Received: 3 April 2020 | Revised: 16 November 2020 | Accepted: 16 November 2020

DOI: 10.1111/1745-9125.12266

CRIMINOLOGY

ARTICLE

Sanction risk perceptions, coherence, and deterrence*

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*We thank Co-Editor Jody Miller and four anonymous reviewers for their guidance and suggestions. We are grateful to Baruch Fischoff, George Loewenstein, Tom Loughran, Chuck Manski, Kyle Thomas, Shaina Herman, Chris Barnum, Robert Apel, Volkan Topali, and Jean-Louis van Gelder for valuable feedback on earlier versions.

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Abstract

Research from environmental criminology, policing, and related literatures consistently finds that objective conditions related to risk of apprehension affect crime. The mechanism underlying this relationship is not explicitly tested; instead, perceptual deterrence is assumed. In this analysis we explicitly investigate that mechanism. This test is not straightforward, however, as some research shows that risk perceptions are susceptible to various cognitive biases and framing effects. Thus, we advance a framework of sanction risk perception that combines individual and contextual determinants. Specifically, we investigate whether contextual factors materially influence risk perceptions and in turn intentions to offend after accounting for the influence of individual-specific determinants. Our data come from an experimental survey on speeding (N = 1,919). Respondents viewed videos from the driver's perspective of a sedan speeding on a highway and provided estimates of sanction risk, safety perceptions, and behavioral intentions. Although sanction risk and safety perceptions for speeding varied widely across respondents, they remained grounded in the objective conditions of the experimental videos. In turn, citizen perceptions of apprehension risk were comparable with risk estimates elicited from state troopers after viewing the same videos. The results suggest

deterrence and safety considerations are important contributing factors that help shape intentions to transgress.

KEYWORDS
coherence, deterrence, risk perceptions, video experiment

1 | INTRODUCTION

More than four decades ago, criminologists (Grasmick & Bryjak, 1980; Meier & Johnson, 1977; Tittle, 1977) were in the vanguard of a line of research that builds from the foundational proposition that, at its core, deterrence is a perceptual phenomenon. Research on perceptual deterrence addresses two key questions: 1) Is actual or intended offending behavior affected by perceptions of the risk of punishment and 2) are these "sanction-risk perceptions" grounded in reality? An extensive body of research addressing the first question consistently demonstrates a negative correlation between sanction-risk perceptions and lawbreaking (see Apel & Nagin, 2011; Nagin, 2013; Paternoster, 2010, for reviews). Surprisingly little research, however, has addressed the second question. Consequently, it is unclear whether any deterrent effects produced by sanction-risk perceptions stem from objective factors related to offending decisions, including policies aimed at crime control. As such, the current study aims to examine more closely the relationship between would-be offenders' risk perceptions and the situations in which offending opportunities arise.

A prerequisite for perceptions to be grounded in reality is that perceptions reflect and respond to objective conditions and personal experience that influence sanction risk. This premise is a central feature of environmental criminology (Brantingham & Brantingham, 1981, 1990, 1982; Jeffery, 1977), opportunity-based theories (Clarke, 1983, 1997), routine activity theory (Clarke & Felson, 1993; Felson, 1987; Groff, 2008; Sherman et al., 1989), and Sampson's (2013) theory of context. Each of these literatures identifies situational characteristics of the physical and social environment that affect the vulnerability of potential criminal targets, whether human or physical, to victimization.

The mechanism by which reduced vulnerability is achieved, however, remains implicit in this research. That is, perceived risk of apprehension is assumed to be a major contributing factor but is not directly measured. For example, Clarke and Cornish (1985) argued that burglars do not victimize just any home on a hypothetical block but are attuned to particular residential characteristics (e.g., alarms, lighting, and absence of residents) that influence the risk of apprehension. Similarly, field experiments with various forms of proactive policing consistently find that increased police presence reduces crime and disorder. Here again the presumed mechanism is deterrence (Chalfin & McCrary, 2018; Lum et al., 2011; Nagin, 2013). Yet the policing literature as it relates to crime control is primarily evaluative—by how much, if at all, do police numbers and deployment strategies affect crime rates? Again, the mechanism by which the crime reduction is presumably achieved is left in the background.

Given the importance of risk perceptions in these literatures, the current study has two primary objectives: 1) empirically evaluating whether would-be offenders' risk perceptions are in fact *coherently* anchored in objective features of a criminal opportunity, and 2) testing whether these coherently informed perceptions result in deterrent effects on intentions to offend. Coherence of sanction risk perceptions requires that objective features of the opportunity that (decrease)

increase objective risk are similarly reflected in perceptions and, *ceteris paribus*, opportunities that are perceived as (less) riskier are also judged (more) less attractive.

A valid test of coherence, however, must recognize that sanction risk perceptions are also influenced by a "person-specific component" arising from two distinct sources: 1) cognitive bias resulting from well-documented difficulties that humans have in expressing risk perceptions as well-formed objective probabilities (e.g., heuristics and biases) and 2) private but unmeasured individual-level information that coherently influences objective probabilities (e.g., experience). Unless taken into account, this person-specific component may obscure the coherent anchoring of risk perceptions in measured features of objective reality (see, e.g., Thomas et al., 2018). As such, the current study sets out a theoretical model designed to account for the influence of both individual-specific factors and measured objective factors on reported risk perceptions. The aim is to layout a framework for testing whether measured objective conditions coherently influence risk perceptions and in turn coherently influence intentions to offend once the effect of the individual-specific component is accounted for.

The current study also has a third objective: to introduce a methodology that better calibrates the influence of objective circumstances on sanction risk perceptions than the traditional vignette approach in which a criminal opportunity is described solely with written text. Here we increase the amount of information provided to the respondent by having them view videos in which circumstances affecting apprehension risk are experimentally manipulated.

The initial proponents of vignette research, Nagin and Paternoster (1994) and Nagin and Klepper (1989a, 1989b), argued that it advanced perceptual deterrence research by providing the context for the lawbreaking opportunity that had previously been neglected (see also Pogarsky, 2004). For example, in the first generation of perceptual deterrence studies, respondents were simply asked to estimate the chance of arrest were they to commit a larceny. Respondents therefore had to impute the circumstances of the larceny to answer. As a consequence, cross-respondent variation in estimates might reflect differences in the imputed circumstances of larceny rather than differences in their perceptions of how specific target characteristics such as surveillance technology or personal experience affect apprehension risk. Compared with written vignettes, videos have the advantage inherent in the adage, "a picture is worth a thousand words." In 15 seconds, we can communicate far more information about the circumstances of the lawbreaking opportunity than can be communicated in a 100- to 200-word scenario in a way that comes much closer to the reality in which real-world decisions are made.

Our empirical demonstration is framed in the context of a widespread form of lawbreaking that is undoubtedly familiar to readers, speeding. Although speeding is not a form of lawbreaking that is typically the focus of perceptual deterrence research, its familiarity makes it ideal for demonstrating a point that is applicable to research on risk perceptions for lawbreaking more generally. The objective probability of being sanctioned particularly as it relates to risk of apprehension for speeding is highly dependent on circumstances—the probability of apprehension for speeding when traveling at 71 mph on an interstate highway with a 70 mile per hour speed limit is negligible, but it is near certain for a driver overtaking a police vehicle at 90 miles per hour. Likewise, the probability of apprehension for robbing a lone older person on a deserted street at night is small, whereas that same probability is near one if the target is extremely well protected, such as a high-end jewelry store like Tiffany's in New York City.

Our focus on speeding has an additional advantage, we are able to observe directly, rather than simply assume as in prior deterrence research, whether our participants' perceptions about speeding accord with those tasked with enforcing traffic laws. We compare citizen perceptions of apprehension risk with the perceptions of State Troopers with extensive experience in

traffic enforcement on interstate highways similar to the one depicted in our videos. Not only do the findings discussed in this article suggest that respondent's perceptions are coherently anchored in objective conditions and that these perceptions produce deterrent effects on intentions to speed, but also civilian perceptions of apprehension risk closely correspond with those of experienced State Troopers.

2 | ARE RISK PERCEPTIONS COHERENTLY ANCHORED IN REALITY?

