subjects' cost-benefit calculus in a number of ways. First, as the number of subjects increases, the expected liability of each decreases (because liability is shared by all), and consequently, the financial gain from the tortious activity increases. In other words, with more tortfeasors, each stands to profit more. Second, not only do individual profits increase with the number of tortfeasors, social gains can increase in the same way. Thus, subjects may justify the tortious activity (e.g., pollution due to production of cement) as a necessary evil: the sacrifice of one (who is fully compensated) for the benefit of many. Group liability may also *reduce* the psychological (non-monetary) cost associated with the tortious activity. Under the liability regime, the victim is compensated, which may reduce actors' moral hesitation or psychic cost from harming another. Additionally, we

[13] *See infra* Part III.B.4 (explaining the use of the Startegy Method to illicit subjects' preferfences).

observe that in the liability regime, subjects' reported fairness levels increased monotonically with the number of actors. In other words, the more tortfeasors joined the activity, the more just it was considered: to the actors, the victim, and society.

The article contributes to the economic and empirical research on tort law in a number of important ways. First, to our knowledge, the article is the first to test the effect of *group causation* theories on actors' behavior in a novel experimental setting. Previous studies have focused on the effect of tort law generally on actors' decisions to engage in tortious activities but, due to design limitations, could not focus directly on the effect of *causation* law. Second, with few exceptions, earlier studies focused on a single tortfeasor. They could not therefore analyze the effect of causation law on torts involving multiple actors. Third, our study employs a unique design that allows us to observe actors' causal decisions at the individual level. Fourth, unlike previous studies, we also test whether and to what extent an individual's decision to engage in a tortious activity is influenced by the decisions of others. The remainder of the article proceeds as follows. Part II discusses the theory and is divided into two sections. The first focuses on the conditions and mechanisms under which liability may encourage the commission of torts with multiple actors. The second centers on the actual causation requirement and the applicability of the but-for test in cases involving multiple actors. Part III reviews the relevant empirical literature, describes the experimental design, presents the testable hypotheses and the theoretical predictions, and summarizes the results. Part IV provides concluding remarks.

II. THE THEORY

A. Group Liability and Incentivized Torts

A major insight of the economic account of tort law is its role as a deterrent. By imposing appropriate costs on injurers, tort law incentivizes them to take care and avoid harming others.[14] Economic accounts of tort law also contemplate that actors with private information may decide to commit torts when the benefits exceed the costs from liability. Courts and commentators have generally focused on the deterrence rationale in extending group liability, while largely ignoring the possibility that tort law can incentivize rather than deter some tortious activity. We use a stylized example below to illustrate how this second consequence from tort law can arise and demonstrate its link to causation in group torts.

In some cases, the imposition of liability on a group of wrongdoers can produce a dilution effect that can incentivize actors to join in committing a

[14] GUIDO CALABRESI, THE COST OF ACCIDENTS (1970); Richard A. Posner, *A Theory of Negligence*, 1 J. LEGAL STUD. 29, 32 (1972), STEVEN SHAVELL, ECONOMIC ANALYSIS OF ACCIDENT LAW 108, 164–67 (1987)

wrongdoing—a "tortfest" dynamic.[15] As illustrated in our example below, in some cases, group liability may not only lead to the tort being profitable to the tortfeasors; it may also be welfare enhancing if its social value increases with the number of tortfeasors.

> **Example 1**. A number of actors (e.g., factories) must choose between two activities: (1) a harmless activity (e.g., producing limestone) or (2) an alternative tortious activity (e.g., producing cement—a necessary ingredient for construction but which causes pollution). The harmless activity promises a $24 benefit for each actor, whereas the alternative activity promises $35. However, if one or more actors engage in the alternative activity, an innocent victim will incur an expected harm of $24. The alternative activity is subject to liability, shared equally by all participants in the tortious activity.[16]

Standard rational choice theory predicts that if only one or two actors are expected to choose the tortious activity, actors will engage in the harmless activity. In the case of one actor, the decision whether to engage in the harmless activity or the alternative activity is easy. Engaging in the harmless activity promises an expected gain of $24. By contrast, the alternative activity promises only $11, the difference between the $35 expected benefit and the $24 expected liability.

With two actors, the incentive to engage in the harmless activity remains strong. If both parties pursue the alternative activity, both will be held liable using a group causation theory. For example, in the case of polluting factories, courts may apply the substantial factor doctrine.[17] If the actors are participants (drivers or spectators) in a drag race in which one of the drivers injured the victim, both would be considered as acting in concert.[18] And, in the case of careless hunters where only one injured the victim, both would be liable under a theory of alternative liability.[19] As a result, each actor can expect to pay half of the victim's damage, $12 (24/2), and therefore receive a gain of $23 (35-12).[20] They would thus prefer the harmless activity (24>23).

However, once three actors are expected to participate, engaging in the alternative and harmful activity becomes a winning strategy: it promises each actor more profit compared to the harmless activity. If all three engage in the alternative activity, all would be held liable with the aid of a group causation

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[15] J. Shahar Dillbary, *Tortfest*, 80 U. CHI. L. REV. 953, 978 (2013) [hereinafter Dillbary, *Tortfest*].
[16] Taking care is impossible (or too costly).
[17] *See supra* note 4 and accompanying text.
[18] *See supra* note 3 and accompanying text.
[19] *See supra* note 5 and accompanying text.
[20] With some simplifying assumptions such as solvency, it is easy to show that the result is independent of the apportionment regime (i.e., whether it several liability or joint and several liability (with or without contribution). *See* J. Shahar Dillbary, *Apportioning Liability Behind a Veil of Ignorance*, 62 HASTINGS L.J. 1729, 1758 (2011).

theory. As a result, the expected liability of each will be diluted to $8 (24/3). This means that each of the three tortfeasors can expect to gain $27 (35-8)—more than the $24 gain promised by the harmless activity.[21] Our example illustrates another point. The tortious activity can become more profitable and enticing as more actors join the tortious activity if the expected liability decreases with the number of actors.[22]

B. Actual Causation

Example 1 also illustrates the challenge to the consensus that in group liability settings (e.g., concerted action), the actual causation requirement is missing.[23] In fact, the example proves the consensus wrong. First, consider cases involving concurring causes like polluting factories—the subject of our vignette. The traditional argument is that no one factory can be a but-for reason for the victim's harm because the harm would have materialized in any case because of the other factories.[24] Example 1 shows why this argument is faulty. One or two factories acting together would engage in the harmless activity, as liability makes the tortious activity less profitable. However, the same two factories will switch to the tortious alternative activity if joined by a third factory. Each factory's tortious behavior is, therefore, a but-for cause of the harm because no factory would have

[21] For example, with four actors, each can expect to gain $29 (35-24/4); with ten actors, the expected gain reaches $32.60 (35-24/10). Note that in Example 1, the tortfeasors' and society's interests are aligned. With one or two participants, the tort is welfare decreasing. It would generate at most a net benefit of $46—the difference between the $70 (35x2) benefit to the tortfeasors and the $24 cost to the victim. By contrast, with three (or more) actors, the tortious activity becomes socially desirable. It would generate a net benefit of $81 (35x3-24) compared to a net gain of only $72 (24x3) from the harmless activity. Of course, the social acceptability of a tort may change with the nature of the activity. It is possible that even if many agree that a harmful activity, like producing cement, is justified, less would agree that the same is true for hunting and fewer, if any, would defend injurious drag races in the name of efficiency.

[22] The model assumes that the parties know that the tortious activity (e.g., pollution) is subject to liability and that they are able to engage in an *ex ante* cost–benefit analysis. Importantly, the model does *not* assume that parties (or courts) are omniscient. In fact, it relies on the fact that they are not. Each actor is assumed to know her expected benefits from the activity (but not others's benefits or others' decisions') and to estimate the harm. Moreover, the model is not limited to situations, like Example 1, where damage is constant. There are important examples of indivisible harms that can be produced by concurrent causes, such as injuries to individuals from malpractice involving medical teams, or personal injuries arising from multi-vehicle accidents. However, in many cases, the actual harm and the probability of harming may increase with the number of tortfeasors. It remains possible to show that under certain conditions, a tortfest can still occur when the expected harm increases with the number of actors (i.e., there is an increase in the benefit from the activity that is sufficiently greater than the increase in (diluted) liability from the increased harm). Finally, it is not claimed that tortfests are *always* welfare enhancing (they are not). *See* Dillbary, *Tortfest*, *supra* note 15, at 995.

[23] *See supra* notes 9–10 and accompanying text.

[24] DOBBS, *supra* note 4, § 171, at 414; PROSSER AND KEETON, *supra* note 4, § 41, at 266 (arguing that the but-for test "fails" when multiple sufficient forces concur to bring about the harm).

engaged in the tortious activity of producing cement without the third, and the victim would not be injured as a result.[25]

Example 1 also illustrates that a *non-injuring* party can be a but-for cause of the harm. For example, assume that the alternative activity is drag racing involving two drivers and a spectator. As with the factories, neither one of the drivers would participate in the race unless joined by the two other actors. This is because a group causation theory like concerted action would hold liable the injuring driver *and* the non-injuring parties (the spectator and the driver who did not hit the victim).[26] As with the factories example, it is only once there are three participants in the tortious activity that it becomes the profitable choice for any of them. As a result, each of the non-injuring actors (the non-injuring driver and the spectator) is a but-for cause of the harm because but for their decision to engage in the tortious activity, the actor who physically injured the victim would not engage in the tortious activity either and the victim would not be harmed.[27]

While there is theoretical potential for group liability to incentivize torts because of its dilutive effect, our example makes it clear that this depends on what actors believe and choose in this liability environment. If they expect others to be deterred, then choosing the harmless activity is best. If they believe that the latent cost-dilution incentive will lead enough actors to commit the tort, then that becomes the best choice. There are thus two possible equilibria: deterrence and encouragement of the harmful activity. To date, a deterrent effect of group liability has simply been assumed.

III. THE EXPERIMENT

This article's goal is to empirically *test* how subjects behave in situations like Example 1. More specifically, our goal is to test whether: (1) the imposition of liability with the aid of group causation theories encourages actors to unconditionally engage in tortious activities instead of deterring them; (2) the imposition of liability may result in a tortfest dynamic (i.e., more actors would be willing to commit a tort as the number of actors increases); (3) the but-for test applies in settings like concurrent causes where courts insist it does not; (4) the nature of the activity and perceptions of its social value (e.g., producing a social good versus harming someone to get only a personal benefit) may impact willingness to engage in tortious activity; and (5) fairness perceptions may change

[25] The conduct of each actor can be considered a but-for cause of the harm even when four or more actors engage in the activity. For an in-depth discussion, *see generally* J. Shahar Dillbary, *Causation Actually*, 51 GA. L. REV. 1, 34–39 (2016).

[26] *See, e.g.*, Wilson v. Firestone Tire & Rubber Co., No. 71981, 1985 Mich. App. LEXIS 3192 (Jan. 4, 1985) ("Even if defendant caused no harm himself, he is liable for the harm caused by his fellows because all acted jointly."); RESTATEMENT (SECOND) OF TORTS § 876 cmt. d (AM. LAW INST. 1979).

[27] Indeed, but for the spectator's decision to observe the race with approval, neither driver would agree to engage in the race, and no one would be harmed. Similarly, but for the non-injuring driver, the other driver would not drive carelessly even if encouraged by the spectator.

with the number of actors (e.g., a tortious activity may be considered more equitable if conducted by many). With the theory and goals in mind, we can now turn to the next step—the study's design and its relation to the prior literature.

A. The Prior Literature

We begin with a review of the literature. Previous attempts to measure the deterrent effects of tort law doctrines can be roughly divided into two types: (1) econometric approaches and (2) experimental studies. To the best of our knowledge, none of these studies have directly tested the effect of group causation theories and the effects of dilution of liability or have tried to determine how an actor's decision about whether or not to engage in a tortious activity impacts others who face the same dilemma.[28]

1. The Observational Approach

A number of prior empirical studies have used observational data to compare liability regimes (e.g., liability versus no liability) across states[29] or to assess the impact of different types of remedies on actors' behaviors.[30] In general, these studies provide mixed evidence on the causal impacts of tort law. As Eisenberg and Engel explain, such studies often suffer from a number of limitations.[31] They are unable to "fine tune dependent and independent variables,"[32] cannot observe decisions at the individual level, are often area-specific (e.g., focusing on medical malpractice, car accidents, etc.),[33] cannot

[28] There is a large, more general literature in psychology that investigates the relationships between causality, counterfactual reasoning and attribution of responsibility. However, this literature does not directly engage the law's structure and impacts as we do. See e.g. Mark D. Alicke (2000) "Culpable Control and the Psychology of Blame" 126(4) Psych. Bull. 556; Denis J. Hilton, David Mandel and Patrizia Catellani (Eds) *The Psychology of Counterfactual Thinking* (Routledge: New York, NY, 2005); Barbara Spellman, Alexandra P. Kincannon and Stephen J. Stose (2005) "The relation between counterfactual and causal reasoning" in Hilton, Mandel & Catellani (Eds), *id*. At 28-43.

[29] *See, e.g.*, FRANK A. SLOAN ET AL., DRINKERS, DRIVERS, AND BARTENDERS: BALANCING PRIVATE CHOICES AND PUBLIC ACCOUNTABILITY (2000) (comparing alcohol-related fatalities). For studies investigating the effect of no fault systems, *compare* Alma Cohen & Rajeev Dehejia, *The Effect of Automobile Insurance and Accident Liability Laws on Traffic Fatalities*, 47 J.L. & ECON. 357, 382 (2004) (finding that the adoption of no-fault rules resulted in a 10% increase in fatalities), *and* Paul Zador & Adrian Lund, *Re-Analyses of the Effects of No-Fault Auto Insurance on Fatal Crashes*, 53 J. RISK & INS. 226, 235 (1986) (finding the opposite effect).

[30] Paul H. Rubin & Joanna M. Shepherd, *Tort Reform and Accidental Deaths*, 50 J.L. & ECON. 221 (2007) (analyzing the impact of tort reforms).

[31] *See, e.g.*, Theodore Eisenberg & Chrisoph Engel, *Assuring Civil Damages Adequately Deter: A Public Good Experiment*, 11 J. EMPIRICAL LEGAL STUD. 301, 302 (2014) [hereinafter Eisenberg & Engel, *Public Good Experiment*] (discussing some of these limitations).

[32] *Id.*

[33] A notable exception is Gary T. Schwartz, *Reality in the Economic Analysis of Tort Law: Does Tort Law Really Deter?*, 42 UCLA L. REV. 377 (1994) (analyzing a range of activities and legal regimes including liability for workers' injuries, motorist liability, and medical malpractice). *See also* Don Dewees & Michael Trebilcock, *The Efficacy of the Tort System and Its Alternatives: A*

observe the dynamic of group activities, are unable to observe how the actions of one group member impact the behaviors of others, and may suffer from reverse causality.[34] Most importantly for our purposes, observational studies are often not well-suited to determine causal links. As a recent study explains: "[E]xisting deterrence studies *all* suffer from the same limitation—they use proxies as a means of measuring the causal link between tort liability and changes in tortious behavior."[35] The use of proxies exacerbates another problem that is common to observational studies: the difficulty of distinguishing whether the effects observed are the result of the legal rule investigated, or whether these effects are the product of some unobserved factors or the unique characteristics of the dataset used.