At the outset we observed that coherence requires that objective features of the opportunity that (decrease) increase objective risk are similarly reflected in perceptions and, *ceteris paribus*, opportunities that are perceived as (less) riskier are also judged (more) less attractive. To elaborate, for risk perceptions to serve as a mechanism linking objective features of a criminal opportunity with the commission of crime, it is first necessary to establish whether risk perceptions are responsive to the features that, in reality, affect the risk of apprehension in the actual offending opportunity. As Nagin (1998, p. 5) observed, "The conclusion that crime decisions are affected by sanction risk perceptions is not a sufficient condition for concluding that policy can deter crime. Unless the perceptions themselves are manipulable by policy, the desired deterrent effect will not be achieved." Whereas the research from environmental criminology and related research discussed above implies such grounding likely occurs, not all research is as conclusive.

Specifically, behavioral economists and cognitive psychologists from within and outside of criminology have demonstrated that risk perceptions are highly susceptible to cognitive biases and framing effects (see Pickett, 2018; Pogarsky et al., 2017, 2018). For example, Quillian and Pager (2010) found that assessments of the probability of being victimized by a burglary or robbery are significantly higher than objective measures of neighborhood-level victimization risk. One biasing source leading to overestimation stems from a process labeled the "affect heuristic" (Slovic et al., 2004). Elevated perceived risk compared with the true frequency of an event may be triggered by intense imagery and feelings, in this case fear of victimization. To illustrate, one may feel afraid to fly and instead decide to drive, even though base rates for death by driving are much higher than are base rates for death by flying net of mileage (Gigerenzer, 2004).

Other factors have been shown to skew estimates of risk. Individuals often ignore base rates, show overconfidence in information from small samples, and judge frequency based on their ability to recall similar incidents (Kahneman, 2011). Furthermore, judgments and decisions are influenced by framing effects through an emphasis on choice of reporting categories (e.g., reporting chance of death versus chance of survival; Slovic et al., 2000). Biased risk estimates also result from the tendency of survey respondents to overreport decile values and round probabilistic estimates (Bruine de Bruin et al., 2007; Manski, 2004, Manski & Molinari, 2010; for review see Manski, 2018).[1] Taken together, it is reasonable to expect that even in well-defined criminogenic scenarios, individual differences in all or some of these "bias-generating" influences contribute to apparent inconsistencies observed in risk estimates across persons. These factors, and others, contribute to what we refer to as "person-specific heterogeneity" in risk perceptions.

[1] It should be noted that these are only a few of the possible sources of individual differences in reported risk perceptions. Other sources include self-control and impulsivity (Nagin & Paternoster, 1993; Piquero & Tibbetts, 1996), emotional experiences (Barnum & Solomon, 2019; van Gelder & de Vries, 2012), and a range of cognitive abilities (Paternoster & Pogarsky, 2009; Thomas et al., 2013) that influence criminal decision-making processes (see also Piquero et al., 2011).

Despite research suggesting people struggle to express risk probabilistically, there is evidence that perceptions are, in fact, coherently anchored in personal experience. Examples of such evidence include Horney and Marshall (1992), Paternoster and Piquero (1995), and Pogarsky and Piquero (2003). This research has since been formalized with Bayesian updating models that examine the impact of the experience of escaping apprehension or not on "prior sanction risk perceptions" in shaping "posterior sanction risk perceptions" (Anwar & Loughran, 2011). Bayesian updating analyses consistently find that the experience of apprehension increases risk perceptions, whereas the experience of escaping apprehension reduces risk perceptions (for review see Apel, 2013).

Beyond personal experience, researchers have also demonstrated that contextual features play a role in the formation and maintenance of coherent risk perceptions. For example, Thomas et al. (2018) introduced the concept of "coherent arbitrariness" (see also Ariely et al., 2003) by demonstrating that participants accurately, in our parlance, coherently ranked the relative risk of several different crime types based on severity (i.e., marijuana use versus assault). Importantly, this pattern held even after respondents were exposed to an arbitrary anchor—the percentage of students who contract a sexually transmitted disease—which biased estimates of the absolute level of risk for each crime type. Although this study provides important evidence for the coherent grounding of risk perceptions in reality, the study focused only on the coherent ranking of *different* crimes based on severity with no reference to any additional relevant contextual details.

For perceptions to be anchored in reality, would-be offenders must also coherently interpret sanction risk for the *same* offense under different contextual determinants of the objective risk of sanction. This requirement is foundational to a model of target choice advanced in Nagin et al. (2015). That model assumes that would-be offenders can coherently order criminal opportunities by their attendant risk of apprehension as defined by environmental and situational determinants of the opportunity (e.g., the presence of capable guardians). Accordingly, actors will only victimize targets with a perceived risk of apprehension less than or equal to some maximum level of apprehension risk that they are willing to tolerate based on the above criteria. Such ordering of the relative attractiveness of criminal opportunities is a requirement of the second attribute of coherence such that opportunities with a lower risk of apprehension are more attractive than opportunities with higher risk.

Pogarsky et al. (2017) provided initial evidence for this requirement by asking study participants to compare the odds of arrest for a burglary at night versus day, buying cocaine from a stranger versus a friend, and robbing a bank versus a store. Respondents were also randomly assigned to a high versus low anchor pertaining to the response scale—in the high anchoring condition, the maximum of the scale was "20 times as likely or more" versus "5 times as likely or more" in the low anchoring condition. As expected, the authors found that the scale anchoring manipulation affected the absolute level of response but the coherent ranking of the lowest to highest response category was not affected by the anchoring manipulation. On average, respondents recognized that burglarizing an occupied house during the day was riskier than at night, that buying cocaine from a stranger was riskier than from a friend, and that robbing a bank is riskier than robbing a store (Pogarsky et al., 2017).

Researchers of victimization perceptions similarly find that even as those perceptions are inflated by various biasing factors (e.g., Quillian & Pager, 2010), they are also grounded in objective conditions. For example, several researchers have shown that crime risk perceptions increase with more physical (e.g., dilapidated buildings, lighting, and graffiti) and social disorder (e.g., incivility, loitering, and public drunkenness) in people's immediate environment (Ferraro, 1995; LaGrange & Ferraro, 1989; Lee & Earnest, 2003; McGarrell et al., 1997; Villarreal & Silva, 2006). This body of

research on crime risk perceptions, in conjunction with environmental criminology and related topics (e.g., situational crime prevention; Clarke & Cornish, 1985), makes it clear that *changes* in a criminogenic setting can systematically inform an individual's assessment of risk within that situation.

Although there is conflicting evidence on the anchoring of risk perceptions in reality, the consequences for deterrence theory are sometimes overstated (e.g., Kleck et al., 2005; Pratt et al., 2006; see also Pickett & Roche, 2016). This is because, as the studies above and our own findings suggest, risk perceptions are *simultaneously* influenced by both idiosyncratic differences in abilities to execute cognitive assessments and contextual and situational features of a criminal opportunity. To date, however, few studies have considered this interplay, which confounds the coherence of risk perceptions and potentially limits the efficacy of deterrence-based policies. Therefore, it is imperative to model both sources of information when attempting to accurately capture the effect of context on risk perceptions and, in turn, the effect of risk perceptions on behavior. Below, we provide a combined model of sanction risk perceptions to provide a test of the coherence of risk perceptions in objective reality.

3 | COMBINED MODEL OF PERSON-SPECIFIC AND COHERENT RISK PERCEPTIONS

We formalized our combined model of person-specific and coherent risk perceptions as follows: Let p(c) denote the probability of apprehension for a set of circumstances described by a vector c, and let $PR_i(c)$ denote individual i's subjective estimate of the probability of apprehension in circumstances c. Prior research on sanction risk perceptions reflects large variations in $PR_i(c)$ across individuals, which implies $PR_i(c)$ does not equal objective risk p(c) at least for most individuals. To allow for the level of risk to vary across individuals yet still be grounded in p(c), we model $PR_i(c)$ as a function of two components—the person-specific component, denoted by γ_i, and p(c). One possible model of this relationship is the linear probability model whereby $PR_i(c)$ is the sum of these two components: $PR_i\,(c) = \gamma_i\, + p(c)$. More generally than this additive functional form, $PR_i(c)$ is assumed to increase monotonically in the individual-level parameter, γ_i, and with the objective, situation-dependent risk, p(c). A diagram of the model is depicted in figure 1.