Our innovative experimental design allows us to overcome these shortcomings and directly test the impact of causation law on actors' behaviors. As explained below, by employing a well-known technique called the Strategy Method, we analyze actors' decisions at the individual level. Importantly, the Strategy Method allows us to observe whether a subject's decision to behave tortiously is conditional upon others acting tortiously as well. It is thus especially well-suited to analyze the law's causal effects and the tortfest dynamic.

2. The Experimental Approach

Our design also differs from previous experimental approaches, which are themselves a recent phenomenon in torts scholarship.[36] Some experimental studies use a survey-based approach. An example is a recent study asking first-year law school students to rate the likelihood they would engage in certain tortious activities that found no deterrent effect for tort law (the Cardi Study). Each student completed a survey that experimentally varied one of four possible legal regimes: no liability, criminal liability, tort liability, and unspecified

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Review of Empirical Evidence, 30 Osgoode Hall L.J. 57 (1992) (reviewing evidence on automobile safety, malpractice, product liability, workplace injuries, and environmental harm and concluding mixed evidence of deterrence from tort liability).

[34] Eisenberg & Engel, *Public Good Experiment*, *supra* note 31, at 302 ("The analyst may be unsure about omitted variables and reverse causality is often a concern.").

[35] W. Jonathan Cardi, Randall D. Penfield & Albert H. Yoon, *Does Tort Law Deter Individuals? A Behavioral Science Study*, 9 J. EMPIRICAL LEGAL STUD. 567, 570–71 (2012) (emphasis added) (using a survey methodology to analyze the effect of different legal regimes on actors' willingness to commit a tort and concluding that unlike the threat of criminal liability, the effect of potential tort liability did not have a significant effect on subjects' stated willingness to engage in risky behaviors).

[36] *See, e.g.*, Theodore Eisenberg & Christoph Engel, *Unpacking Negligence Liability: Experimentally Testing the Governance Effect*, 13 J. EMPIRICAL LEGAL STUD. 116, 120 (2016) [hereinafter Eisenberg & Engel, *Unpacking Negligence Liability*] (explaining that while "[i]n economics [the] experimental method has become very popular because experiments directly test formal theoretical models," surprisingly, the "formal economic models of legal institutions have not very often been tested in the lab" and noting that "[t]here is no more than a handful of pertinent experimental papers").

liability.[37] Survey studies are useful, but as the Cardi Study explicitly admits, they suffer from a major drawback that makes them unsuitable to test our hypotheses. Survey studies rely on subjects' self-reported predictions rather than their actual behavior.[38] The concern is that when it comes to making the decision in question—e.g., whether or not to commit a tort—subjects would behave differently than they said they would. Moreover, survey studies are often static in nature and do not allow the researchers to observe the decision dynamic in real time, time trends, or, importantly, whether one's action is dependent on her belief as to whether and how many actors will behave tortiously.

Like the Cardi Study, our methodology tests the causal impact of tort liability by comparing results for regimes with liability and no liability, as well as across contextualized scenarios and neutrally framed ones. However, our design is different in a number of important aspects that we discuss below. Chief among them is that we observe the subjects' actual behaviors in a context with real financial consequences, rather than relying on self-reports. Moreover, using a between-subject framework with multiple decision rounds, we observe the decision dynamic, belief formation, and the stability of beliefs over time.

Lab experiments are a more recent, dynamic form of experimental study. A number of researchers have used experiments to assess how variations in tort liability regimes might affect behavior. In a well-known study, Kornhauser and Schotter asked each of the 113 subjects to choose (at a cost) their level of care, which determined the probability that an accident would occur.[39] Under a strict liability regime, a subject paid a predetermined amount if the accident occurred. Under a negligence regime, payment was due only if the care taken was below an announced standard of care.[40] The authors found the choice of liability regime had a significant effect.[41] Kornhauser and Schotter's experiment "consider[ed] the simplest possible model" in which a "single" actor choses her desired precaution level.[42] Their experiment did not incorporate a victim, consider the tortfeasor's choice of the level of activity, or involve interactions between multiple potential tortfeasors. Subsequent work by Angelova et al. incorporated a victim as part of the experiment, as well as an additional baseline treatment with no liability.[43]

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[37] Cardi et al., *supra* note 35 (in the unspecified regime, no legal regime was given and "subject[s] were left with [their] own understanding of the possibility of sanctions or liability").

[38] *Id.* at 571. The potential gap between self-reported choices and actual choices is a limitation common to all experimental survey designs.

[39] Lewis Kornhauser & Andrew Schotter, *An Experimental Study of Single-Actor Accidents*, 19 J. LEGAL STUD. 203, 204 (1990) (analyzing liability effects in a "model in which the actions of a single individual determine the expected frequency of occurrence of a loss"). The authors found that under a negligence regime, individuals chose the (exogenous) reasonable level of care. By contrast, under the strict liability regime, the investment in care initially exceeded, then fell below, the efficient level.

[40] *Id.* at 208–09.

[41] *Id.* at 213.

[42] *Id.* at 204.

[43] Vera Angelova, Guiseppe Attanasi & Yolande Hiriart, *Relative Performance of Liability Rules: Experimental Evidence* (Jena Econ. Research Papers, Working Paper No. 2012-012, 2012),

Building on this work, Eisenberg and Engel designed an investment task where the more one (the active party) invests, the higher the risk of harm is to another (a passive innocent party).[44] They found that tort law has an expressive function that strengthens its deterrent effect (by creating non-pecuniary motivations to avoid harming others). This expressive function may result in a distaste for harming an innocent party, the tendency to adhere to social norms, and the desire to avoid blame. We follow Eisenberg and Engel's steps by recognizing the possibility that psychological (non-pecuniary) costs may slow down the occurrence of a tortfest. However, unlike Eisenberg and Engel, our design also allows us to investigate how the dynamic interaction between prospective tortfeasors and the impact of shared liability change fairness perceptions. We find some support that psychological costs (to the extent they are correlated with fairness) may be higher in the case of a single tortfeasor, but that they monotonically decrease as the number of tortfeasors increases—a phenomenon Eisenberg and Engel could not observe due to their design.

A few researchers have used public goods-style experiments to assess the impacts of tort law.[45] In a different study, Eisenberg and Engel used a variant of a public goods experiment to study the impact of tort damage regimes.[46] However, their study did not consider the potential for shared liability and joint action by wrongdoers. A more recent study uses a public goods experiment to investigate the impact of liability rules in cases where participants face tradeoffs between privately profitable actions and imposing harm on others (the Deffains et al. Study).[47] Similar to Eisenberg and Engel, the study found that liability rules have a "norm activation" effect, leading participants to put more weight on harms to others (and deterring tortious actions). The effect is strongest for strict liability, and it complements the impact of social norms, which they believe are operative even when legal sanctions are absent or imperfectly enforced. Like its predecessors, however, the study did not consider the impact of liability in the context of multiple tortfeasors or the potential for shared liability.

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https://www.researchgate.net/publication/239808054_Relative_Performance_of_Liability_Rules_Experimental_Evidence. *See e.g.* Croson R.T.A. (2010) public goods experiments. In: Durlauf S.N., Blume L.E. (eds) Behavioural and Experimental Economics. The New Palgrave Economics Collection. Palgrave Macmillan, London.

[44] Eisenberg & Engel, *Unpacking Negligence Liability*, *supra* note 36, at 119.

[45] Public goods experiments generally involve participants making private decisions about contributions to produce a public good which generates benefits that can be shared by all, even those who do not contribute fully. *See e.g.* Croson R.T.A. (2010) public goods experiments. In: Durlauf S.N., Blume L.E. (eds) Behavioural and Experimental Economics. The New Palgrave Economics Collection. Palgrave Macmillan, London.

[46] Eisenberg & Engel, *Public Good Experiment*, *supra* note 34. The authors contrasted individual tort damages with class action and punitive damage analogs and found some impact in the latter two categories.

[47] Bruno Deffains, Romain Espinosa & Claude Fluet, *Laws and Norms: Experimental Evidence with Liability Rules,* CENTRE DE RECHERCHE SUR LES RISQUES LES ENJEUX ÉCONOMIQUES ET LES POLITIQUES PUBLIQUES (2017), https://www.crrep.ca/sites/crrep.ca/files/fichier_publications/crrep-2017-05_0.pdf.

To our knowledge, this article is the first to use an experimental approach to test the impact of shared tort liability on actors' decisions whether or not to engage in a tortious activity while observing the subjects' indivudual preferences. To directly test the effect of group causation theories, we designed a series of experiments, based on Example 1, in which actors independently and simultaneously decide whether or not to engage in a tortious activity, knowing others face the same dilemma. Importantly, in our experiment, acting is worthwhile only if a minimum number of actors decide to engage in the tortious activities. As such, our experiment can be viewed as a form of a "stag hunt" game.[48] Broadly defined, these are cases in which parties' payoffs depend on the level of implicit cooperation among subjects. Parties do not communicate (by signal or contract) with others about their strategies and choices. Rather, cooperation between potential tortfeasors can be achieved through trust or based on belief (in the case of unconditional decisions)[49] that others would behave in a certain way.

Our experiments provide a consistent measure of the hypotheses tested and allow the study of repeated individual behavior over time. Importantly, they allow us to observe individual-level decision-making and, using the Strategy Method (discussed below), to see how actors react causally to different incentive schemes. In the experiments, we manipulate variables of interest (e.g., whether there is tort liability or not) while subjects make choices that expose them to different actual monetary payoffs, dependent on the actions of other subjects, with the potential to impose real losses on a party in the experiment. For these reasons, the approach is especially well-suited to test group dynamics in cases when the actions of one tortfeasor can benefit others through doctrines of causation that result in shared liability.[50]

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[48] The logic of a "stag hunt" game is as follows: let us suppose that there are a number of hunters, who must choose between putting effort toward hunting a hare or a deer. The chances of catching a hare are independent of what others do. There is no chance of catching a deer alone, but the chances of a successful deer hunt go up sharply with the number of hunters who decide to join the hunt. A deer is much more valuable than a hare. Participants must decide independently whether to gamble the sure gain of the hare for the chance of success at a deer. In our experiment, the tort is similar to a "stag" in that committing the tort can be more beneficial than simply keeping the endowment, but only becomes so with more tortfeasors acting. *See e.g.* Schmidt, D., Shupp, R., Walker, J. M. & Ostrom, E. *Playing safe in coordination games: the roles of risk dominance, payoff dominance, and history of play*. 42 GAMES AND ECONOMIC BEHAVIOR 42 281 (2003) for general discussion of Stag Hunt experiments. Our design is also related to threshold public good experiments, where a certain level of cooperation is needed for the production of the public good. In most cases, cooperation beyond the threshold amount is inefficient. We have a threshold in the Liability treatment, but efficiency only improves with "cooperation" beyond that point. For this reason, exactly three of four subjects committing the tort is not a Nash Equilibrium.

[49] The use of unconditional and conditional decisions using the Strategy Method is discussed *infra* Part III.B.4 below.

[50] *See infra* Part III.B.4 below. For the external validity of lab experiments see infra note 105 and accompanying text.

B. The Experimental Design and Procedure

To test our hypotheses, we presented subjects with four incentive schemes ("treatments") similar to the one described in Example 1 (reproduced below for convenience):

> **Example 1**. A number of actors[51] (e.g., factories) must choose between two activities: (1) a harmless activity (e.g., producing limestone) or (2) an alternative tortious activity (e.g., producing cement—a necessary ingredient for construction, but which causes pollution). The harmless activity promises a $24 benefit whereas the alternative activity promises $35. However, if one or more actors engage in the alternative activity, an innocent victim will incur an expected harm of $24. The alternative activity is subject to liability. Taking care is impossible (or too costly).

1. The Conext-Free (Neutrally Framed) Treatments

In the "Context-Free" treatments, the experiment was framed in a way that is "neutral" in the sense that it does not include refrences to "real world" context that might influence participants perceptions. This neutral framing is common in experimental studies as a way to focus on the basic underlying payoffs and how participants respond. We consider it first, before moving to an experiment that describes the context in a way that better reflects the choices facing potential tortfeasors in our "vignette" treatments. Subjects participated in groups of five in a repeated setting (i.e., rounds). In each round, each subject was endowed with 24 experimental tokens. Four of the five subjects, called Type-X, were assigned as actors,[52] and one subject, called Type-Y, was assigned as a party who may incur a loss. Type-X subjects, analogues of the factories in Example 1, decided whether or not to "act" (i.e., whether to engage in the harmful activity). Type-X subjects who chose to act lost their 24-token endowment but in return received 35 tokens (i.e., the higher payoff from the harmful activity). The Type-Y subject, an analogue of the potential victim in Example 1, did not make any decisions during the experiment.[53] However, Type-Y's payoffs depended on the decisions of the Type-X subjects. If at least one Type-X subject chose to act, the Type-Y subject would have lost her 24-token endowment (i.e., the injury from the activity).

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[51] We use the term "actors" to refer to potential tortfeasors—that is, to those who have a choice and must decide whether to engage in a tortious activity. In the context-free frame, these actors are referred to as "Type-X" subjects. In the vignettes they are referred to as the "factories."

[52] *Id*.

[53] All groups, accorss all treatments, included a victim who was an actual participant (referred to as "Type-Y" in the context-free (neutrally framed) treatments and the "Owner" in the vignettes). We allocated this role to a participant for two main reasons. The first, was to avoid deception. Because subjects were told that their actions would result in a harm to a third party the ponteital victim had to be included. In addition, the knowledge that the victim is real and present can impact subjects' decisions. *See infra* note 55–56 and 70 and accompanying text.

The neutrally framed treatments varied in the applicable liability regime: liability vs. no liability for the actors. In the Context-Free-Liability treatment (CF-L), all Type-X subjects who chose to act had to fully compensate the Type-Y subject in equal shares.[54] For instance, if two Type-X subjects chose to act, each lost her 24-token endowment (the opportunity cost of forgoing the harmless activity) and received 35 tokens (the payoff from the harmful activity). Each was then required to transfer 12 tokens (24/2) to the Type-Y subject for a total gain of 23 tokens (35-24/2). If three Type-X subjects chose to act, each gained 27 tokens (35-24/3).

In the Context-Free-No-Liability treatment (CF-NL), none of the Type-X subjects who chose to act was required to compensate the Type-Y subject. Thus, if at least one of the Type-X subjects chose to act, the Type-Y subject simply lost her 24-token endowment. For example, if two Type-X subjects chose to act, each received 35 tokens from acting, and neither was required to transfer tokens to the Type-Y subject.

This means that, under the No Liability treatment, the monetary payoffs for Type-X subjects who chose to act were constant and equal to 35 tokens. By contrast, under the Liability treatment, the monetary payoffs of Type-X subjects who chose to act were dependent on the total number of Type-X subjects who chose to act. As Table 1 below shows, in the Liability treatment a Type-X subject was better off acting only if she was joined by two or three additional Type-X subjects (27, 29>24) but otherwise was better off keeping her 24-token endowment and refraining from acting (11, 23<24).

The Number of Acting Type-X Subjects	**Payoffs of Each Acting Type-X Subject**
0	**24** (=endow.)
1	**11** (=35-24/1)
2	**23** (=35-24/2)
3	**27** (=35-24/3)
4	**29** (=35-24/4)

Table 1: The Incentives to Act as a Function of the Number of Actors

Note that although all Type-X subjects faced the same *monetary* incentive scheme, their actual gains from acting likely varied. The reason is that subjects may hold heterogeneous non-monetary valuations associated with their actions. Notions of fairness, morality, inequality aversion, social preferences, or other-regarding preferences, to name a few determinants, may impact the actors' subjective payoffs and accordingly their decisions.[55] For example, some subjects

[54] This apportionment rule is similar to that of several liability or joint and several liability with contribution. Since all subjects received an initial endowment, each is solvent.

[55] Ernst Fehr & Klaus M. Schmidt. *A Theory of Fairness, Competition, and Cooperation,* 114 Q.J. ECON. 817 (1999) (inequity aversion); Gary Charness & Matthew Rabin, *Understanding Social Preferences with Simple Tests*, 117 Q.J. ECON. 817 (2002) (social preferences); James Konow,

could be comfortable knowing that if they act, the Type-Y subject would lose her endowment. Others may experience some non-monetary (psychological) cost from gaining at the expense of another, regardless of whether the Type-Y subject is compensated.[56] In general, we would not expect these non-monetary costs to be large in our experimental setting, as the endowment at stake is a relatively small amount of money that all players are given at the beginning of each round, and participants interact anonymously.

2. The Vignettes

In addition to the Context-Free treatments, we also conduct vignette-based treatments, which use contextualized "real world" settings. The liability regimes and payoffs remained the same as in the Context-Free treatments; the only difference was in the framing of the instructions. These additional treatments used vignettes to frame the decisions in a "real-world" setting. In the Vignette-Liability (V-L) and Vignette-No-Liability (V-NL) treatments, four of the subjects—the actors who had to decide whether to engage in the tortious acitivity—were referred to as Factories. The fifth subject, the potential victim, was referred to as the Owner of another structure nearby. Each factory chose whether to keep producing limestone (i.e., "not acting" in the Context-Free treatments) or switch to producing cement (i.e., "acting" in the Context-Free treatments). If a factory produced limestone, it kept its 24-token endowment. If a factory switched to producing cement, the tortious activity, it lost its endowment but in return earned 35 tokens from producing cement. However, if at least one factory switched to producing cement, the Owner nearby lost 24 tokens—the full value of her structure.

Table 1A below summarizes the differences in framing across treatments. These changes to the frame of the instructions did not alter the monetary incentives of the decision environment. They may, however, have changed subjects' perceptions and any associated psychological costs.[57] The contextual frames of the vignettes allow us to test the robustness of our results from the neutrally framed experiments in this more realistic setting.

	Context Free (CF-L, CF-NL)	**Vignettes (V-L, V-NL)**
Actors	Type-X	Factories
Pontential Victim	Type-Y	Owner

Which Is the Fairest One of All? A Positive Analysis of Justice Theories, 41 J. ECON. LITERATURE 1188 (2003) (theories of fairness).

[56] For an example of the impact of non-monetary costs on actors' willingness to engage in a tortious activity, *see infra* note 70 and accompanying text.

[57] Contextualized instructions in economics experiments can, in some instances, change behavior compared to behavior with neutral instructions. *See* Leigh Raymond & Timothy N. Cason, *Can Affirmative Motivations Improve Compliance in Emissions Trading Programs*?, 39 POL'Y STUD. J. 659 (2011); Aleksandr Alekseev, Gary Charness & Uri Gneezy, *Experimental methods: When and why contextual instructions are important*, 134 J. ECON. BEHAV. & ORG. 48 (2017).

Decision	Whether "to act"	Switch to cement production

Table 1A: The Difference in Framing Across Treatments

For brevity and consistency when discussing the treatments, we refer collectively to choices to act (in the Context-Free treatments) and produce cement (in the Vignettes)—simply as the "choice to act." Declining to act and producing limestone are referred to as the "choice not to act."

3. Sessions and Rounds

Each of the four treatments (summarized in Table 3 in Section III.D. below) was administered in multiple separate sessions during which the treatment was repeated in seven rounds. At the beginning of each session, subjects were randomly assigned to one of two types: "Type-X" or "Type-Y" in the context-free treatments and "Factory" and "Owner" in the vignettes. In each treatment, subjects in both roles (e.g., Type-X and Type-Y) received the same instructions.[58] Subjects assigned as Type-Xs or Factories (*i.e.*, the actors) made their decisions in each round simultaneously—that is, without any knowledge of the other actors' decisions in the given round. At the beginning of each round, groups were randomly re-matched (i.e., stranger matching) to mitigate any reputational effect from repeated play with the same individuals. However, a subject's type (e.g., Type-X or Type-Y) remained constant throughout the entire session. This avoided any potential effects that might have arisen from the order in which subjects played the two roles. At the end of each round, all subjects received information on the number of actors (i.e., subjects assigned as Type-Xs or Factories) who chose to act and the final token earnings for the round. Additionally, actors were notified about their payoffs; and the potential victim (i.e., subjects assigned as Type-Y or Owner) was notified whether she incurred any losses and whether she was compensated. All subjects' payoffs were a function of the liability regime and the number of subjects who chose to act.

4. The Strategy Method

To test the applicability of the but-for test in settings like concurrent causes and whether and under what conditions a tortfest would develop, we employed the Strategy Method.[59] The method is used frequently to analyze

[58] To avoid influencing subjects, the instructions did not use terms such as actor, aggrieved party, tortfeasor, victim, or tort.

[59] Urs Fischbacher, Simon Gächter & Ernst Fehr, *Are people conditionally cooperative? Evidence from a public goods experiment,* 71 ECON. LETTERS 397, 397–404 (2001); Urs Fischbacher & Simon Gächter, *Social Preferences, Beliefs, and the Dynamics of Free Riding in Public Goods Experiments,* 100 AM. ECON. REV. 541, 541–556 (2010). For a recent survey of the literature regarding the effectiveness of the method, *see* Jordi Brandts & Gary Charness, *The strategy versus the direct-response method: a first survey of experimental comparisons*, 14 EXPERIMENTAL ECON. 375, 395 (2011) (reporting that, in a few instances, employing the strategy method compared to the "direct-response" method (i.e., only making unconditional decisions) may

subjects' "willingness to contribute to public goods conditional on others' contributions," [60] and is therefore especially suited for our purposes. This method allows us to observe whether a subject's decision to act was conditional on the others' decisions to do the same. For example, it allows us to observe whether a factory would prefer to engage in the tortious activity only if two or more other factories would do the same but would prefer to engage in the harmless activity otherwise.

The method works as follows. In the beginning of each round, every actor (i.e., subjects assigned as Type-X or Factories) made two types of decisions. First, the actor made an unconditional decision to act (as shown in Table 2A below). Following the unconditional decision, each actor made conditional decisions by filling out an Action Table (as shown in Table 2B below) in which they chose whether to act in all possible conditional scenarios. The Action Table in the context-free treatments are reproduced below as Table 2A and 2B.

Your Unconditional Decision to Act	
Do you choose to act?	Act or Not

Table 2A: Type-X Subject Unconditional Decision to Act

Your Conditional Decisions to Act (Action Table)	
If none of the other three Type-X members choose to act, would you choose to act?	Act or Not
If one of the other Type-X members chooses to act, but the other two Type-X members choose not to act, would you choose to act?	Act or Not
If two of the other Type-X members choose to act, but the other Type-X member chooses not to act, would you choose to act?	Act or Not
If all three of the other Type-X members choose to act, would you choose to act?	Act or Not

Table 2B: Type-X Subject Conditional Decision to Act (Action Table)

At the end of each round, the action table of one of the four actors was randomly chosen to be used in the calculation of earnings for that round.[61] For the other three actors in the group, only their unconditional decisions were used to calculate earnings in that round. The following example illustrates the procedure.

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have impacted subjects' behaviors, but arguing that their study "should at least dispel the impression that the strategy method inevitably yields results that differ significantly from results gathered using the traditional direct-response method").

[60] Urs Fischbacher & Simon Gächter, *The behavioral validity of the strategy method in public good experiments*, 33 J. ECON. PSYCHOL. 897, 897–98 (2012) (finding that "the strategy method and the direct response method yield qualitatively similar results" and "that consistency between expressed cooperation preferences and actual contributions increases over time").

[61] In addition to their Types (X or Y), subjects were also assigned an anonymous ID each round. Type X IDs were X1, X2, X3, and X4. The Type Y ID was Y. In the contextually framed Vignette treatments, Factory IDs were F1, F2, F3, and F4, and the Owner ID was O.

> **Example 2**. Consider a Context-Free treatment with a Liability regime. Suppose Type-X subject X1 is randomly chosen in a round. This means the computer will use X1's action table to calculate earnings in this round. The unconditional decisions for Type-X subjects X2, X3, and X4 will be used to calculate earnings. Suppose further that X2 and X3 made unconditional decisions to act and X4 made the unconditional decision not to act.

Suppose X1 indicated in her action table that she would act if two other Type-X subjects chose to act. In such a case, X2 and X3 (who chose to act unconditionally) and X1 (who chose to act if two others joined her) would act in this round. As a result, X1's, X2's, and X3's (monetary) earnings would each be 27 tokens (35-24/3).[62] The earnings of X4 (who chose not to act unconditionally) would be 24 tokens. Type-Y's earnings would be 24 tokens. The Strategy Method creates appropriate incentives for individuals to reveal their true preferences because of the chance their (unconditional and conditional) choices will be used to determine their payoffs from the experiment.

5. Procedure: Review Questions, Risk Proclivity, & Exit Questionnaire

All sessions (for the pilot and main treatments) were conducted at Appalachian State University in the Appalachian Experimental Economics Lab (AppEEL) using z-Tree software. After entering the lab, subjects were randomly assigned to computer stations. After reading the instructions, subjects answered review questions to test their understanding of the basic protocol and incentives of the experiment. The first round began only after all review questions were answered correctly. Following the seven rounds of the experiment, subjects also completed the monetarily-incentivized Holt and Laury risk-preference task to measure risk aversion.[63]

Subjects then completed a post-experiment questionnaire. In addition to demographic data on subject's characteristics, such as age and education, subjects were asked to rank the fairness of the decision to act (tortiously) as a function of the number of actors. Using a scale from 0 to 5 (with 0 being unfair and 5 being completely fair) subjects evaluated the fairness to: (1) the victim (i.e., Type-Y in the Conext-Free treatments and the Owner in the Vigenettes), (2) the actors (i.e.,

[62] The difference between the 35 tokens from acting and the 8 tokens (24/3) that each will need to transfer to fully compensate Y for her 24-token loss.

[63] Charles A. Holt & Susan K. Laury, *Risk Aversion and Incentive Effects,* 92 AM. ECON. REV. 1644 (2002). This has become the standard method for assessing risk aversion in experimental settings, or the "gold standard." *See, e.g.*, Lisa R. Anderson & Jennifer M. Mellor, *Are risk preferences stable? Comparing an experimental measure with a validated survey-based measure*, 39 J. RISK & UNCERTAINTY 137 (2009). This measure allowed us to control for the possibility that differences in risk tolerance across participants might be influencing our results.

the Type-X subjects and the Factories), and (3) society—defined as all the subjects in the group (e.g., the four Type-X subjects and the one Type Y).[64]

To reduce the incentive to hedge across rounds, subjects were paid in cash at the end of each session. The payment was based on one randomly chosen decision round in the experiment. For example, if Round 4 was randomly chosen from the seven rounds, the subjects received a cash amount based on the number of tokens they earned in Round 4.

C. The Hypotheses and Theoretical Predictions

We use the various treatments and the Strategy Method to test the following hypotheses:

> Hypothesis 1 (Reduced Deterrence): The imposition of tort liability on multiple actors can encourage (rather than discourage) actors to engage in tortious activities. We hypothesize that the imposition of liability on multiple actors will incentivize an actor who would alone engage in a harmless activity to *switch* to a tortious activity if liability is imposed on a large enough number of actors. We test this hypothesis by comparing decisions to act in settings in the Liability regime to settings in the No Liability regime.
>
> Hypothesis 2 (Tortfest): The imposition of tort liability can result in a tortfest, where the more actors join the tortious activity, the more beneficial and enticing it becomes. We hypothesize that the demand for a tortfest will increase with the number of tortfeasors. We test this hypothesis by using the Strategy Method to compare individuals' conditional decisions as the number of actors increases.
>
> Hypothesis 3 (But-For): The but-for test can be operable in tortious activities involving multiple actors such as concurrent causes. In overdetermined cases (where each actor's action can alone destroy the victim's endowment), each concurring force is a but-for cause of the harm. This means that in the case of *n* actors, but for the engagement of the marginal tortfeasor, none will engage in the activity and the victim will not be harmed. This hypothesis is also tested by examining individuals' conditional decisions using the Strategy Method.
>
> Hypothesis 4 (The Nature of the Activity—Context): We hypothesize that the context of a tortious behavior can affect the salience of costs and benefits, including any fairness concerns—making them more apparent to individuals. We test this hypothesis by contrasting the Vignette, a

[64] In these questions, subjects ranked the fairness of decisions to act from 0 to 5 (with 0 being unfair and 5 being completely fair).

contextualized frame, with a Context-Free Frame. The factory vignette uses a realistic scenario that highlights the social benefit from the tort (cement production). By contrast, in the Context-Free Frame, the social benefits from the activity are less salient. Although the payoffs are the same in both treatments, we hypothesize that the willingness to act will be higher in the Vignette compared to the Context-Free Frame.

Hypothesis 5 (Alternative Fairness Ideals): Tort liability is often linked to ideas of fairness. We have two competing hypotheses about the way tort liability may impact actors' perceptions of fairness, depending on the number of actors:

A. The Expressive Function and Moral Culpability: One possibility is that, in addition to its consequent monetary costs, tort liability may signal the unfairness or moral culpability of an action.[65] This would suggest individuals will be less willing to act under the Liability regime and perceive acting as less fair to the victim. The activity may be perceived as more morally reprehensible as the number of tortfeasors increases—that is, as more actors "gang up" on the victim.