Both the linear and the general specification imply that the impact of perceived risk on lawbreaking, $PR_i(c)$, in specified circumstances, c, will vary across individuals but will still be grounded in objective conditions affecting apprehension risk. Consider two sets of circumstances c' and c'' such that $p(c') > p(c'')$. In this example, our model of perceived risk implies that $PR_i(c') > PR_i(c'')$, the consequences being that fewer individuals will engage in lawbreaking in circumstance c' than c'' if deterrence is an active mechanism in decision-making. It is for this reason that we describe risk perceptions under this model as coherent even if they vary across individuals as a result of cognitive biases and personal experiences.

We test this model of combined risk perceptions with an experiment involving a car speeding on an interstate highway. Although we expect that respondents' risk perceptions will vary widely across persons, we expect these perceptions will coherently align with the measured objective conditions presented in the video scenarios and, in turn, coherently influence intentions to speed. We further assess the robustness of the coherent component by comparing risk estimates of our respondents with a group of state troopers with extensive experience who viewed the same videos. We outline the experiment in the next section followed by a discussion of the results and the theoretical and policy implications.

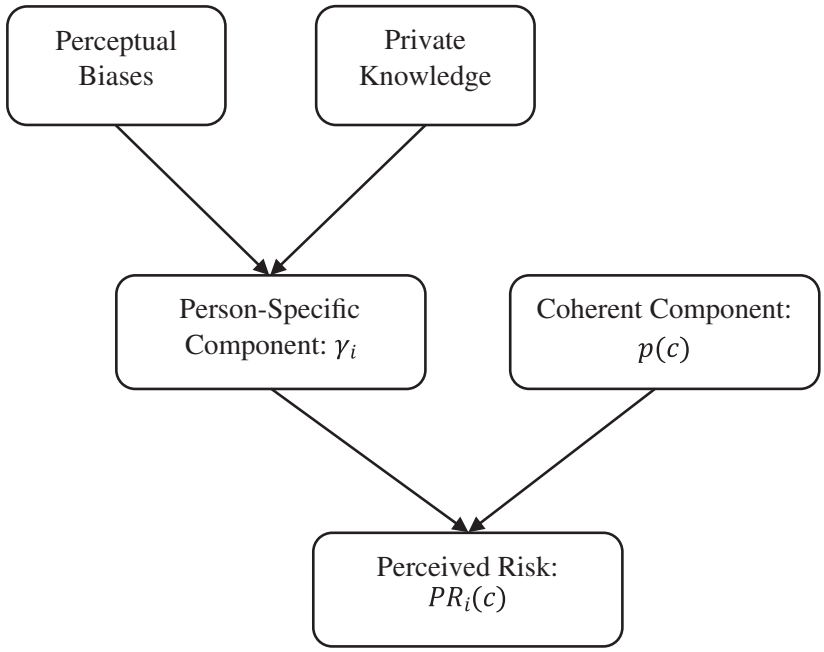

FIGURE 1 Combined model of person-specific and coherent risk perceptions

4 | METHOD

4.1 | Data and sample

We administered an online survey during the fall of 2019 to a nationwide sample of adult (18 and older) U.S. residents. The participants for the current study were recruited from Amazon's Mechanical Turk (MTurk), a widely used source of data in academic research (e.g., Barnum & Solomon, 2019; Dowling & Wichowsky, 2015; Herman & Pogarsky, 2020; Pogarsky et al., 2017; Ratner et al., 2014). Furthermore, Coppock et al. (2018) showed that a lack of effect heterogeneity explained why experimental findings from MTurk samples usually generalize to population-based samples (see also Mullinix et al., 2015; Weinberg et al., 2014). We followed standard practices for using MTurk samples (Levay et al., 2016; Peer et al., 2014; Pickett et al., 2018; Shank, 2016).

A total of 2,084 respondents began the survey with 2,011 (96 percent) complete responses recorded. Importantly, 1,976 (or ~98 percent) of the respondents reported having a valid driver's license at the time of the survey. We removed cases without a valid driver's license ($n = 35$) to promote the internal validity of the experimental videos. Finally, we excluded an additional 22 cases (or ~1 percent) with item nonresponse on key variables, yielding a final analytic sample of 1,919 participants. The MTurk respondents in our sample proved to be well suited for the current study. On average, participants reported driving between 11 and 15 miles per day, while driving on the interstate highway at least weekly, suggesting extensive driving experience. Full sample characteristics are presented in table 1.

TABLE 1 Summary statistics (N = 1919)

Variable	Mean (or %)	Std. Dev.	Min	Max
Driving Background				
Type of Vehicle				
Sedan	42.019%	—	0	1
SUV	26.963%	—	0	1
Compact Car	15.964%	—	0	1
Other	15.062%	—	0	1
State Speed Limit				
65 mph or Lower	11.317%	—	0	1
70 mph	66.347%	—	0	1
75 mph or Higher	22.365%	—	0	1
Highway Driving Frequency	3.801	1.199	1	5
Number of Tickets	1.308	.670	1	5
Police Detector	16.154%	—	0	1
Texting While Driving	1.547	.802	1	5
Aggressive Driver	1.601	.654	1	3
Driver Characteristics				
Risk Seeking	2.782	.918	1	5
Age	39.279	12.642	18	81
Male	44.815%	—	0	1
Non-Hispanic White	73.991%	—	0	1
Employment Status	81.130%	—	0	1

4.2 | Procedure

In this study, we elicited risk perceptions with experimental video vignettes depicting a car speeding on an interstate highway from the driver's perspective. To inform which features of the video to manipulate or control for experimentally, we conducted a prestudy survey on MTurk ($N = 503$).[2] Half of the participants rated the importance of 10 researcher generated factors on a 5-point Likert scale (1 = extremely important to 5 = extremely unimportant), and the other half generated their own list of important factors. Taken together, four categories of risk factors emerged: 1) personal driving speed and style, 2) the speed and driving style of others on the road, 3) environmental features of the road (e.g., winding road, overpasses), and 4) perceived police strategies in the area (e.g., a speeding crackdown is underway).

We accounted for these four risk factors when creating the experimental videos, either by controlling for them or experimentally manipulating them across videos. To do so, we filmed the videos on a four-lane (two in each direction) interstate highway located in the Northeast United States. The videos were filmed on a moderately traveled, mile-long stretch of highway between an entrance and an exit ramp that had a posted speed limit of 70 mph. By filming all videos on the same stretch of highway, we were able to control for important environmental features across

[2] Prestudy survey participants were blocked from participating in the survey used for the current study through the use of a qualification code on Amazon Mechanical Turk's interface.

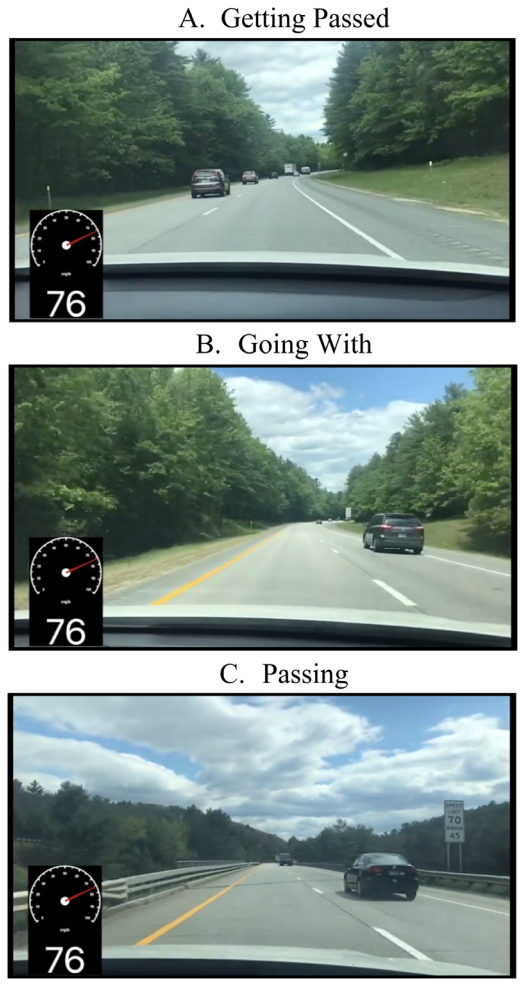

FIGURE 2 Video Screenshots for three traffic conditions [Color figure can be viewed at wileyonlinelibrary.com]

Notes: The speedometer randomly presented one of three speeds (i.e., 76, 82, and 86), which were held constant within persons across three traffic conditions

experimental conditions. Specifically, several factors beyond highway characteristics influence driving behavior, including the time of day and weather conditions. To this point, we underscore a critical aspect of our study design—the videos were filmed in a naturalistic setting. Thus, even beyond staged videos, our approach offers a particularly ecologically valid viewing experience. The goal is to increase the salience of the viewing experience and to enhance the viewer's sense of "presence" in the virtual environment (Slater et al., 2009; van Gelder et al., 2019).