B. Moral Excuses and Mob Mentality: Another possibility is that tort liability may *mitigate* perceptions of unfairness. For example, actors may see liability as a "price" for acting. This "price" may crowd out social norms[66] and reduce any psychological costs from harming the victim, so they are more easily offset by monetary benefits.[67] A larger number of acting participants may also imply that the tortious activity is socially acceptable or at least not as reprehensible as it would be perceived if only one or a few engaged in it.[68] Because the monetary "price" imposed by

[65] For work on the expressive function of law in shaping such social and moral norms, *see e.g.* Paul H. Robinson & John M. Darley, *The Utility of Desert*, 91 NORTHWESTERN UNIV. L. REV. 453 (1997); R. Cooter, Expressive Law & Economics, 27 J. LEGAL STUD. 585 (1998); R. McAdams, *An Attitudinal Theory of Expressive Law*, 79 Oregon L. Rev. 339 (2000); Y. Feldman & J. Nadler, *The Law & Norms of File Sharing*, 43 SAN DIEGO L. REV. 577 (2006); J. Nadler , Expressive Law, *Social Norms & Social Groups*, 42 LAW & SOCIAL INQUIRY 60 (2017).

[66] Uri Gneezy & Aldo Rustichini, *A Fine is a Price*, 29 J. LEGAL STUD. 1, 2 (2000) (arguing that liability can crowd out social norms and lead to an increase in the condoned behavior). But see C. Metcalf, E. Satterwaite, J. Dillbary and B. Stoddard, *Is Fine Still a Price? Replication as Robustness in Empirical Legal Studies*, 63 INTL. REV. LAW& ECON. 1 (2020) (finding that theory may have limited applicability).

[67] See e.g. B. Deffains & C. Fluet, Legal Liability when Individuals have Moral Concerns, 29 *Journal of Law, Economics & Organization* 930 (2013) (using theoretical treatment and finding crowding out of moral concerns with perfectly enforced tort liability). It is important to note that our particular experiments allow us to test this theory only in the context of harms to property—not tortious physical harm to individuals.

[68] Here, it is important to note that in a tortfest dynamic, when the social benefit of the action changes from negative to positive, there may also be a corresponding effect on fairness perception: as more actors join in a "harmful" activity, the action may be perceived as more morally acceptable. For similar arguments related to potential expressive role for law, social norms see *supra* note 67 and accompanying text.

tort liability decreases with the number of tortfeasors (as liability is shared by all), a tortfest may also erode the psychological costs associated with the tortious activity when the activity is conducted by many.

We test these competing hypotheses by comparing willingness to act across the liability treatments and by examining the fairness ratings in the post-experiment questionnaire.

We recognize that under the No-Liability regimes, the actors (i.e., Type-X subjects in the Context-Free treatments and the Factories in the Vignettes) may incur a moral (or psychological) cost if they decide to act, as acting imposes an uncompensated loss on the innocent subject (the Type-Y subject and Owner).[69] Accordingly, a few observations regarding the No-Liability treatments are in place. First, we expect that the psychic cost would be highest when an actor decides to act alone, since that actor would be the sole reason for the harm. Consequently, the psychological cost may decrease with the number of actors as moral responsibility is shared. A large number of tortfeasors may also imply that the activity is more socially acceptable and thus, by definition, less morally costly. Third, the monetary benefits may simply outweigh any psychological costs. We expect that subjective psychological costs would not be especially high in our experimental setting, but subjects who have particularly strong moral intuitions may still decline to act because of these psychological costs.[70]

In the Liability regimes, there is no dominant strategy in terms of expected monetary payoffs. With only one or two subjects acting, each is better off not acting, but with two or more subjects acting together, each is better off acting.[71] There are therefore two possible pure strategy Nash equilibria: no subjects choose to act or all four subjects choose to act. Subjects' unconditional choices reflect their beliefs about the degree of implicit cooperation (trust or belief) with the shared liability rule in place. The Strategy Method allows us to observe subjects' conditional strategies and test for the impact of the shared liability regime directly.

D. The Pilot

[69] *Id.*

[70] To illustrate, consider a no liability session in which each of the four Type-X subjects, X1–X4, must decide whether to act for a gain of 35 tokens or refrain from acting and gain only 24 tokens. Suppose that, due to moral preferences, the psychological cost from engaging in an activity that inflicts harm on another (the Type-Y subject) is 4, 8, 16, and 20 tokens respectively. This means that the net gain from the activity for each respectively is \$31 (35-4), \$27 (35-8), \$19 (35-16), and \$15 (35-20). In such a case, X1 (who values acting at 31 tokens) and X2 (who values acting at 27 tokens) would act, but X3 and X4 would not (19, 15, 15<24).

[71] *See supra* Part II (analyzing the incentive scheme in Example 1 under a liability regime).

Prior to running the full range of treatments, we conducted a pilot that allowed us to test the procedures and basic design of the experiments. Below we report briefly on the main results from the pilot sessions.

Sixty-four subjects participated in the pilot, which involved two Context-Free-Liability (CF-L) sessions and two Context-Free-No-Liability (CF-NL) sessions, each with 7 rounds. These treatments differed from the treatments used in primary analysis (reported in Part E below), in that groups had only four members: three Type-X subjects and one Type-Y subject. A limitation of the pilot results is that the smaller group size and payoff incentives, combined with the use of the Strategy Method, created a dominant strategy for unconditional action in the liability treatment (discussed in Appendix I). The treatments in the full experiment were modified to increase the number of Type-X subjects (from 3 to 4) and adjust the monetary payoffs to avoid the creation of a dominant strategy in the liability treatment. Despite (and even because of) this limitation in the pilot, the results are still of interest.

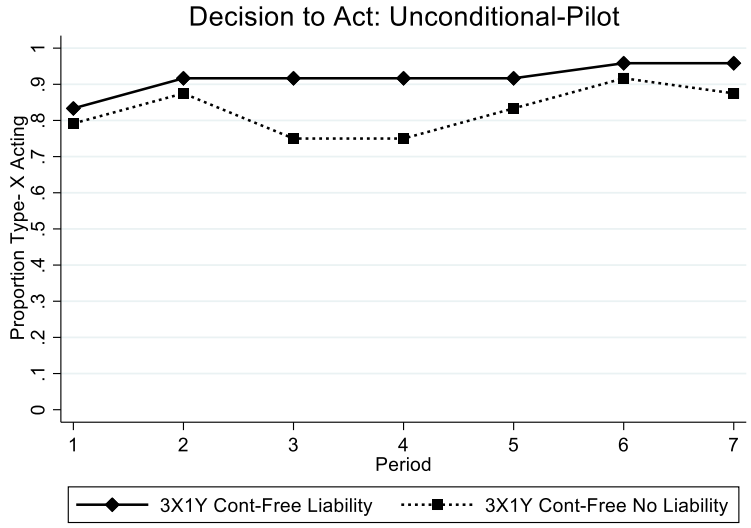

Figure 1: Average Unconditional Decisions by Liability Treatment in Pilot

Although a detailed analysis of the pilot session is reported in Appendix I, it is worth noting here two results from the pilot sessions. For each treatment, Figure 1 above shows the average unconditional decisions to act in each of the seven rounds. The vertical axis is the proportion of Type-X subjects who chose to act in a particular round. The horizontal axis is the round number. Notice that in every round the proportion of Type-X subjects choosing to act is *higher* in the CF-L (liability) regime than in the CF-NL (no liability) regime. In the CF-NL treatment, subjects were also much less willing to act alone than when joined by one or two others. These results are surprising given that the dominant strategy to act in CF-NL, was clearer than the dominant strategy to act in CF-L. The result

may indicate Type-X subjects' other-regarding preferences,[72] such as kindness or guilt for the Type-Y subject who was left with zero tokens when one Type-X subject acted in CF-NL. The results are also consistent with the prediction that under the no liability regime, an actor will be less inclined to engage in a tortious activity by herself but more inclined to do so with others. While not as consistent in the main treatments, we find similar evidence when the unconditional dominant strategy to act is removed.

E. The Full Experiment

The full experiment involved 200 subjects. We conducted three independent sessions for each of our treatments: the Context-Free treatment with no liability (CF-NL) and liability (CF-L) and the vignette (factories) with no liability (V-NL) and liability (V-L). As with the pilot, each session involved seven rounds with randomly re-matched subjects for each round. A summary of the experiments is shown in Table 3 below.[73]

Treatment	Group Composition	Tort Liability	Sessions	Subjects
Context-Free Liability (CF-L)	4 Type-X 1 Type-Y	Liability	3	45
Context-Free No Liability (CF-NL)	4 Type-X 1 Type-Y	None	3	45
Vignette Liability (V-L)	4 Factories 1 Owner	Liability	3	50
Vignette No Liability (V-NL)	4 Factories 1 Owner	None	3	60

Table 3: Summary of Experiments

The summary statistics across sessions and rounds for the full range of treatments are shown in Table 4 below. We begin by comparing liability regimes (Liability versus No Liability) in the Context-Free treatments, followed by an analysis of the Vignette (contextualized) treatments.

[72] *See infra* notes 106–107 and accompanying text.
[73] The average earning per subject was $18.20 per session.

	Con-Free Liab. N=36	Con-Free No Liab. N=36	Vignette Liab. N=40	Vignette No Liab. N=48
Unconditional Decision to Act	**68.25%** (37.11%)	**81.75%** (27.87%)	**85.36%** (27.92%)	**91.67%** (11.35%)
Conditional Decision to Act upon:				
0 other Type-X/Factory acting (0X)	**15.08%** (28.76%)	**48.81%** (41.74%)	**12.50%** (30.03%)	**62.20%** (45.22%)
1 other Type-X/Factory acting (1X)	**29.76%** (42.29%)	**79.76%** (32.46%)	**23.57%** (38.35%)	**91.07%** (20.55)
2 other Type-X/Factory acting (2X)	**92.06%** (15.06%)	**87.70%** (24.66%)	**86.79%** (27.14%)	**86.90%** (27.46%)
3 other Type-X/Factory acting (3X)	**96.42%** (11.00%)	**88.89%** (22.16%)	**94.64%** (16.71%)	**87.80%** (27.17%)

Table 4: Descriptive Statistics-Across All Rounds[74]

1. The Context-Free Treatment: Tort Liability and Deterrence

The first hypothesis we seek to test with our experiments relates to the deterrent effect of tort law in cases involving group causation where liability is diluted as the number of liable tortfeasors increases.

(i) Unconditional Decisions to Act. We begin by examining the unconditional decisions to act. On average, a smaller proportion of Type-X subjects chose to act under the Liability regime compared to No Liability (68.25% versus 81.75% in the Context-Free treatment). This can be seen below in Figure 2 (showing averages across rounds in the Context-Free treatment). However, these apparent differences are not statistically significant.[75] This result provides some support for our general hypothesis. The possibility that shared liability may dilute the costs of action appears to *weaken* the deterrent effect of tort liability to the point that its effect is statistically indistinguishable from willingness to act under a No Liability regime.

[74] Proportion of subjects (*i.e.*, Type-Xs in the Context-Free treatments and factories in the Vignettes) who decided to act, averaged across all seven rounds. Values in parentheses are standard deviations across actors' (Type-X subjects and Factories) average decisions to act. The difference in sample sizes for each treatment in Table 3 and Table 4 is the number of innocent (non-actors) parties (Type-Y subjects and Owners) (40) in the experiment.

[75] Using non-parametric Wilcoxon Ranksum tests, we reject the hypothesis that more subjects choose to act when they do not face liability (*p-value*=0.1456, n=72).

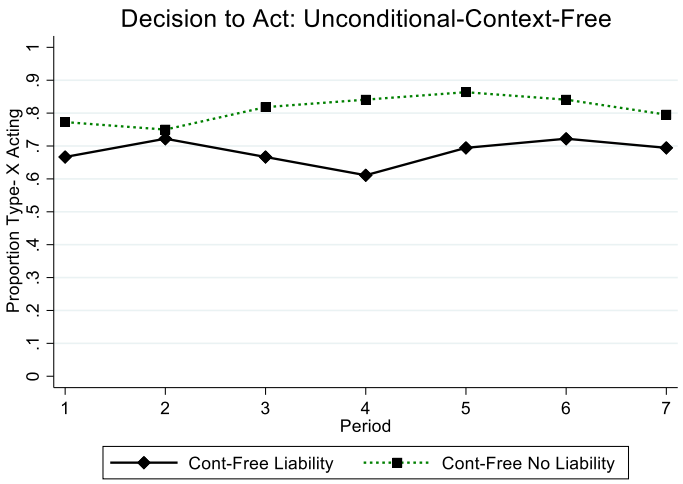

Figure 2: Average Unconditional Decisions to Act by Round

Formal regression analysis allows us to take advantage of the panel nature of the data (i.e., multiple subjects each made decisions whether or not to act in seven rounds). We use a multi-level logit panel regression to examine the likelihood a Type-X subject chooses to act (0 or 1). The primary independent variable is a dummy variable that captures the effect of liability introduced in the CF-L treatment relative to the omitted CF-NL treatment.[76] Table 5 reports our logit regression coefficients as odds ratios for unconditional decisions (Model 1) and for the various conditional decisions (Models 2-5). An odds ratio for CF-L is defined as the probability a subject in CF-L acts divided by the probability a subject in CF-NL acts. Thus, when the odds ratio is less than 1, the likelihood of acting when subject to Liability is relatively less than the likelihood of acting under No Liability. Conversely, an odds ratio greater than 1 would indicate that actors are more likely to act under Liability than under No Liability.

Independent Variables	**Model 1 Uncond Odds Ratio**	**Model 2 Cond-0X Odds Ratio**	**Model 3 Cond-1X Odds Ratio**	**Model 4 Cond-2X Odds Ratio**	**Model 5 Cond-3X Odds Ratio**
N-FL Dummy	0.25* *p*=0.066	0.01*** *p*<0.001	<0.01*** *p*<0.001	1.41 *p*=0.685	6.01 *p*=0.160

Table 5: Mixed-Effects Logit Regression—Context-Free Treatment Comparisons[77]

Starting with the unconditional decision to act, the coefficient for the CF-L dummy variable in Model 1 is less than 1 but only weakly significant at the 10%

[76] The multi-level regression also controls for statistical dependence at the session and individual level. *See* Appendix II for further details.
[77] The full regression models are reported in Appendix II.

level (*p-value*=0.066). This implies that actors are less likely to act unconditionally under a Liability regime (compared to No Liability), although this evidence of a deterrent effect is not highly significant.

(ii) Conditional Decisions to Act. Turning to conditional willingness to act, under a No Liability regime, subjects are more likely to act (compared with when they face liability) when they act *alone* (48.81% versus 15.08%) or with only *one* other (79.76% versus 29.76%). These differences in percentages of subjects acting are highly statistically significant.[78] This behavior is consistent with the theory. When facing liability, acting alone or with another is a losing strategy: it yields fewer benefits ($11 and $23 respectively) compared to not acting ($24). As predicted by the theory, tort liability deters in these circumstances.

By contrast, with a group of three or more actors—that is, when acting yields monetary gains under liability—the proportion of Type-X subjects who were willing to engage in the tortious activity was actually higher with Liability than with No Liability (92.06% versus 87.70% for X2 and 96.42% versus 88.89% for X3). While these differences across liability regimes are not statistically significant, the results show that once joined by enough actors, the dilution of liability renders any deterrent effect of tort law indistinguishable from a regime with No Liability.[79] An examination of the odds ratios in Table 5 provides additional support: conditional on two or three others, the odds ratio estimates switch from being less than 1 to being greater than 1—indicating that more actors are likely to behave tortiously under a Liability regime (although, again, this effect is not statistically significant).[80]

The results are consistent with our first hypothesis—that group causation theories *erode* the deterrent effect of liability regimes. They are also consistent with the tortfest dynamic we observe (discussed in the next section). As the number of actors increases, liability is further diluted, the individual monetary benefits increase, and, consequently, more are willing to engage in the tortious behavior. In the Context-Free-Liability (CF-L) treatment, conditional on two others acting (when acting becomes profitable), liability loses its deterrent effect.

[78] Using non-parametric Wilcoxon Ranksum tests, differences in willingness to act with Liability vs. No Liability conditional on 0 others and 1 other are statistically significant (each comparison *p-value*<0.001, n=72). Regression analysis also supports this conclusion as the CF-L coefficients in Models 2 and 3 of Table 5 are less than one and highly significant (*p-values*<0.001 in both comparisons).

[79] Using non-parametric Wilcoxon Ranksum tests, the difference in willingness to act with Liability vs. No Liability is not statistically significant conditional on 2 others and is weakly significant conditional on 3 others (*p-value*=0.931 conditional on 2 others acting & *p-value*=0.105 conditional on 3 others, n=72). However, multi-level panel regressions find treatment differences are not statistically different for both comparisons. The coefficients in Models 3 & 4 of Table 5 are greater than one but not statistically significant (*p-value*=0.685 conditional on 2 others acting; *p-value*=0.160 conditional on 3 others acting).

[80] The individual odds ratio estimates are not statistically different from 1 due to large standard errors. P-values are found in Table 5 for the individual estimates. The lack of significance here only illustrates the *absence* of a deterrent effect for tort law at these higher participation levels.

Conditional on three others acting, as the gain increases, our point estimates indicate actors may be even more likely to engage in the tortious behavior compared to a no liability regime. This may seem odd at first. But a number of reasons could support the pattern. First, under a Liability regime, the victim is compensated. Actors may thus experience a reduction in their moral cost compared to No Liability. Second, as we show below, we observe that fairness ratings levels increase with the number of tortfeasors, thus suggesting another decrease in non-pecuniary costs. Third, the increase in the number of actors increases the individual monetary payoff of each actor. Finally, as the individual payoffs become positive, so do the net social gains. Thus, actors may be able to view their actions and the ensuing harm to the compensated victim as necessary for the greater good.

2. Context-FreeTreatment: Tortfest and Causation

i. Tortfest

Our second and third hypotheses relate to the potential for tort law itself to induce multiple subjects to join in the tort—the tortfest dynamic. In part, this dynamic arises because but-for causation is operative, even though, according to tort law jurisprudence and scholarship, it does not function in concurring causes cases.[81]

By analyzing the conditional decisions made in the Strategy Method, we provide support for the tortfest dynamic. Table 4 shows that the proportion of subjects willing to commit a tort under Liability (averaged across all decision rounds) *increases* as the number of others committing the tort increases. Conditional on zero and one other Type-X subject committing a tort, the proportion of Type-X subjects choosing to act increases from 15.08% to 29.76%. While this is higher than the theoretical prediction of 0%, the Tortfest and but-for predictions are extremely stark when examining the increase in willingness to commit a tort conditional on two and three others also committing the tort: 92.06% and 96.42% respectively. It is clear that subjects understand the incentives created by the liability regime and would like to engage in group "wrongdoing" if a large enough number of participants join them.

The right graph in Figure 3 below shows that under the Liability treatments, we observe a monotonic increase in the average proportion of Type-X actors as we move from decisions conditional on zero to one, two, and three other Type-X subjects participating. *Each* of these jumps in Type-X's conditional willingness to participate is statistically significant.[82]

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[81] *See supra* notes 4 and 9–10, and Part II.B.

[82] Using non-parametric Wilcoxon signed rank tests, each of these jumps in Type-X's conditional willingness to participate is statistically significant (comparing average conditional willingness to act across all rounds, 15.08% to 29.76% p=0.022, to 92.06% p<0.001, and to 96.42% p=0.055, n=36). Panel regression analysis comparing individuals' conditional decisions in all decision rounds controlling for individual-level and session-level dependencies is not possible. An alternative robustness check is discussed in Appendix II.

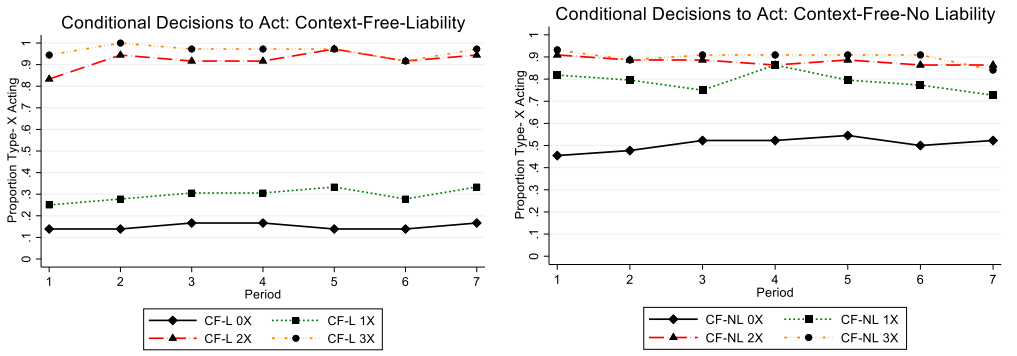

Figure 3: Conditional Decisions to Act under Liability and No-Liability Treatments by Round

In the treatments with No Liability (the right graph in Figure 3 above), we see a different pattern. We still observe a similar increase in conditional willingness to participate in tortious activity as the number of participants grows: from 48.81% (conditional on no one else acting) to 79.76% (conditional on another acting), rising to 87.70% (conditional on two others acting), and to 88.89% (conditional on three others acting). However, unlike the Liability treatment, the largest, statistically significant jump is between willingness to act conditional on no one else acting (that is, 0X) and willingness to act conditional on one other person acting (1X). The differences in willingness to act after that (that is, between 1X, 2X, and 3X) are smaller and not consistently significant.[83]

Although Type-Xs are clearly reluctant to act alone, even without facing liability, this hesitation generally disappears once they are joined by even one other Type-X. From that point on, the participation of additional Type-Xs is not systematically influential in the same way we see under the Liability regime. In particular, in the Liability treatment there is a marked difference in the effect of an additional tortfeasor when moving from 1X to 2X. Under shared liability, as the tortfest theory predicts, the increase in the number of actors also systematically increases willingness to participate for Type-X. These differences from No Liability provide strong support for the tortfest effect.

ii. But-For Causation

We also find strong evidence suggesting that the but-for test can operate in cases involving group causation such as concurrent causes, thus supporting our third hypothesis. Under the Liability regime, we observe how but-for causation influences the results by examining the Type-Xs' conditional decisions. As

[83] Using non-parametric Wilcoxon signed rank tests comparing average conditional willingness to act across all rounds, the increase in Type-X's conditional willingness to participate is statistically significant between conditional on 0X and 1X (p<0.001, n=36). The further increase between conditional on 1X and 2X is weakly significant (79.76% to 87.70% p=0.089), and the increase between conditional on 2X and 3X is not significant (87.70% to 92.06% p<0.646, n=36). An alternative robustness check is discussed in Appendix II.

discussed above and shown in Figure 3, in general Type-X subjects are unwilling to act unless joined by at least two others. Below this threshold, at most 30% of Type-Xs would act on average. This is consistent with the theoretical prediction discussed in Part II above. With only one or two Type-X subjects acting, we observe very little willingness to act. But with two or more Type-X subjects participating, actors seem to be eager to join the tortfest because of the dilution of liability. Graphically, the left graph in Figure 3 above illustrates the but-for dynamic, by creating a clear, very large and statistically significant jump from acting conditional upon one other subject acting as well (X1) to acting conditionally upon two other subjects acting (X2)—more than 62% increase in willingness to act (from 29.76% to 92.06%). We observe the same, equally strong effect in the Vignette and the pilot.

The increased willingness to act conditional on two or three others acting together is consistent with the financial incentive effect for a tortfest created by shared liability. This effect and our results provide additional evidence that a tortfest would not develop *but for* participation by others. The increased willingness to join conditional on two or three others may also reflect a *decrease* in psychological (non-pecuniary) costs. For example, participants may believe that a larger number of tortfeasors indicates less moral culpability from acting. In such a case, one would expect that more actors would be willing to gradually join the tortfest as the number of actors increases. We indeed find strong evidence for this fairness hypothesis (discussed below).

The importance of but-for causation in our results is clear. The number of Type-X actors who are willing to participate unconditionally in the tortious act depends critically on their expectations about what others will choose. The relatively high proportion of Type-X who act unconditionally under the liability regimes (68.25% in CF-L and 85.36% in V-L) reflects actors' general belief that they will in fact be joined by others. But-for the belief that a third or a fourth person will also engage in the tortious activity, their conditional decisions indicate they would not act, and the harm to the Type-Y would not occur.

3. Context: Re-examining Tortfest and Deterrence

The fourth hypothesis relates to the way the context of the tort setting interacts with tortfests and deterrence. To test the effect of context, we compare decisions to act in the Neutral Frame to the Factory Vignette. We predict that the willingness to commit the tort will be *higher* in the Factory Vignette than in the Context-Free Frame, as the Factory Vignette makes the social benefit from the tort (producing cement) more salient compared to the context-free frame.[84]

(i) Unconditional Decisions to Act. Table 4 above reports that unconditional average proportions of willingness to act are higher in the Vignettes than in the Context-Free treatments. This is true under Liability (V-L 85.36%

[84] Alekseev et al., *supra* note **Error! Bookmark not defined.**(examining the effect of contextualized instructions in economic experiments); Raymond & Cason, *supra* note **Error! Bookmark not defined.** (same).

versus CF-L 68.25%) and under No Liability (V-NL 91.67% versus CF-NL 81.75%). In other words, *regardless* of the liability regime, more actors are willing to unconditionally commit a tort in the contextualized treatment.

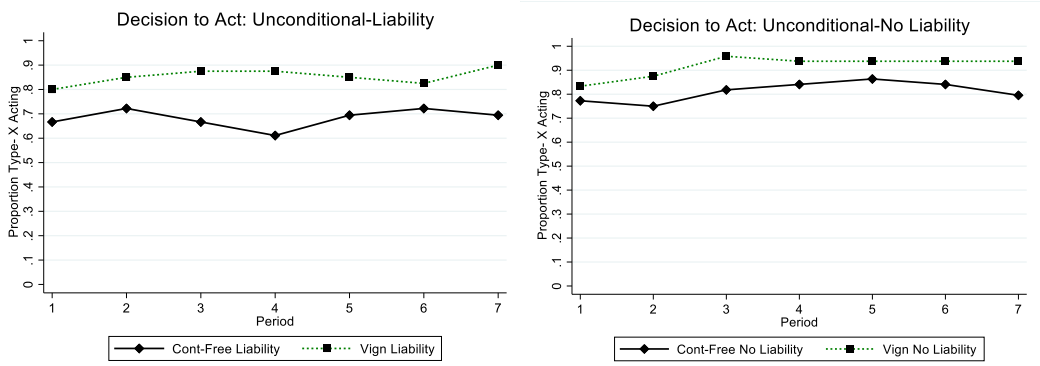

Figure 4: Unconditional Decisions to Act across Liability Regimes: Vignette vs. Context-Free Framings

The differences are also clearly observed in Figure 4 above, which displays the proportion of subjects (Type-Xs and Factories) acting unconditionally in each round. The left graph of Figure 4 displays the data for acting unconditionally in the Liability treatments (CF-L and V-L). The right graph is corresponding data for the No Liability treatments (CF-NL and V-NL). It is easy to see that the proportion of subjects (Type-Xs and Factories) acting is higher in the Vignette treatments for both liability treatments in every round. This contextual difference is highly statistically significant with Liability and weakly significant with No Liability.[85]

Recall that the first hypothesis predicts reduced deterrence of tort law as a result of imposing liability on multiple actors, which at some point may even lead to higher participation in tortious activity than when actors face no liability. The results from our contextualized unconditional decisions support this reduced deterrence effect. The average proportion of subjects acting unconditionally in V-L (85.36%) is not significantly different than the average proportion in V-NL (91.67%).[86] The finding that liability does not significantly influence unconditional willingness to act is robust across both our non-parametric tests and regression results in the Vignette setting. If anything, context appears to strengthen this "reduced-deterrence" effect.

[85] Non-parametric ranksum tests report that the median difference in willingness to act across contextualized instructions is significant with Liability (*p-value*=0.025, n=76) but not with No Liability (*p-value*=0.262, n=84). However, formal multilevel logit regression analysis reported in Models 6 & 7 of Table 6 finds that differences between Neutral and Vignette treatments are significant at the 1% level with Liability (Model 6, $p = 0.008$) and at the 10% level with No Liability (Model 7, $p = 0.075$).

[86] This is verified in a non-parametric ranksum test (*p-value*=0.934, n=88) and multilevel logit regression analysis reported in Model 8 of Table 6 (*p-value*=0.453).

Independent Variables	Model 6 Uncond Odds Ratio	Model 7 Uncond Odds Ratio	Model 8 Uncond Odds Ratio
V-L Dummy	8.78*** *p*=0.008	----	0.65 *p*=0.453
V-NL Dummy	----	2.54* *p*=0.075	----

Table 6: Mixed-Effects Logit Regression-Contextual Treatment Comparisons[87]

(ii) Conditional Decisions to Act. Hypotheses two and three concern the tortfest dynamic and but-for causation. We examine the effect of the more realistic context in our vignettes on these hypotheses by again looking to the conditional decisions subjects made using the Strategy Method.

We begin by comparing conditional decisions with Liability under the Vignette and Context-Free treatments (i.e., CF-L v. V-L). Our results here appear to be robust to context. The average proportions in Table 4 for CF-L and V-L are all very similar and not statistically different: conditional on zero others (15.08% versus 12.50%); conditional on one (29.76% versus 23.57%); conditional on two (92.06% versus 86.79%); and conditional on three (96.42% versus 94.64%).[88] These results are confirmed by regression analysis reported in Table 7 below. The omitted dummy variable in each Model is a variable for CF-L. While the odds ratios are all less than 1, indicating a lower likelihood of acting in the V-L condition relative to the Context-Free Frame, these differences are nowhere near statistical significance. These results are reassuring, in that they suggest the tortfest dynamic and but-for causation effects under Liability are robust to presentation in a more realistic context. At the level of conditional decisions, the more realistic Vignette treatment does not appear to lead to individuals being more willing to act, as we hypothesized. However, the statistically significant difference in unconditional willingness to act in the Liability treatment perhaps suggests it is easier for actors (*i.e.*, subjects assignged as Type-X or Facotries) to implicitly predict others' participation in the tortfest that leads to their own higher willingness to act.