In total, we created three versions of the scenario, each filmed from the vantage point of the driver, representing three different traffic conditions (see figure 2 for screenshots of all three videos). Version 1 depicted the driver getting passed by traffic in the right lane. The second version depicted the driver going with traffic in the left lane. The final version depicted the driver passing traffic in the left lane. All three versions showed the driver passing a 70 mph speed limit sign and were 15 seconds long.

In combination with traffic conditions, we manipulated two factors related to speeding. First, each video presented a speedometer in the lower left-hand corner containing one of three driving speeds: 76, 82, or 86 miles per hour. Second, one of two different informational cues were provided to respondents immediately preceding each video: 1) "Assume the speed limit is 70 mph" or 2) "Assume the speed limit is 70 mph. Also, imagine it is a holiday weekend and you heard extra police could be out on patrol." Other than this cue, there were no direct references to the police in the actual videos. Finally, after viewing the consent and instruction pages, participants were presented with either a low or a high anchor that read as follows: "A recently published study conducted by the US Department of Transportation showed that [33/71]% of Americans report that they drive a car every day. Because of this, we are interested in your perceptions of highway driving."[3]

The videos were embedded into a survey with a total of 2 (anchor) × 2 (informational cue) × 3 (speed condition) = 12 possible experimental conditions.[4] Figure 3 outlines the survey flow including the sample size per condition. In addition to random assignment, respondents viewed all three traffic condition videos in random order. Each video was followed by questions concerning the likelihood of getting pulled over, perceived safety, and intentions to speed. The 12 possible experimental conditions were intended to provide the data to test whether they were coherently reflected not only in risk of apprehension perceptions and intentions to speed but also perceptions of safety.

4.3 | Situational measures

4.3.1 | Perceived probability of getting pulled over

To measure perceptions of detection for speeding, we asked participants to "Imagine you have been driving for approximately half an hour under the same conditions as in the video presented above. What is the PERCENT CHANCE (or CHANCES OUT OF 100) you would get caught by the police for speeding?" Participants were presented with this question on the survey immediately following all three video vignettes. We converted percentages into probabilities by dividing participants' estimates by 100 so that scores ranged from 0 to 1.

[3] The decision to include an anchoring manipulation was motivated by research on "coherent arbitrariness" by Ariely et al. (2003) and later introduced in criminology by Thomas et al. (2018). Ariely et al. (2003) advanced evidence that valuations of willingness-to-pay (WTP) for a commodity, a construct fundamental to economics, can be manipulated by referencing extraneous quantities (e.g., "Is your WTP for a specified product more or less than the last two digits of your social security number?"). Yet even though valuations can be influenced by such arbitrary anchors, Ariely et al. (2003) went on to show that valuations remain internally coherent.

[4] We recruited a large sample size (N = 2,084) to ensure our analyses would have sufficient statistical power. Indeed, at least 150 participants were randomly assigned to each of the 12 experimental conditions (see Auspurg & Hinz, 2015; Cohen, 1992; Mutz, 2011). Furthermore, pooling the two anchor conditions resulted in 300 plus participants in each of the remaining six conditions (see Figure 3). With such large samples by experimental condition, we were confident that we had sufficient statistical power to detect treatment effects, which turned out to be the case as supported by the results reported in table 3.

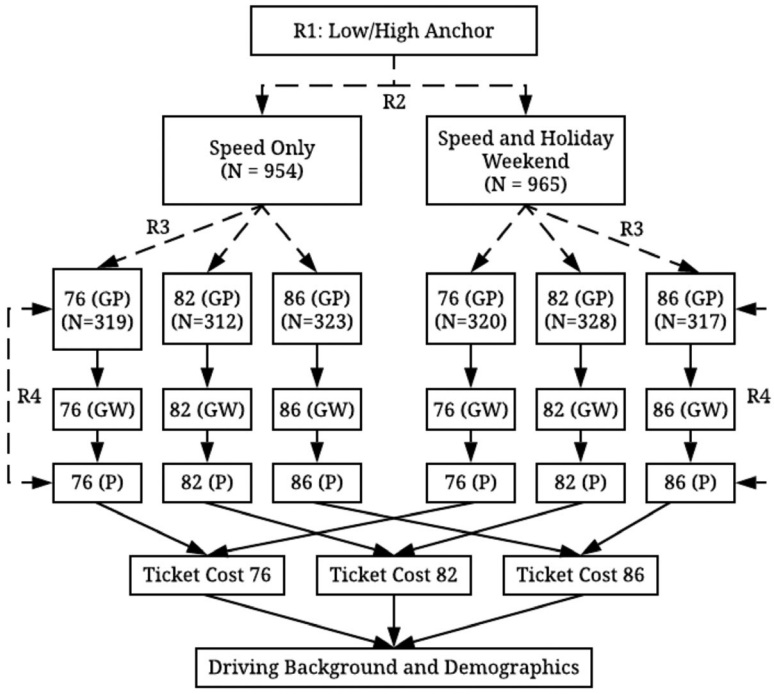

FIGURE 3 Survey design ($N = 1{,}919$)

Notes: All participants initially viewed an IRB-approved consent form and instructions for the survey before being assigned to experimental groups. The speed in the video was held constant within individuals (i.e., 76, 82, or 86 miles per hour). The three traffic condition videos were presented in random order. Dashed lines signify additional levels of randomization.

Abbreviations: GP = getting passed; GW = going with. P = passing; R1, R2, R3, R4 = randomization order

4.3.2 | Perceived safety

Safety is another relevant consideration in the decision to speed. Given that we expect perceived safety to decline with speed even as we anticipate that perceived risk of detection increases, accounting for perceptions of safety is important to obtaining an unbiased estimate of the deterrent effect of perceived detection risk. More generally, McCarthy and Hagan (2005) demonstrated that danger plays a key role in the decision to offend. To measure perceived safety, we asked participants "How SAFE or UNSAFE would it be for you if you drove like the car in the video under these conditions?" Responses ranged from 1 = extremely safe to 5 = extremely unsafe. Because of the coding scale, we refer to this variable as "perceived (un)safety," which was measured after all three videos.

4.3.3 | Intention to speed

To capture participants' intentions to speed, we asked "Now, thinking about the video above, if you were actually driving in these conditions, would you drive at the same speed as the car in the

video?" Responses were recoded so that 0 = no and 1 = yes. Participants provided their willingness to speed after all three videos.

4.3.4 | Perceived cost of speeding ticket

Finally, to account for the severity of being issued a speeding citation, we asked participants "how much do you think the fine is in DOLLARS for driving [6/12/16, depending on their assignment] mph over the speed limit?" Participants were posed this question one time after they viewed all three videos.

4.4 | Background measures

We captured several driving and demographic characteristics that may influence perceptions of detection and intentions to speed in the person-specific component of perceived risk of being ticketed. These include *highway driving frequency*, which ranged from 1 = never to 5 = daily, and number of *prior tickets* by asking "in the past 5 years, how many speeding tickets have you received?" measured by 1 = none to 5 = four or more tickets. We also asked participants three questions about their *driving styles*. These include their use of a radar detector or a navigation app (e.g., Waze) to detect police in their area (yes = 1), the frequency that respondents read e-mail or text messages on their phones while driving recorded by 1 = never and 5 = always, and whether the respondent saw her/him-self as being "MORE or LESS aggressive than the average driver" coded as 1 = less aggressive, 2 = about the same, and 3 = more aggressive. We also asked respondents their state of residence for the purpose of categorizing them by the maximum speed in their state of residence (Hawaii was the lowest at 60 mph and Texas the highest at 85 mph).

We measured several demographic and other variables including risk seeking, age, gender, race, and employment status. *Risk seeking* is the average of four items from the Brief Sensation Seeking Scale (BSSS-4; e.g., "I like to explore strange places"; Stephenson et al., 2003). Response options range from 1 = strongly disagree to 5 = strongly agree ($\alpha = .802$). Finally, respondents provided their *sex* (1 = male), *race* (1 = Non-Hispanic White), *age in years*, and *employment status* (1 = currently employed). All background measures were captured for the purpose of being included in subsequent multivariate regression analyses.

4.5 | State trooper supplemental sample

We supplemented the MTurk sample with a sample of state troopers, in which they viewed the experimental videos and rated the likelihood the hypothetical driver would encounter a police officer and get pulled over for speeding. The purpose of this supplementary sample was to provide a comparison for perceptions of apprehension risk between experienced drivers and experienced officers who enforce traffic laws on interstate highways. The troopers in the current sample primarily patrol similar stretches of highway to those depicted in the videos with a speed limit of 70 mph. Furthermore, the sample of troopers has extensive experience, with 75 percent reporting 11 or more years of service time. As such, comparable risk estimates between MTurk drivers and state troopers would provide further evidence that civilian reported risk perceptions are coherently grounded in reality.

State troopers were recruited from two command areas of a Midwest state over a 2-week period during the winter of 2020. A total of 85 troopers and supervisors were recruited from the first area with 60 troopers completing the survey (71 percent response rate). Sixty-nine troopers and supervisors were recruited from the second area with 63 troopers completing the survey (91 percent response rate; one officer was omitted for item nonresponse). In total, 123 (of 154) state troopers completed the survey for a total response rate of 80 percent.

After consenting to the study, and viewing general survey instructions, officers were randomly assigned to one of three possible speed conditions—76, 82, or 86 miles per hour.[5] The troopers then viewed all three traffic condition videos in randomized order. After watching each video, troopers answered the following question: "Suppose a citizen were to drive for approximately half an hour under the same conditions as in the video. Based on your experience with traffic enforcement what is the PERCENT CHANCE (or CHANCES OUT OF 100) the driver of this vehicle would encounter a state or local police officer and that officer would make a determination to pull them over for speeding?" Responses were divided by 100 to transform them into probabilities.

5 | RESULTS

With regard to driving style and tendencies, 42 percent of the sample reported driving a sedan (the same vehicle used to film the videos), and approximately 66 percent of the sample reported living in a state with a top speed limit of 70 mph on interstate highways. Study participants also seemed to be conservative and safe drivers. On average, respondents reported less than one speeding ticket in the past 5 years, they are rarely on their phones while driving (58 percent report never), and they view themselves as about the same or less aggressive than the average driver.

Turning now to responses to the videos, we found no evidence of the anchoring effects reported in Thomas et al. (2018) or Ariely et al. (2003). There are no statistically significant differences in perceptions of apprehension risk or safety between those randomized to the high versus low anchoring cue on the percentage of Americans who drive every day. Thus, for all the analyses reported below, we combine data across the anchoring conditions.[6]

5.1 | Person-specific variation in risk perceptions

Despite the null finding on anchoring, the person-specific component of perceptions of risk appeared to be highly variable across respondents even within every 1 of the 18 possible permutations of experimental conditions—2 (heightened enforcement conditions) × 3 (speed conditions) × 3 (traffic flow conditions). As an example, figure 4 shows cross subject histograms of apprehension risk for the "going with" traffic condition traveling at 76, 82, and 86 miles per hour in the condition for non-heightened enforcement. Responses are spread across the spectrum of

[5] Troopers only received the speed manipulation; they did not get an anchor or any information regarding heightened enforcement.

[6] Although purely speculative, it is possible anchoring effects did not emerge here as a result of the rich contextual information provided in the experimental videos. Thomas et al. (2018) provided no context in which to assess the risk of the crimes they examined; thus, the anchor was the only source of information they were given, thereby increasing its salience. Relatedly, people are likely to be more familiar with speeding compared with more serious offenses and therefore are less susceptible to the influence of "arbitrary" information.

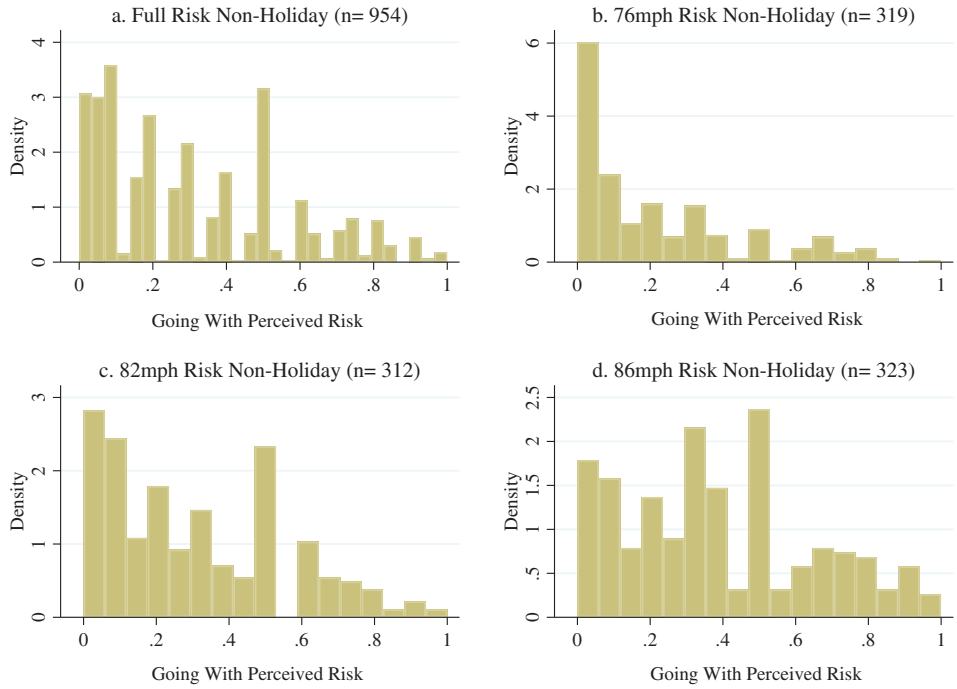

FIGURE 4 Histograms of perceived probability of getting pulled over for the "Going With" condition [Color figure can be viewed at wileyonlinelibrary.com]

possible values from 0 to 1. There is also substantial evidence of respondents rounding to decile values even within specific combinations of experimental condition. In each of the figure 4 histograms, there is a notable spike at 50 percent. Overall 58.1 percent of risk responses were decile values.

Table 2 reports summary statistics of the risk response to the first viewed video for the 18 possible combinations of experimental conditions. For each possible permutation of situational conditions, the coefficient of variation, the standard deviation divided by the mean, is never less than 46.7 percent and can be as high as 132.5 percent. The average is 81.1 percent. These summary statistics show that even after specifying the amount over the speed limit, passing condition, and whether there is a report of heightened enforcement, variation in risk perception across subjects is large.

Recall that the linear probability model of $PR_i(c)$ is that perceived risk is equal to the sum of the person-specific component and the systematic component based on objective risk: $PR_i(c) = \gamma_i + p(c)$. Under this specification, the person-specific component, γ_i, for each respondent can be estimated based on the respondent's perceived risk of apprehension assessment across the three videos of their speed relative to traffic flow. Specifically, γ_i, for each respondent was estimated by a fixed effect regression of the following form:

$$PR_{ij} = \gamma_i + \beta_2 o_2 + \beta_3 o_3 + \theta_1 GW_{ij} + \theta_2 P_{ij},$$

Figure 5 is a histogram of the estimates of γ_i. Like the variability of perceived risk within each of the experimental conditions, estimates of γ_i are highly variable and account for more than 72 percent of the variation in PR_{ij} across i and j. The value of γ_i also substantially influences

TABLE 2 Summary statistics of perceived risk across experimental conditions (N = 1,919)

	76 mph					82 mph					86 mph				
Variable	**Mean**	**SD**	**CV**	**Min**	**Max**	**Mean**	**SD**	**CV**	**Min**	**Max**	**Mean**	**SD**	**CV**	**Min**	**Max**
Non-Holiday Condition															
Getting Passed	.150	.198	1.325	0	1	.221	.223	1.011	0	.900	.301	.267	.888	0	1
Going With	.218	.226	1.035	0	1	.311	.243	.778	0	1	.389	.260	.669	0	1
Passing	.320	.258	.805	0	1	.448	.256	.572	0	1	.511	.252	.493	0	1
Holiday Condition															
Getting Passed	.166	.208	1.253	0	1	.285	.253	.887	0	1	.326	.259	.794	0	1
Going With	.227	.231	1.019	0	1	.381	.260	.681	0	1	.422	.269	.637	0	1
Passing	.359	.269	.750	0	1	.508	.267	.526	0	1	.536	.251	.467	0	1

Abbreviations: CV = coefficient of variance; SD = standard deviation.