[87] The full regression models are reported in Appendix II.

[88] Non-parametric ranksum tests (n=88) and multilevel panel logit regressions reported in Models 9–12 of Table 7 confirm that the differences between conditional decisions in Context-Free and Vignette treatments with Liability are not statistically significant (*p-values*>0.54 for each comparison).

Independent Variables	Model 9 Cond-0X Odds Ratio	Model 10 Cond-1X Odds Ratio	Model 11 Cond-2X Odds Ratio	Model 12 Cond-3X Odds Ratio
V-FL Dummy	0.81 *p*=0.850	0.52 *p*=0.632	0.60 *p*=0.547	0.74 *p*=0.815

Table 7: Mixed-Effects Logit Regression- Liability Contextual Treatment Comparisons[89]

In addition to testing the impact of context within the Liability treatment, we also assess the robustness our tortfest dynamic and but-for causation results across liability treatments (e.g. V-L v. V-NL). Figure 5 below visually confirms that the same patterns observed in conditional decision-making in the Context-Free treatments (in Figure 3 above) are also present in the more realistic Vignette treatments. The left graph of Figure 5 illustrates the tortfest dynamic in V-L, with a substantial and highly significant increase between acting conditional on one other to conditional on two others acting.[90]

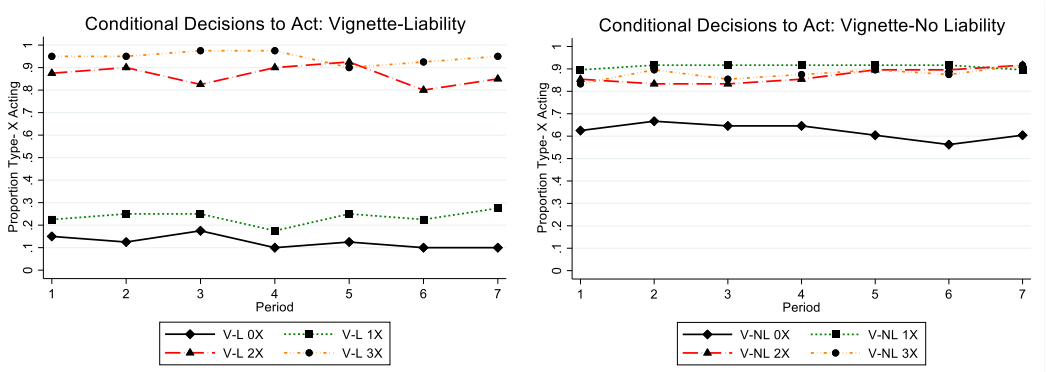

Figure 5: Average Conditional Decisions to Act in Vignette: Liability vs. No Liability by Round

The right graph of Figure 5 illustrates the proportion of Factories acting conditional on others acting under a No Liability regime. Again, as in CF-NL, in V-NL there is a significant increase in willingness to act between acting alone and acting conditional on one other joining the activity (0X to 1X).[91] In other words, it appears that in the Contextualized No Liability regime a significant proportion of subjects are reluctant to act on their own to secure a gain at another's cost.

[89] The full regression models are reported in Appendix II.
[90] Comparing average conditional willingness to act across all rounds, Wilcoxon signed rank, *p-value*<0.001, n=40). An additional robustness check is examined in Appendix II.
[91] Comparing average conditional willingness to act across all rounds, Wilcoxon signed rank, *p-value*<0.001, n=48). An additional robustness check is examined in Appendix II.

However, once joined by at least one other person, subjects are much more willing to commit the tort. Willingness to act alone is *higher* in the Vignette Frame than the corresponding figure in the Context-Free Frame (V-NL to CF-NL conditional 0X), which perhaps suggests that the benefits are more salient in the Contextualized Frame.[92]

4. Tort Liability and Fairness

Our final hypotheses relate to the way in which tort liability interacts with the perceived fairness of an individual's decision to act. Our experimental design allows us to examine the ways in which the private costs and benefits of actors (*i.e.*, the Type-X subjects in the Conext-Free Frame and the Factories in the Vignettes) are balanced against fairness concerns for the pontential victim (i.e., the Type-Y subject and the Owner). We do so by comparing unconditional and conditional decisions to act across our liability conditions. We also use subjects' responses to the fairness questions. We hypothesize that tort liability can potentially blunt fairness concerns and may even create a tortfest dynamic in fairness perceptions, rather than signaling moral culpability.

It is unclear *ex ante* how a liability regime may interact with subjects' concerns about fairness.[93] Prior studies suggest that there may be a "norm activation" impact that helps deter activity that imposes harms on others[94] or a deterrence aspect that arises through an expressive function of tort liability in declaring and denouncing behavior from a social perspective.[95] However, a more general literature supports an alternative: that subjects may treat the liability obligation as the "price" to engage in the activity. Under this view, liability more readily allows actors to weigh the "cost" of acting against their own private benefits from acting.[96] In the case of shared liability and the potential for a tortfest dynamic, an additional possibility is that as more individuals join the tortfest, it may be perceived as less harmful and more socially acceptable. The existence of the liability rule may help to focus subjects' attention on the shared benefits and costs of the group and lower psychological costs that may be associated with distributive aspects of the activity.[97]

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[92] Comparing average conditional willingness to act conditional 0X across all rounds, Wilcoxon signed rank, *p-value*=0.104, n=84.

[93] For discussion and empirical results in the breach of contract setting, *see* Tess Wilkinson-Ryan, *Incentives to Breach*, 17 AM. L. & ECON. REV. 290 (2015).

[94] *See* Eisenberg & Engel*, Unpacking Negligence Liability, supra* note 44 and accompanying text.

[95] *Ibid.*

[96] *See, e.g.*, Uri Gneezy, Stephan Meier & Pedro Rey-Biel, *When and Why Incentives (Don't) Work to Modify Behavior*, 25 J. ECON. PERSPECTIVES 191 (2011); Gneezy & Rustichini, *supra* note 66, Deffains & Fluet, *supra* note 67.

[97] A large literature confirms that subjects often depart from behavior predicted by self-interested monetary payoffs in experimental settings and, instead, appear to behave in ways consistent with a degree of regard for the welfare of others and an aversion to inequality. *See, e.g.*, Gary Charness & Matthew Rabin, *Understanding Social Preferences with Simple Tests*, 117 Q.J. ECON. 817 (2002).

i. Observed Behavior

One of the first points to note from our experimental results is that subjects are generally reluctant to act at the expense of an innocent victim if they are the only Type-X to benefit from the activity. This is perhaps most evident in the average conditional willingness to act in the scenario with No Liability, reported in Table 4 above. In the Context-Free Frame, only 48% of Type-X subjects indicate willingness to act alone, although the monetary payoff is significant (35 tokens versus 24). In the Vignette Frame, more subjects (Factories) are willing to act alone, but 37.8% of subjects would not act unless accompanied by others, even though acting under a No Liability regime promises a gain at no (monetary) costs.

However, once subjects are no longer acting alone, the pattern across liability treatments begins to diverge. In the No Liability regime, Type-X individuals are much more willing to act to gain the benefit at Type-Y's expense. Conditional on one actor joining, the willingness to commit a tort jumps to 79% in the Context-Free Frame and 91% in the Vignette. These proportions are far higher than in the treatments where Type-Xs face liability: conditional on one other acting, 29% are willing to act in the Context-Free Frame with liability and 23% in the Vignette.[98] These differences are strongly statistically significant.[99]

However, once two other subjects are acting, the proportions of those who are willing to act on average converge across liability treatments. In the Context-Free Frame, 92% act with liability versus 87% without liability. In the Vignette Frame, the corresponding proportions are 87% for both treatments. There is no statistically significant difference across liability regimes once three actors are involved. Interestingly, conditional on three actors joining, the share of actors willing to act becomes higher in the Liability regime, rising in the CF-L to 96% (compared to 88% in the CF-NL) and in the V-L 94% (compared to 87% in the V-NL).[100] By contrast, there is virtually no change in the no-liability conditions (88.89% in the CF-NL compared to 87.80% in V-NL).

These differences at the higher levels of expected actors' participation imply that tort liability may be incentivizing participation in the harmful activity by (1) reducing the monetary cost to the actors and also (2) by mitigating fairness concerns. Behavior in the No Liability treatments appears consistent with subjects generally being willing to act for private gain with a loss to the victim—so long as they are not solely responsible. However, actors seem perhaps less willing to participate in some situations where they benefit and only another is harmed than in the case where liability provides compensation to the victim. The provision of compensation to the victim potentially helps the actors to focus on the collective

[98] *See supra* Table 4.

[99] Testing for equivalence across liability treatments in the Neutral Frame, we reject with $P<0.0001$, $n=72$, and in the Vignette Frame $P<0.0001$, $n=88$.

[100] While the higher average willingness to act in the Liability treatments is not generally significant, the results approach it in the Neutral Frame. Testing for equivalence between N-FL and N-NL conditional on the others acting can be rejected but only weakly as $P=0.1050$, $n=72$.

benefits and dilutes moral culpability from acting as more participants join in the tort.

ii. Fairness Attitudes

These intuitions appear to be consistent with results from the fairness questions. In this set of questions administered following the seven rounds of the experiment in each session, we asked subjects to rate the fairness when one, two, three, and four actors act. Subjects were asked to assess overall fairness and also asked to assess the fairness to the those who acted, the victim, and for all subjects (that is, the four Type-Xs and the Type-Y in the Contect-Free Frame and the four Factories and Owner in the Vigenette). We used a scale from zero to five, with five being "completely fair." We can assess fairness both within and across liability treatments.

Figure 6: Response to Fairness Questions: Fairness to Actors, Victim, and to the Entire Group

Figure 6 displays the average fairness rating to the actors (Type X subjects and Factories), the victim (Type-Y subject and the Owner), and the entire group. Within each of the three graphs, there are average fairness points for each possible scenario: one subject acting, two subjects, three subjects, and all four subjects in the group acting. In order to increase the statistical power of the questionnaire, data is pooled by liability regime. For instance, the blue line in each graph of Figure 6 illustrates the trend of average fairness ratings for subjects in CF-NL and V-NL together. Importantly, these average fairness ratings only contain responses from subjects assigned as actors, as we are particularly interested in the responses of subjects who made the decision whether or not to act.

The top-left graph in Figure 6 displays the average fairness rating to the actors. With No Liability, the fairness ratings are relatively stable as the number of actors increases. By contrast, with Liability there is a clear upward trend. Comparing fairness with one acting to fairness with four acting, the difference is statistically significant at the 5% level (non-parametric signed rank, *p-value*-=0.028, n=6).[101] The trend is so pronounced that, while the average fairness rating when one subject acting is significantly higher with No Liability, when four subjects acting average fairness ratings are significantly higher with Liability (non-parametric ranksum, *p-value*=0.025 and 0.005, respectively, n=12). This marked rise in the perceived fairness of the activity under the Liability regime is consistent with tort liability acting to facilitate rather than deter the activity, by lowering the psychological costs that may be associated with acting alone to cause harm or benefiting at the expense of a single victim.

The top-right graph in Figure 6 displays the average fairness rating to the victim. The clearest observation from Figure 6 is the large differences between the liability regimes in every scenario. Comparing average fairness ratings across liability regimes, fairness is higher with Liability than with No Liability and is significant in every case (non-parametric ranksum, *p-value*<0.004 in each case, n=12). Also note that, since 2.5 is the middle of the fairness rating range, actors always felt that acting was unfair to the victim with No Liability, regardless of the number of acting subjects. By contrast, liability works the other way: in the Liability regime, actors always felt (on average) that engaging in the harmful activity was fair to the victim. However, comparing the case with one subject acting to the case with four acting, the fairness ratings significantly increase with No Liability but not with Liability (non-parametric ranksum, *p-value*=0.046 and 0.600, respectively, n=12).

The bottom graph in Figure 6 displays the average fairness ratings to the entire group (e.g., Type-Xs and Type-Y)—a proxy for "society." Figure 6 presents a clear pattern of fairness ratings: In each liability regime, fairness increases as the number of actors increases (non-parametric signed rank, *p-value*=0.028 for each liability regime, n=6). The other apparent pattern is that, in every case, average fairness ratings are greater with Liability than with No Liability (non-parametric ranksum, *p-value*<=0.01 in each case).

To summarize, we observe the tortfest dynamic in the fairness ratings to the entire group—a result we did not expect. Although, there is a level effect when it comes to the liability regime, fairness ratings to the entire group are consistently and significantly higher with Liability than with No Liability. It is also interesting to point out that with No Liability fairness ratings to the entire group start out slightly unfair (2.33) and end in the fair portion of the scale (3.35).

[101] Recall that with Strangers Matching during the experiment, subjects were randomly re-matched with others in the same session. This leads to alternative approaches to control for such independence. Appendix II provides a discussion of these approaches.

5. Regression Results with Controls

In the previous sections we reported multilevel logit regression analysis examining treatment differences in individuals' decisions to act or not. In these regressions, the independent variables were treatment dummy variables and a time trend, which controlled for the round of the session in which the observations were generated. In addition to these regressions, we ran several models using additional demographic and other controls. These additional controls include (1) measures of subjects' risk proclivity, (2) the number of previous economics experiments subjects have participated in, (3) a male dummy variable, (4) a dummy variable for a subject with a business major, (5) a dummy variable for a subject who is white, (5) a dummy variable for a subject who self-reports to be a believer in any supernatural being, (6) dummy variables for whether a subject is a democrat or republican (independent is the omitted dummy), and (7) a subject's political party intensity (zero to five, five being very intense).[102] The regression models with these additional controls pooled individuals' observations across liability treatments and used dummies for contextualized instructions.[103] As mentioned in previous sections, we incorporate random effects at the individual and session levels. We also include a round variable to control for any time trend (e.g. learning). These regressions are reported in Appendix II of the paper.

Regarding the differences between Context-Free and Vignette treatments, the results reported earlier are qualitatively confirmed in regressions with these additional controls. We find a significantly higher likelihood to act unconditionally in Vignette treatments than in Context-Free treatments with both Liability and No Liability regimes. Decisions to act conditional on zero or one other actor are significantly more likely to occur in the Vignette treatment with No Liability. However, the Vignette treatment does not lead to statistically different likelihoods to act conditional on two or three other subjects acting. With Liability, the likelihood of acting does not change with the Vignette compared to the Context-Free instructions in any of the four conditional decisions.

Although we include a variety of controls, in general these are not systematically significant in our regressions. This is somewhat reassuring, as it suggests that our results are not driven by particular characteristics of our sample.