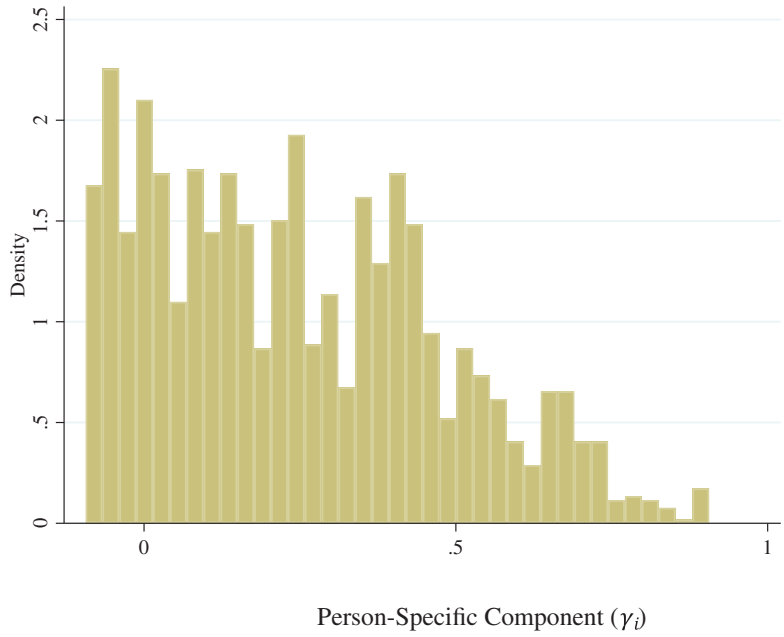

FIGURE 5 Histogram of person-specific component [Color figure can be viewed at wileyonlinelibrary.com]

intentions to speed. On average, respondents in the lower quartile of γ_i reported a 53.3 percent chance of speeding across the three videos viewed, whereas those in the upper quartile reported a 30.7 percent chance of speeding with intentions declining monotonically in the second and third quartiles. Despite large person-specific variation and its corresponding influence on intentions, the estimated impact of the traffic condition dummy variables is large and highly significant. Compared with the being passed condition, the going with condition and passing conditions increase perceived risk by, respectively, .084 ($t = 17.92$) and .206 ($t = 44.02$) and as discussed below substantially influence intentions. These demonstrate that the traffic flow conditions are coherently influencing intentions to speed even after accounting for the person-specific component.

5.2 | Coherence in risk perceptions and intentions

In line with the findings from the fixed-effects model above that situational factors influence risk perceptions coherently, the experimental results reported in table 3 show that, on average, perceptions of risk and safety and level of fine are grounded in a sensible fashion to objective conditions. For each passing condition, perceived risk increases with the amount over the speed limit and with being in the heightened enforcement condition. In accord with the fixed-effects regression results, perceived risk is highest for the condition where the vehicle is passing traffic and therefore further over the speed limit than other traffic and lowest in the condition where the vehicle is being passed by traffic and therefore less over the speed limit than other vehicles. In between is the risk estimate for traveling with traffic. All differences are significant at the .01 level or smaller.

Concerning perceived (un)safety, for each passing condition, perceptions of (un)safety increase with speed and are highest in the passing condition and lowest in the being passed condition. All

TABLE 3 Risk perceptions and intentions to speed by experimental conditions (N = 1,919)

	Full Sample				Speed Condition				Holiday Condition		
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**76**	**82**	**86**	***p* value**[a]	**Sign Only**	**Holiday**	***p* value**[b]
Perceived Risk											
Getting Passed	.242	.245	0	1	.158	.254	.314	***	.224	.259	**
Going With	.325	.261	0	1	.223	.347	.405	***	.307	.343	**
Passing	.447	.271	0	1	.339	.480	.523	***	.426	.468	***
Perceived Safety											
Getting Passed	2.703	1.080	1	5	2.266	2.756	3.086	***	2.698	2.701	ns
Going With	2.850	1.106	1	5	2.430	2.916	3.205	***	2.847	2.854	ns
Passing	3.323	1.069	1	5	2.901	3.372	3.694	***	3.314	3.329	ns
Perceived Fine	180.720	261.240	0	5000	127.361	187.782	226.929	***	192.211	169.350	ns
Intention to Speed											
Getting Passed	.511	.500	0	1	.662	.461	.411	***	.504	.518	ns
Going With	.479	.499	0	1	.657	.448	.334	***	.483	.477	ns
Passing	.283	.451	0	1	.449	.248	.152	***	.309	.256	*

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed).

[a]*p* values obtained from an analysis of variance test.

[b]*p* values obtained from a two-sample *t* test.

differences are significant at the .01 level or smaller. Safety perceptions also significantly varied across traffic conditions at the .001 level: getting passed ($\bar{X} = 2.81$); going with ($\bar{X} = 2.90$); and passing ($\bar{X} = 3.11$). Safety perceptions are unaffected by assignment to the heightened enforcement condition, a situational factor that, unlike risk of detection, is objectively unrelated to safety.

Perceived fine was only asked once, after viewing all three passing condition videos. Perceived fine increases with the amount over the speed limit, a condition that was fixed within subjects, but it is unaffected by the heightened enforcement condition. Both of these findings accord with reality—fine levels increase with amount over the speed limit but are not statutorily related to enforcement intensity.

Also reported in table 3 is variation in intent to speed across experimental conditions. Intent declines significantly with amount over the speed limit. It is lowest for the 86 mph condition and highest for the 76 mph condition and in between for the 82 mph condition. These differences are also highly significant. Significant mean differences for intentions to speed across the traffic conditions in the first viewed video emerged at the .01 level with participants reporting the highest level of intent in the getting passed condition ($\bar{X} = .46$) followed by the going with condition ($\bar{X} = .43$) and the passing condition ($\bar{X} = .37$). Intent, however, is only significantly related to the heightened enforcement condition in the passing condition.

All of the relationships reported in table 3 can be interpreted as causal because the experimental conditions were randomly assigned. As is the case with all experiments, the relationships in table 3 do not establish the mechanism by which factors causally affecting risk and safety perceptions are exerting their causal influence on intent. Two leading candidates are deterrence and concerns about safety. The regressions reported in table 4 aim to shed statistical light on the mechanism.

The first two regressions are based on cross-subject variation in responses to the first video viewed.[7] They are logit models in which the response variable is intention to speed. In the first regression, explanatory variables are perceived risk, perceived (un)safety, and perceived fine as well as a variety of individual-level variables. The second adds the situational conditions to which the respondent was randomly assigned. In both regressions perceived risk and (un)safety have a negative and highly significant association with intent. Perceived ticket cost is also negatively and significantly associated with intent at the $\alpha = .05$ level. These findings suggest that deterrence and safety concerns are salient underlying mechanisms affecting intent to speed. The findings also show the number of past tickets, use of radar detection devices, propensity to text or e-mail while driving, and an aggressive driving style are associated with a heightened intention to speed.

The third regression reported in table 4 is a fixed-effects logit model. This model is estimated using responses to all three videos viewed by respondents. Recall that respondents were randomly assigned to amount over the speed limit condition and to the heightened enforcement condition. They then viewed all three passing condition videos in random order. The logit analyses just described are for the first video observed, whereas the fixed-effects model takes advantage of all three video data points. Fixed-effects logit models, like their counterpart panel regression models, are intended to control for fixed individual effects, which is the person-specific effect, that influence both perceived risk and safety and independently influence intent. The influence of

[7] We estimated regression models with the "first viewed video" to parse out between-person comparisons across traffic conditions given that respondents viewed all three videos in randomized order. The randomization component ensures that one third of the sample viewed the getting passed video, one third the going with, and one third the passing video as their first video. Thus, in the second model in table 4, the getting passed condition serves as the reference category for the traffic condition variables. Importantly, we estimated the same analyses for the second and third video viewed. Results are almost identical, which further suggests no ordering effects.

TABLE 4 Regressions predicting intention to speed

	Model 1: Reduced Logit		Model 2: Full Logit		Model 3: Fixed Effects Logit	
Intent to Speed	**Coef.**	**SE**	**Coef.**	**SE**	**Coef.**	**SE**
Perceived Risk	−1.732***	.281	−1.310***	.295	−3.657***	.488
Perceived (Un)Safe	−1.417***	.074	−1.353***	.075	−1.351***	.098
Perceived Fine	−.001*	.000	−.000	.000		
Experimental Conditions						
Holiday Condition	—	—	−.187	.150		
Speed Condition (76 mph *ref.*)						
82 mph	—	—	−.772***	.150		
86 mph	—	—	−1.154***	.164		
Traffic Condition (Getting Passed *ref.*)						
Going With	—	—	−.023	.150		
Passing	—	—	−.006	.161		
Controls						
Highway Driving	−.016	.063	.002	.065		
Past Tickets	.364***	.101	.312**	.101		
Police Detector	.506**	.176	.550**	.180		
Texting While Driving	.232**	.087	.260**	.087		
Aggressive Driving	.268**	.100	.283**	.102		
Speed Limit (65 and Below *ref.*)						
70 mph	.140	.199	.159	.205		
75+ mph	.149	.225	.156	.231		
Risk Seeking	.154*	.073	.154*	.074		
Age	−.012*	.005	−.014**	.005		
Male	−.238	.125	−.216	.129		
Non-Hispanic White	−.253	.145	−.214	.147		
Employed	−.088	.160	−.138	.164		
Intercept	3.240***	.505	3.618***	.529		
Pseudo R^2	.359		.380			
Model N	1919		1919		896	

Notes: Fixed-effects logistic regression (model 3) included dummy variables for the three traffic conditions (getting passed was the reference category). Participants who reported they would always speed or never speed were omitted from analysis (n = 1,031). Fixed-effects estimates based on 2,688 observations nested in 896 persons.

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed).

Abbreviation: SE = standard error.

perceived risk and safety independent of person specific effects on intent is identified based on the association of changes in intent with changes in perceived risk and perceived safety. Consequently, individuals who report that they will never speed or always speed across the passing videos do not contribute to identification. Also, as with all fixed-effects models, estimation of the association of invariant individual-level variables with intent is no longer possible. Such variables include all the individual-level variables and perceived fine, which was asked only once. The

TABLE 5 Comparisons of mean level apprehension risk perceptions between citizens and state troopers

	By Traffic Condition				By Speed Condition		
	State Patrol	Citizen	*p* value		State Patrol	Citizen	*p* value
Getting Passed	.210	.224	*ns*	76 mph	.215	.229	*ns*
Going With	.345	.307	*ns*	82 mph	.367	.327	*ns*
Passing	.392	.426	*ns*	86 mph	.368	.400	*ns*

Notes: State Patrol $n = 123$; Citizen $n = 954$ (only respondents in non-heightened enforcement condition). *p* values from *t* tests.

results show that perceived risk and perceived (un)safety continue to have a negative and highly significant association with intent.

The results of the fixed-effects logit model imply that within-subject variations in perceived risk, safety, and intent are highly coherent. Within-subject coherence implies that perceived risk/(un)safety in the being passed condition should be less than or equal to these quantities in the going with condition that in turn should be less than or equal to these quantities in the passing condition. For perceived apprehension risk, 86 percent of respondents reported that risk in the going with condition is greater than or equal to risk in the being passed condition and 89 percent reported risk in the passing condition is greater than or equal to risk in the going with condition. Overall, the risk perceptions of 77 percent were coherent across all three conditions. For perceived (un)safety, 93 percent of respondents are coherent across all three conditions. With regard to intent, coherence requires that a subject who is unwilling to speed in the being passed conditions should also be unwilling to speed in the going with and passing conditions. This is true for 68 percent of respondents. For individuals who are unwilling to speed in the going with condition coherence requires that they also be unwilling to speed in the passing condition. This is true for 91 percent of respondents. Coherence also requires that anyone who is willing to speed in the passing condition also should be willing to speed in the other two conditions and that anyone who is willing to speed in the going with condition also should be willing to speed in the being passed condition. These orderings hold for, respectively, 67 percent and 76 percent of respondents.

5.3 | State trooper correspondence

How well do respondent perceptions of the risk of apprehension for speeding correspond with the estimates of the troopers charged with enforcement of speed limits? Recall that the troopers were assigned to one of the three amounts over the speed limit conditions but always in the non–heightened-enforcement condition. They then viewed, in random order, the three relative traffic flow videos. Table 5 compares the average response of the police sample with the 954 citizens who viewed videos in the non–heightened-enforcement condition. There is a close correspondence between the citizen and trooper risk estimates across conditions. In no case does the difference between the two samples reach statistical significance. We recognize that our citizen sample is from across the United States, but we note that respondent's home state speed limit was not significantly associated apprehension risk perceptions and that a large majority of respondents' home state maximum speed limit is 70 mph as is the case in the Midwest state in which the troopers are employed. We interpret these results as strong evidence of the coherent grounding of perceptions in objective conditions.

6 | DISCUSSION

Findings from environmental criminology and related research suggest that risk perceptions are strongly influenced by situational and contextual features of a criminal opportunity. To date, however, the mechanism has been assumed rather than directly tested. As such, a key contribution of this study was providing an empirical demonstration that for a common form of lawbreaking, speeding, the mechanism underlying the link between environmental and situational determinants and intentions to offend is deterrence and safety considerations. To do so, we laid out a combined model of person-specific and coherent risk perceptions. The model provides a framework for testing whether measured objective conditions *coherently* influence risk perceptions and in turn *coherently* influence intentions to offend, once the effect of person-specific variation in perceptions is accounted for.

In line with prior research, subjective estimates of apprehension risk varied widely across subjects. In 17 of 18 of the possible permutations of experimental conditions, subject perceptions of apprehension risk spanned the entire range of probability values—zero to one. Yet across respondents' perceptions still depended sensibly on objective conditions. On average, perceived risk of apprehension increased with the amount over the speed limit and with the suggestion of heightened enforcement activity. Perceptions also coherently aligned with the vehicle's speed relative to traffic. Similarly, perceptions of (un)safety and expected fine depended on objective conditions with both increasing with the amount over the speed limit although, importantly, not with the suggestion of heightened enforcement, a condition that in reality will have no effect on either. Within-subject variations in perceptions of risk apprehension and safety, also, were coherently related to objective conditions for a large majority of respondents. For these reasons we describe perceptions as being coherently anchored in reality. Importantly, and in line with the second attribute of coherence, these coherent risk perceptions, along with safety concerns, are negatively associated with intentions to speed, suggesting deterrence and safety considerations are key mechanisms linking the objective environment with behavioral intent.

Our findings build on a model of target choice advanced in Nagin et al. (2015). That model assumes that would-be offenders can coherently order criminal opportunities by their attendant risk of apprehension and, ceteris paribus, only victimize targets with a perceived risk of apprehension less than or equal to some maximum level of apprehension risk that they are willing to tolerate (see also Thomas et al., 2018). Our findings suggest that the person-specific component (γ_i) is also contributing substantially to perceived risk and thereby the offending choices modeled in the Nagin et al. model.

The person specific component is comprised of two distinct elements: 1) cognitive biases and 2) private information such as experience. Differences in cognitive abilities and personal experience vary randomly across individuals and therefore help explain why two persons facing the same offending opportunity might perceive drastically different likelihoods of apprehension risk. In this light, we observe that risk perceptions are highly "idiosyncratic." Nevertheless, people are still capable of coherently adjusting their perceptions based on new and relevant information. This point is reflected by, for example, individuals in the 76 mph condition who faced objectively low apprehension risk in an "absolute" sense nevertheless perceived higher apprehension risk in a "relative" sense by virtue of simply approaching and then passing someone who is driving at an even slower speed. In this regard we echo the observation of Thaler et al. (2010, p. 428): "People do not make choices in a vacuum. They make them in an environment where many features, noticed

and unnoticed, can influence their decisions." Thus, an alternative label for our combined model, which we prefer, is "idiosyncratically coherent risk perceptions."