IV. CONCLUSION

The use of group causation theories (e.g., substantial factor, concerted action, and alternative liability) is *assumed* to deter potential injurers and prevent harm to victims. However, to date, the discourse regarding the deterrent effect of group causation theories has been based on intuition and conjecture. This discourse has not been attentive enough to the potential that liability will incentivize tortious activity. It also lacked the critical support that empirical

[102] Subjects could identify as male, female, transgender, or other.

[103] The individual data are panels, with seven observations for each individual subject for each round in the session.

evidence provides. In this article, we undertake to fill this gap by testing, for the first time, the effect of causation law on group wrongdoing. Using an incentivized experiment in a lab setting, we tested different liability regimes in both contextualized and neutral framings. Our analysis of over 1,200 data points from 200 subjects confirms that group causation doctrines, such as substantial factor and concerted action, can *encourage* rather than discourage actors to engage in tortious activities.

In the Liability regime, we observed a clear tortfest dynamic. In the Context-Free framing, the willingness to engage in the tortious activity increased with the number of tortfeasors from 15% (conditional upon acting alone), to 30% (conditional upon acting with another), to 92% (conditional upon acting with three others), to 96% (conditional upon acting with four others). We observe the same dynamic in the Contextualized framing: willingness to behave tortiously increased with the number of actors from 12% to 23% to 86% to 94%. These jumps were statistically significant at the 1% level. In sum, despite—in fact, *because of*—the imposition of liability, the tortious activity became more beneficial, and the pressure to join the activity grew stronger as more actors joined the activity.

An analysis of the unconditional decisions to act in the liability regimes reveals that actors were also willing to take a "leap of faith." Although acting tortiously was worthwhile only if an acting subject was joined by two others, the high willingness to act unconditionally—68% in the Context-Free framing and 85% in the Vignette—implies that actors believed or expected that others would choose to behave tortiously as well. The results also reveal that actors were more willing to behave tortiously, and unconditionally so, in the Vignette (the polluting factories)—than the Context-Free framing. One possible explanation is that in the contextualized framing, the costs to the victim and the benefits from the tortious activity are more salient. Consequently, actors may more easily see that they can reap a private gain and increase total welfare at a cost to a compensated victim. The result is similar to the one observed in a potential Pareto public-good experiments.

In addition to evidence of the financial incentives from a tortfest, our results show that tort law can also blunt fairness concerns about acting in a way that harms others. Under the liability regimes, participants experienced the analog to a tortfest in their perceptions of fairness to the group. Just like the willingness to engage in a tortious activity, the level of perceived fairness to the group increased monotonically with the number of acting subjects.[104] In other words,

[104] This is also apparent in the consistently high proportion of individuals who are conditionally *unwilling* to act alone to cause harm to our Type-Y subjects—even when they do *not* face liability. The social dimension to fairness perceptions is also apparent in our No Liability treatment. Fairness perceptions in this variant also increase as more participants join the harmful activity. This is important, since it suggests that there may even be potential for a synergistic effect: shared liability creates financial incentives for tortfests that may also transform perceptions of fairness.

participants viewed the tortfest as *more* fair as the number of tortfeasors increased.

Moreover, under both framings, more actors were willing to engage in the tortious activity under Liability as compared to No Liability, conditional on being a part of a group of four tortfeasors (96% versus 88% in the Context-Free frame and 94% versus 87% in the Vignettes). While some of the results are only weakly significant, they suggest that the imposition of liability did *not* discourage actors and may have even done the opposite. This result initially may seem counter-intuitive, but we offer a number of possible explanations. These include the fact that a liability regime may crowd out social norms and impose what may be perceived as a "price" that is discounted with the number of acting subjects. This discounted price may also suggest a low moral culpability. The tortious activity may even be justified by a "mob-mentality"—an "everyone-does-it" rationale. It could also be viewed as morally acceptable when the activity produces a product from which society benefits, notwithstanding the harm to the (compensated) individual victim.

We also find clear evidence in support of the applicability of the but-for test in the Liability regime. Very few actors chose to act by themselves or with another (15% and 29% in the Context-Free treatment and 12% and 23% in the Vignette). However, consistent with the theory, the willingness to engage in the tortious activity jumped significantly conditional on two others joining them—when the tortious activity became profitable—increasing to 92% in the Context-Free framing and 86% in the Vignette. This willingness reached a whopping 96% in the Context-Free framing and 94% in the Vignette group of four actors. The jump from acting with one other to acting with two others (29% versus 92% in the Context-Free frame and 23% versus 94% in the Vignette) is substantial and statistically significant at the 1% level. It supports the conclusion that, consistent with the theory, the large majority of subjects (63% in the Context-Free frame and 71% in the Vignette frame) would not engage in the tortious activity but for two or more joining them. Formal regression analysis supports these results.

Our study also makes a number of important contributions to the prior economic and empirical literature. Previous studies focused on the effect of liability on a single tortfeasor, but they could not observe decisions at the individual level. Previous studies also could not test how imposing liability on many actors impacts the members of the group. By contrast, our unique design allows us to directly test the effect of causation law in cases involving multiple actors. We are also able to observe individuals' decisions, including whether and to what extent they are dependent on the actions of others.

Still, a key question for any experimental study in a laboratory setting is how relevant it may be in the "real world."[105] Does our experimental study reflect

[105] A natural question when using laboratory experiments with student samples is, "does behavior observed in student samples generalize to the behavior of the population in general?" Smith argues that a major benefit of controlled experiments is their internal validity. See Smith, V. *Economics in the laboratory*, 8 J. OF ECON. PERSPECTIVES 113 (1994). However, Levitt and List question the

insights important in the practical world of tort law? While there are some features of our experimental design that may suggest caution in extending its findings, we believe that the basic incentive structure underlying our experiment potentially applies in numerous settings where causation law creates the potential for shared liability. One such common setting is medical malpractice cases where multiple actors (e.g., doctors and nurses performing a surgery using tools manufactured and produced by third parties) may be responsible for an indivisible harm to the victim. Other settings, more closely aligned with our experiment, could include environmental harms, such as decisions about whether or not to properly dispose of potential contaminants.

We end with a call for additional research. Many tort disputes involve personal injuries, not just injury to property, and accordingly some caution would be required in extending our results to the context of personal harms. This area would be an important future extension of our current experimental work. However, our experiment provides evidence that shared liability can support but-for causation and create incentives for tortfests that seriously weaken the disincentive effects of tort law.

external validity of experiments to settings in the field. Levitt, S.D. & List, J.A. (2007) *What do laboratory experiments measuring social preferences reveal about the real world?*, 21 J. OF ECON. PERSPECTIVES 153 (2007). In a highly cited working paper, Camerer critiques the arguments in Levitt and List. C. Camerer, C.F., *The promise and success of lab-field generalizability in experimental economics: A critical reply to Levitt and List*, HANDBOOK OF EXPERIMENTAL ECONOMIC METOHOLOGY (2015) (edited by G. Frechette and A. Schotter). For instance, while lab experiments may not extend to a particular field setting, they do further scientific knowledge by increasing understanding of the general way people respond to incentives captured in the lab. Numerous lab experiments find behavior consistent with that observed in the real world. *See e.g.*, Alm, J., Bloomquist, K.M., & McKee, M. (2015) *On the external validity of laboratory tax compliance experiments*, 53 ECONOMIC INQUIRY 1170 (2015) (finding that tax compliance behavior observed in the lab is similar to that observed in the real world).

Appendix I: Pilot Results

The pilot involved two CF-L sessions and two CF-NL sessions. Each session had seven rounds and sixteen subjects, for a total of sixty-four subjects (summarized in Table AI-1 below).

Treatment	Group Composition	Type-X Liability	Sessions	Subjects
Liability	3 Type-X 1 Type-Y	Liable	2	32
No Liability	3 Type-X 1 Type-Y	None	2	32

Table AI-1: Summary of the Three Pilot Sessions

As explained in Part III.D, a limitation of the pilot results is that the smaller group size and payoff incentives, combined with the use of the strategy method, created a dominant strategy for unconditional action in the Liability treatment. In the pilot's decision environment, the initial endowment from not acting was 18 tokens, and the return from acting was 30 tokens. As a result, each Type-X subject was better off acting conditional on at least one other Type-X subject acting (30-18/2>18).[106] Knowing that the other Type-X subjects had a dominant strategy to act conditional on one other Type-X subject acting, Type-X subjects also had a dominant strategy to act in their unconditional decision, even in the simultaneous decision environment.[107] As explained in detail above, the treatments in the full experiment were modified to avoid the creation of a dominant strategy in the liability treatment. However, this "limitation" turned out to be a benefit, since we were able to compare two liability regimes where actors had a dominant strategy to act.

While the pilot lacks sufficient power for conducting formal statistical tests, we can examine summary statistics and trends observed in these sessions to see if they are broadly consistent with our hypotheses.

Table AI-2 below reports the proportion of rounds where Type-X subjects chose to act, averaged across all seven rounds. The values in parentheses are the standard deviations of average proportions across Type-X subjects. The larger the

[106] With two Type-X subjects splitting equally the 18-token compensation to the Type-Y subject, each Type-X subject is promised a payoff of 21 tokens (30-18/2)—a higher payoff compared to the 18 tokens from not acting.

[107] To see why, and without limitation, consider X1's conditional response. If X1's action table indicated that she would not act under any circumstances, the Type-X subject will not act and thus expects a gain of $18. If X1's Action Table indicated that she would act if one other actor would, the activity will take place only if another Type-X subject acts. In such a case, X1 can expect 21 tokens, which is higher compared to not acting (21>18). Thus, X1's best strategy is to act conditional on one other acting. The same is true for all other Type-X subjects. Knowing this, all Type-X subjects would choose to act in their unconditional decision.

standard deviation, the more heterogeneity exists in the data. For instance, the second column reports the average proportion of rounds where a Type-X subject chose to act unconditionally. On average, subjects chose to act unconditionally in CF-L in over 90% of the rounds. While perhaps not surprising given the dominant strategy to act unconditionally, this result indicates that subjects understand and are responding to the incentive scheme. In comparison, subjects chose to act unconditionally in the CF-NL in over 80% of the rounds on average. The fact that subjects chose to act *less* often in CF-NL is surprising, given that acting when there is no liability is a clear dominant strategy—in fact, a much clearer dominant strategy than in CF-L. The results may indicate Type-X subjects' other-regarding preferences,[108] such as kindness or guilt for the Type-Y subject who was left with zero tokens when one Type-X subject acted. This is also supported by the average unconditional acting of the two treatments in Figure AI-1 (a reprint of Figure 1 above). The average proportion of subjects acting across all Type-X subjects is lower in all CF-NL rounds compared to CF-L rounds.

	Context-Free Liab. N=24	**Context-Free No Liab. N=24**
Unconditional Decision to Act	91.67% (23.04%)	82.74% (37.90%)
Conditional Decision to Act upon:		
0 Other Type-X acting (0X)	**12.50%** (30.76%)	**51.19%** (50.14%)
1 Other Type-X acting (2X)	**95.24%** (20.49%)	**88.10%** (32.48%)
2 Other Type-X acting (3X)	**99.40%** (2.92%)	**93.45%** (24.81%)

Table AI-2: Descriptive Statistics Across All Rounds[109]

[108] An individual with "other-regarding preferences" is different than one with "self-regarding preferences," in that she also considers other individuals' utility or consumption levels. For example, someone with altruistic other-regarding preferences may prefer a situation in which others consume or have more wealth, whereas the envious would prefer that others do worse.

[109] Proportion of Type-X subjects who decided to act, averaged across all seven rounds. Values in parentheses are standard deviations across Type-X subjects' average decisions to act. Total number of subjects was 48 (24 in the CF-L and 24 in the CF-NL) resulting in 336 observations (32x7).

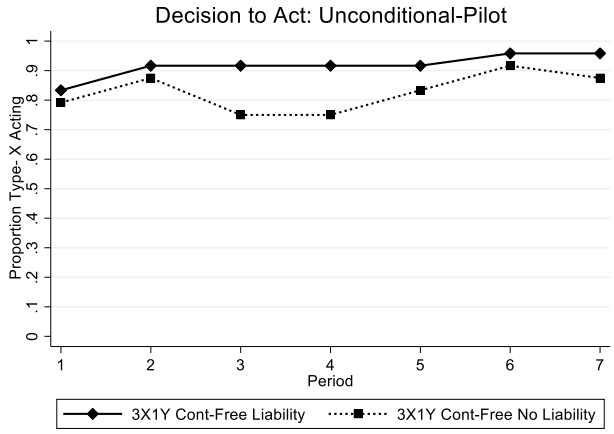

Figure AI-1: Average Unconditional Decisions

Columns 3-6 in Table AI-2 report average conditional choices to act using the Strategy Method. In CF-L, about 10% of subjects chose to act conditional on no other Type-X subjects acting. It is not clear why a Type-X subject would choose to act in this situation. This result may indicate a small amount of confusion on the part of the subjects while filling out the action table. Over 95% of subjects chose to act conditional on one other Type-X subject acting, and over 99% chose to act conditional on two other Type-X subjects acting. Taken together, these results indicate that subjects' willingness to act increases with the number of others choosing to act. These findings support our hypotheses and, for the most part, are consistent with the main experiment.

In CF-NL, about 50% of Type-X subjects indicate a willingness to act if they are the only Type-X subject acting. The proportion of Type-X subjects choosing to act surges to 85% or more when there is at least one other Type-X subject acting—a trend we also observe in the main analysis. This jump occurs despite no change in the monetary incentives across conditional decisions to act in this treatment. This is another instance where it appears that subjects are responding to monetary incentives but not as strongly as one may predict. Subjects may be either self-regarding with a predilection for conforming, or they may have other-regarding preferences (e.g., feeling guilty if they are the only subject acting), or both.

Compared to CF-L, in CF-NL, more subjects are willing to act conditional on no other Type-X subjects acting (that is, conditional on acting alone). However, conditional on one or two other Type-X subjects acting, when it is a dominant strategy to act under liability, there is *less* acting with no liability. This is illustrated in Figure AI-2 below, which reports the average proportion of subjects acting in each conditional decision described. These pilot results are consistent with a deterrent effect for liability that switches to an incentive to act, once multiple subjects are sharing the costs of providing compensation.