Failing to account for both idiosyncratic and coherent sources of risk perceptions may result in researchers underestimating the grounding of risk perception in objective reality. An example is a line of research that examines the relationship between "sanctioning" in a place, typically reflected by the arrest clearance rate in a county, and residents' perceptions of sanctioning in that place. An exemplar of such research is Kleck et al. (2005) who surveyed residents by phone in 300 large, urban counties. They found that county residents' estimates of the arrest clearance rate for homicide, robbery, aggravated assault, and burglary were uncorrelated with the corresponding, actual clearance rates. Comparable findings have been reported by Kleck and Barnes (2013, 2014) and Lochner (2007); see also Pickett and Roche (2016). From this the authors conclude that perceptions are not grounded in reality.

Apel (2013), Braga and Apel (2016), and Pogarsky and Loughran (2016) included extended critiques of this line of thinking. To their critiques, we add another fundamental criticism—because risk perceptions are highly dependent on circumstances, questions about risk without details on context are ill posed (see also Thomas, 2017; van Gelder et al., 2019). As we have already noted, the probability of avoiding apprehension for robbing a lone older person on a deserted street at night is negligible, whereas that same probability is near one if the target is extremely well protected like a high-end jewelry store in midtown New York City. When circumstances relevant to apprehension risk are not well specified, respondents must impute the circumstances (van Gelder et. al., 2019). Differences in estimates across respondents, thus, may not reflect differences in risk perceptions under well-specified circumstances but differences in the circumstances imputed by the respondent. Likewise, tasking survey respondents with the estimation of solution rates for various, decontextualized crime types means that they necessarily must impute the circumstances in which the crime is committed. The imputed circumstance, however, may have no resemblance to the circumstances in which such crimes are typically committed, which themselves might be varied.

In addition to imputation, a lack of relevant contextual information may increase the salience of unmeasured idiosyncrasies in risk estimates. Because the circumstances surrounding speeding are so fluid, an especially salient "biasing factor" may be ambiguity aversion—the tendency to favor the known over the unknown, including, *ceteris paribus*, known risk over unknown risk (Ellsberg, 1961). The current findings provide initial support for this point. Recall the risk distributions depicted in figure 4: There are noticeable spikes in estimates at or around 50 percent. Several decision-making scholars across a range of domains have identified this phenomenon (e.g., Brim, 1955; Bruine de Bruin et al., 2006, 2007; Manski, 2004; Pickett et al., 2015). They have argued that as people become increasingly unsure or ambiguous about the likelihood of some event occurring, they shift their estimates toward middle values effectively treating the outcome as a "50/50" guess. This has important implications for the effect of risk perceptions on behavioral outcomes because, as Loughran et al. (2011) demonstrated, ambiguity can produce an asymmetrical effect on decision-making depending on whether the certainty of apprehension is viewed as low or high. Future research should extend our model to incorporate ambiguity aversion.

Of course, several other cognitive processes likely influence perceptions of apprehension risk for not only speeding but more serious crimes as well, such as the availability heuristic: People estimate the probability of an outcome based on the ease in which they can recall that event (e.g., prior or vicarious arrest; Pickett, 2018; Pogarsky et al., 2017). Given the multitude of factors—both cognitive and experiential—that can bias decision-making processes, it is imperative that researchers continue to unpack the idiosyncratic component of risk perceptions.

Our framework on sanction risk perceptions can also be applied more broadly to other criminal behaviors, both violent and nonviolent. For example, some evidence suggests there is idiosyncratic variation in expectations about being victimized (e.g., older women overestimate risks of victimization compared with young men when in reality they have a lower chance of victimization; Hale, 1996; Henson & Reyns, 2015; Warr, 1984), whereas victimization assessments seem to coherently reflect contextual determinants known to influence the objective probability of being victimized. Our model potentially accounts for both of these oddities while providing a remedy in the form of detailed context.

The results also demonstrate that, at least for speeding, driver's risk perceptions correspond with the perceptions of experienced state troopers who ultimately determine whether to stop a speeding car and issue the driver a citation. This suggests police practices aimed at traffic violations are highly effective and may provide a model for other, more serious offenses. Given the high degree of correspondence between police and civilian perceptions in our study, as well as the coherent consistency of within-individual perceptions across the three speeding contexts, a logical next step for researchers should be to determine the degree to which policy changes in policing and related strategies affect peoples' perceptions of sanction risk and safety concerns for a range of criminal offenses. Notably, our study does not examine how quickly perceptions adjust to changes in sanction and enforcement policy particularly as it relates to apprehension risk.

Indeed, researchers of hot-spots studies have begun incorporating surveys that get at fear of crime and perceptions of crime and disorder, which begin to tap into these issues; however, these studies typically do not ask directly about sanction risk perceptions (e.g., Haberman et al., 2016; Ratcliffe et al., 2015; Weisburd et al., 2011). More generally, this approach may shed light on some of the core critiques of situational crime prevention (SCP) theory and practice (e.g., Clarke & Cornish, 1985): It is hard to conceptualize experimental tests of SCP interventions because the situational context of the problem varies so much. Based on the current findings, further investigation of the interplay between individual-level and contextual factors that shape risk perceptions within a criminal opportunity may render greater policy returns of SCP practices (e.g., lighting; Chalfin et al., 2019). As such, we recommend that greater research attention be given to the dynamics of how risk perceptions adjust to changes in crime-prevention policy.

In addition to the influence of sanction risk perceptions, the consideration of safety seems to be a key dimension of deterrence, a finding that accords with arguments posed by McCarthy and Hagan (2005). Furthermore, like sanction risk perceptions, safety considerations are also coherently anchored in reality and therefore likely susceptible to policy changes. As such, more work is needed to determine the extent that safety and related perceptions produce deterrent effects beyond sanction risk perceptions. This line of research may be especially relevant for more serious offenses as several qualitative studies suggest that safety considerations are weighed heavily by would-be offenders when determining the underlying success rate of a criminal endeavor (e.g., Jacobs & Cherbonneau, 2017; Topalli, 2005; Wright & Decker, 1994, 1997).

The current study also featured a novel methodology, which has recently been employed in policing studies about legitimacy and procedural justice (e.g., Johnson et al., 2017; Maguire et al., 2017; Solomon, 2019), for researching the correspondence of risk perceptions in a measured objective reality. Given the consistency of our results, we recommend future research using vignette-based methodology replace (or at least supplement) written descriptions of criminal opportunities with more visually stimulating scenarios. Here, videos and related methodologies like virtual reality allow researchers to transmit and control for contextual information that otherwise may not be detected in the scenario's written counterpart. This is important because realistic videos can evoke a sense of "presence," or the subjective feeling of being in the virtual environment rather than the

actual physical environment where their body is located (Slater et al. 2009; van Gelder et al., 2019). Presence can increase the fidelity of the behavior displayed in the videos in relation to how one behaves in the real world (van Gelder et al., 2014). Virtual reality scenarios have an additional advantage: They can present interactive criminal opportunities, depicting fluid momentary processes that undoubtedly shape offending decisions (see Nee et al., 2019). Although this is a missing feature in the current study (and quantitative tests of perceptual deterrence in general), qualitative works have suggested that the fluidity of an offending situation creates feedback loops prompting momentary changes in perceptions and decision outcomes (e.g., Cherbonneau & Jacobs, 2019).

The findings presented in this study suggest risk perceptions, at least as they relate to speeding, are highly responsive to contextual features of a criminal opportunity and closely match the perceptions of police officers charged with the enforcement of laws pertaining to speeding. We urge researchers to carefully consider the role of decision-making contexts when testing deterrence-based predictions because the omission of such factors likely confounds any true association between risk perceptions and offending behaviors and intentions. This is because real people make decisions in the real world, and the features of these contexts inform how the decisions are ultimately made.

ACKNOWLEDGEMENTS

Open access funding enabled and organized by Projekt DEAL.

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How to cite this article: Barnum TC Nagin DS, Pogarsky G. Sanction risk perceptions, coherence, and deterrence. *Criminology*, 2021;1-29. https://doi.org/10.1111/1745-9125.12266