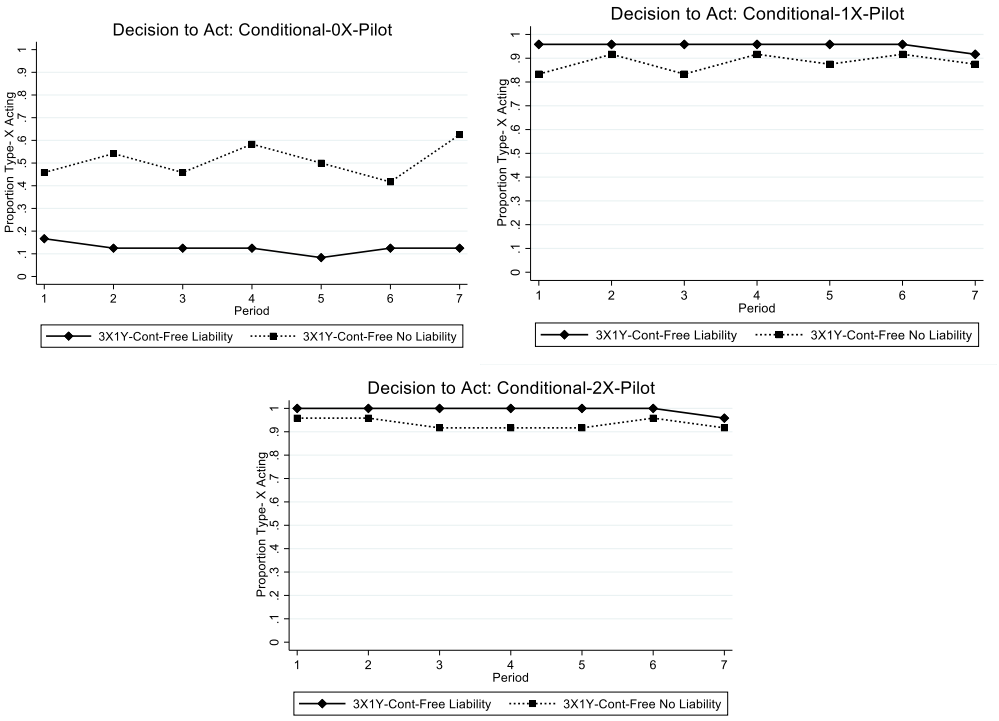

Figure AI-2: Conditional Decisions to Act Using the Strategy Method

Another support for the consistency and stability of the pilot results can be found in the fairness feedback, gathered from subjects' direct responses to the post-experiment questions and described in Figure AI-3 below. Subjects were asked to rank on a scale from 0 to 5 (with 0 being unfair and 5 being completely fair) the fairness of Type-X subjects acting as a function of the number of actors. The results show that under both CF-NL and CF-L, the (tortious) activity was considered more fair than unfair (i.e., fairness levels were always above the 2.5 median). Moreover, under both liability regimes, fairness levels monotonically increased with the number of actors. In other words, subjects in CF-NL seemed to have thought that when three actors inflict an indivisible harm on the Type-Y subject, the result is fairer compared to two actors doing the same, which is still fairer compared to one actor solely inflicting the harm. However, compared to the CF-NL, under CF-L, acting was perceived as fairer when two or three Type-X subjects act.

Figure AI-3: Fairness of Action as a Function of the Number of Actors

In summary, the pilot results indicate that subjects generally understood the nature of the experiment, instructions, and procedure. The liability manipulation appears to influence subjects' behavior in a way that is generally consistent with our design and expectations. Results seem to support our main hypotheses. Subjects were willing to act more often under Liability compared to No liability, despite having a dominant strategy to act in both treatments, suggesting that shared liability may reduce deterrence (Hypothesis 1). It also appears that subjects were more willing to participate in the tortious activity as the number of actors increases, indicating a tortfest dynamic (Hypothesis 2). Finally, the results support the claim that the but-for test is operable in multiple-causes cases (Hypothesis 3), as subjects were more willing to act in the tort conditional on others acting—as theory predicts.

Appendix II: Detailed Description of the Main Results

This appendix provides a more detailed description of the statistical analysis reported above. Table AII-1 below is a more comprehensive version of Table 5 in Part III.E.1 above and reports more results of our mixed-effect logit regressions. The multi-level model used in these regressions has (1) individual-level random effects to control for correlation between an individuals' decisions over time, as well as (2) session-level random effects to control for correlation between subjects who are randomly re-matched within a session by strangers matching.[110] Table AII-1 reports an additional variable (not reported in Table 5) called Round. Because each subject participated in seven decision-rounds, we test if and in what way a subject's behavior changed over time. The concern is that subjects might be learning about the incentives of the experiment from one round to another and that this learning effect may drive some of the results. If so, we would expect to see Round significantly affecting the decision to act. However, Round is insignificant in each model, so we can conclude that subjects have a good understanding of the incentives of the experiment in round 1. Their decisions to act do not change over time.

Independent Variables	Model 1 Uncond Odds Ratio	Model 2 Cond-0X Odds Ratio	Model 3 Cond-1X Odds Ratio	Model 4 Cond-2X Odds Ratio	Model 5 Cond-3X Odds Ratio
N-FL Dummy	0.25*	0.01***	<0.01***	1.41	6.01
	(0.19)	(0.01)	(<0.00)	(1.19)	(7.67)
	p=0.066	*p*<0.001	*p*<0.001	*p*=0.685	*p*=0.160
Round	1.08 (0.08)	1.13 (0.09)	0.08 (0.10)	1.02 (0.10)	0.86 (0.10)
	p=0.299	*p*=0.122	*p*=0.387	*p*=0.849	*p*=0.184

Table AII-1: Mixed-Effects Logit Regression—Neutral Treatment Comparisons[111]

We performed some additional variations in our regression analysis to confirm the robustness of the main results reported in Table 5 in Part III.E.1. Our analysis and results are not qualitatively or statistically altered if we include a lagged decision to act as an independent variable (which is another way of testing for dependence in the decisions to act that could influence the results). We also use an alternative estimation strategy: a mixed-effects linear panel regression model. The structure of the logit model we use for our main results is a better fit for the nature of our decision because it corresponds well with the binary choice

[110] PETER G. MOFFAT, EXPERIMETRICS: ECONOMETRICS FOR EXPERIMENTAL ECONOMICS (2016); Guillaume R. Fréchette, *Session-effects in the laboratory,* 15 EXPERIMENTAL ECON. 485 (2012).

[111] Standard errors in parentheses. Models 1–5: random effects at the individual and session level. n=504. Omitted dummy variable is CF-NL.

to act (1) or not (0). However, the linear model is a possible alternative estimation strategy. We do use this strategy for Model 3 (X1), since our mixed-effects logit Model 3 did not converge. We continue to control for random effects at the individual level (in case individual specific effects influenced the results). Again, our qualitative and statistical results remained robust.

The analysis in section III.E.2 looks for statistically significant effects of variation in our liability treatments (Liability versus No Liability) across subjects' conditional decisions. In order to use a panel regression approach, individuals can only make one decision in each round. It is not possible to use a panel regression approach to capture all four conditional decisions in each round at the same time as a common function of the liability regime and our other controls (e.g., that capture individual- and session-level dependencies). Instead, our main results are based on non-parametric tests for conditional decisions averaged across all rounds. Below, we also report results based on non-parametric tests examining individual decisions from the first round only, as a robustness check. Individual decisions are statistically independent in round 1, because subjects have not yet received feedback on others' decisions. These non-parametric tests eliminate one of the dependencies that would otherwise be controlled for in panel regressions. Also, as seen in Figure 3 in Part III.E.2, on average, subjects' decisions are relatively stable over time. This observation implies decisions in round 1 describe behavior fairly closely to when decisions across all rounds are averaged. The results confirm those reported and discussed in section E.2.[112]

The analysis in Part III.E.3 involves comparison of results across the Context-Free and Vignette frames. Table AII-2 below reports expanded results for our mixed effect logit regressions on unconditional decisions to act in these two treatments. Model 6 compares V-L to CF-L, Model 7 compares V-NL to CF-NL, and Model 8 compares V-NL to V-L. Recall that the "Round" dummy variable captures any change in willingness to act as individuals complete subsequent rounds of the experiment. The Round dummy variable is greater than one and significant in Models 7 & 8. This indicates that subjects are becoming more willing to act unconditionally as the experiment progresses. It appears this is particularly true in for V-NL (as Round is insignificant in Model 6 with V-L).

[112] With regard to the CF-L treatment: Signed rank tests, round 1 shows a statistically significant difference between decisions in Cond-1X and Cond-2X (Cond-0X vs. Cond-1X, p=0.103; Cond-1X vs. Cond-2X, p<0.001 (this is the same highly significant jump at the point where shared liability makes the tort monetarily attractive); Cond-2X vs. Cond-3X, p=0.103, n=36). With regard to the CF-L treatment: Signed rank tests, round 1 shows a statistically significant difference between decisions in Cond-0X and Cond-1X (Cond-0X vs. Cond-1X, p=0.005 (this is the highly statistically significant unwillingness to act alone even when there is no liability); Cond-1X vs. Cond-2X, p<0.103; Cond-2X vs. Cond-3X, p>0.999, n=36).

Independent Variables	Model 6 Uncond Odds Ratio	Model 7 Uncond Odds Ratio	Model 8 Uncond Odds Ratio
V-L Dummy	8.78 (7.19) *p*=0.008	----	0.65 (0.38) *p*=0.453
V-NL Dummy	----	2.54 (1.33) *p*=0.075	----
Round	1.08 (0.09) *p*=0.306	1.17 (0.09) *p*=0.030	1.20 (0.10) *p*=0.027

Table AII-2: Mixed-Effects Logit Regression - Contextual Treatment Comparisons[113]

In Part III.E.3, we also discuss the impact of the realistic Vignette treatment on conditional willingness to act—that is, we compare V-L to CF-L. Table AII-3 below provides expanded results for Models 9–12 (the four conditional decisions) in Table 7, which are the analog to results for the Context-Free Frame in Table 5 and Table AII-1 above. Again, the Round variable is not significant in any Model, implying subjects' conditional decisions are relatively stable over decision rounds.

Independent Variables	Model 9 Cond-0X Odds Ratio	Model 10 Cond-1X Odds Ratio	Model 11 Cond-2X Odds Ratio	Model 12 Cond-3X Odds Ratio
V-L Dummy	0.81 (0.91) *p*=0.850	0.52 (0.71) *p*=0.632	0.60 (0.50) *p*=0.547	0.74 (0.96) *p*=0.815
Round	0.91 (0.10) *p*=0.378	1.18 (0.13) *p*=0.140	1.05 (0.10) *p*=0.636	0.85 (0.12) *p*=0.269

Table AII-3: Mixed-Effects Logit Regression-Liability Contextual Treatment Comparisons[114]

As noted above, it is not possible to use a panel data approach to simultaneously capture the impact of varying the Vignette liability treatment across all four conditional decisions in each round. We generate results for this discussion in Part III.E.3 by using the same non-parametric approach discussed above for the Context-Free Frame. Critical robustness checks include: V-L

[113] Standard errors in parentheses. Random effects at the individual and session level.
Model 6: sessions=6, subjects=76, n=532. Omitted dummy variable: CF-L.
Model 7: sessions=6, subjects=84, n=588. Omitted dummy variable: CF-NL.
Model 8: sessions=6, subjects=88, n=616. Omitted dummy variable: V-NL.
[114] Standard errors in parentheses. Models 9–12: random effects at the individual and session level. n=532. Omitted dummy variable is CF-L.

willingness to act is significantly higher conditional on 2X than 1X acting (Wilcoxon signed rank test using only round 1 data, $p<0.001$, n=40); V-NL willingness to act is significantly higher conditional on 1X acting than 0X (Wilcoxon signed rank test using only round 1 data, $p<0.001$, n=48).

Part III.E.4 discusses our fairness rating results, both across liability treatments and as the number of Type-X acting increased. We use individual-level fairness rankings to conduct our non-parametric statistical analysis. Recall that our experimental procedure used "Strangers Matching" to randomly re-match individuals in each round. The most conservative approach to statistically test for fairness ratings would have been to focus on session-level measures. This approach would fully control for statistical dependency between subjects within a session but would generate only 6 observations per liability treatment. We believe our less conservative approach is reasonable with Stranger Matching, but as we do not have a full robustness check for this type of dependency, this remains a caveat to our fairness rating results. Such a caveat is not required for the primary analysis of the decision to act.[115]

Risk and Demographic controls	No Liability N=82	Liability N=75
Econ Experiments	1.09 (1.39)	1.48 (1.82)
Risk Intensity	4.71 (1.88)	4.46 (1.53)
Male Dummy[116]	0.402 (33/82)	0.480 (36/75)
Business Major Dummy	0.365 (30/82)	0.506 (38/75)
White Dummy	0.804 (66/82)	0.733 (55/75)
Believers Dummy	0.512 (42/82)	0.613 (46/75)
Democrat Dummy	0.292 (24/82)	0.213 (16/75)
Republican Dummy	0.231 (19/82)	0.226 (17/75)
Political Party Intensity (out of 5)	2.24 (1.28)	2.00 (1.36)

Table AII-4: Summary Statistics for Risk and Demographic Controls[117]

[115] Robustness checks on the analysis of the decision to act are possible because subjects made decisions to act across seven rounds. Thus, where possible, we also used panel regressions examining the decisions to act that control for individual-level and session-level dependencies as robustness checks for the individual-level non-parametric tests. In instances where panel regressions were not possible, non-parametric tests were conducted using only round 1 data, as subjects were statistically independent at that point in the experiment.

[116] Dropped transgender subjects for this analysis (3 subjects, 21 observations)

[117] The summary statistic for Econ Experiments is the average number of other economics experiment subjects have previously participated in. The summary statistic for Risk Intensity is average risk intensity on a scale from 0–10, with 1 being extremely risk seeking and 10 being extremely risk averse. The summary statistics for dummies are the percentages of subjects who responded affirmatively to those categories.

In addition to the core individual choice and fairness perception data that we analyze in the paper, we also collected information about a number of additional variables for our participants. Table AII-4 above reports the summary statistics for the variables used as additional controls in the regression analysis discussed in Part III.E.5. These additional controls generally had no statistically significant impact on our results. To illustrate, Table AII-5 below provides results for unconditional decisions (Vignette and Context-Free combined) using the multi-level Logit regression analysis with our additional controls. Results from additional regressions and analysis integrating these controls were also generally insignificant and revealed no systematic impact from these controls on our results.

Independent Variables	Uncond No Liability Odds Ratios	Uncond Liability Odds Ratio
Vignette Dummy	3.51**	6.28**
	(1.90) *p*=0.020	(5.44) *p*=0.034
# Other Econ Experiments	1.02	0.73
	(0.19) *p*=0.919	(0.17) *p*=0.167
Risk Intensity	1.16	0.98
	(0.17) *p*=0.295	(0.26) *p*=0.943
Male Dummy	2.45	0.33
	(1.46) *p*=0.130	(0.30) *p*=0.228
Business Major Dummy	0.42	3.95
	(0.25) *p*=0.149	(4.01) *p*=0.176
White Dummy	0.55	4.61
	(0.37) *p*=0.380	(4.51) *p*=0.119
Believers Dummy	1.08	4.22
	(0.57) *p*=0.886	(3.90) *p*=0.118
Democrat Dummy	0.55	0.83
	(0.33) *p*=0.321	(0.89) *p*=0.862
Republican Dummy	3.14	0.38
	(2.40) *p*=0.135	(0.43) *p*=0.396
Political Party Intensity (out of 5)	1.04	1.06
	(0.22) *p*=0.859	(0.33) *p*=0.857
Round	1.21	1.08
	(0.09) *p*=0.0.016	(0.09) *p*=0.374

Table AII-5: Panel Logit Regression with Additional Risk and Demographic Controls