The Dynamics of Risk Perception for Soft Target Terrorism

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Abstract: Understanding the public's response to soft-target terrorism (low-tech terror attacks on unsecured public spaces) is crucial to effectively managing its consequences. Yet while most research on public terror reactions has focused on the construct of *risk perception*, the precise psychological nature of this construct remains ambiguous. Given the unique nature of soft-target terrorism as a threat, it is important to understand how the public perceives it over time, and precisely how public perceptions depend on individuals' affective, cognitive, and behavioral reactions to this threat. Using a longitudinal survey of terrorism attitudes over six months, during which multiple high-profile terror attacks occurred, we test for 1) the effects of such events on participants' risk perceptions, and 2) how participants' risk perceptions depended on more basic psychological variables, such as fear or estimates of attack consequences and likelihood. We find that the 2016 Orlando shooting had a moderate impact on respondents' risk perceptions, but not on expressed levels of fear or risk-reducing behaviors. Furthermore, risk perceptions were mostly impacted by prior estimates of terror attack likelihood, while risk-reducing behaviors only significantly depended on prior levels of fear. We discuss the implications for various psychological theories of risk perception.

Keywords: Risk perception, public response, terrorism, psychology

1. INTRODUCTION

Psychological science has long wrestled with the question of what, exactly, we mean by the term *risk* [1,2]. While it originally referred to the objective threat posed by a certain hazard, psychologists began to acknowledge that lay perceptions of risk could diverge sharply from experts' "objective" risk estimates [3,4,5]. Researchers within the *psychometric paradigm* began to conceptualize public risk perception as dependent not just on objective risk, but on a host of emotion-laden considerations such as a hazard's controllability or familiarity [3,5]. Yet while great progress has been made in explaining variance in risk perceptions, the question of what *risk perception* concretely means arguably remains. As late as 2002, years after the original development of the influential psychometric paradigm of risk perception, Slovic and Weber [6] acknowledged that the concept of risk was ambiguous and could take on multiple meanings based on the context. This leads to the question of how to best conceptualize risk perception on a psychological level and what researchers mean when studying how risk is perceived by the lay public.

While the answers to these questions have implications for all types of societal hazards, we argue they are especially crucial for understanding the public response to soft-target terror attacks. Soft-target terror attacks are low-tech, small scale assaults on unsecure public places that contrast with lower-probability, higher-consequence methods of terrorism, such as commercial airplane hijackings or CBRN (chemical, biological, radiological, nuclear) attack methods. Soft-target terror attacks are typically highly salient, widely publicized events that can have severe public consequences, yet are a more frequent and consistent threat than other forms of terrorism. Despite their small-scale nature, soft-target terror attacks can still induce changes in public behavior that can have adverse economic and public consequences, yet, as aforementioned, the psychological basis for *public risk perception* of this threat is not totally understood, and it is unclear which features of the threat (such as its consequences or likelihood) or of individuals' reactions to the threat (such as emotional states) loom largest in the risk perception process. It is thus important to understand how the public's risk

judgments of these types of terror attacks are formed over time, which features of the threat they are most sensitive to, and how such risk judgments are manifested in individual behavior.

1.1. Affective and Cognitive Facets of Risk Perception

In thinking about how the public perceives the risks associated with soft-target terrorism, we might best start at the normative definition of *risk* as an expected value—that is, a sum over the values of various outcomes, weighted by their probability of occurrence. Perhaps the two most obvious facets of any risk perception judgment, then, would be the perceived *consequences* of the hazard in question and its *likelihood* of occurrence. Yet it is unclear how one's estimation of these values contributes to overall perceptions of risk. Von Winterfeldt, John, and Borcherding [7] correlated individuals' judgments of risk for various personal hazards (such as hang gliding or living near a nuclear reactor) with estimates of 1) their likelihood of fatality due to the hazard, 2) the number annual fatalities caused by the hazard, and 3) the number of fatalities that would result from a *disastrous accident* involving the hazard, and found that estimates of risk correlated most strongly with likelihood judgments, though the consequences of disastrous accidents were also strongly predictive for hazards with low likelihood values.

Yet there remains ambiguity in how risk perception is measured in terms of these components. Some researchers have operationalized risk perception as based only on estimates of a hazard's likelihood [8,9], essentially equating overall risk judgments with judgments of probability, with no role for expected consequences. Yet a line of research on *probability neglect*, originating with Sunstein [10], argues that, for affect-rich hazards (such as terrorism, or nuclear explosions), judgments of consequence should overshadow judgments of likelihood. Sunstein points to research (taken from [11]) illustrating that participants placed relatively equivalent values on the possibility of receiving an electric shock, regardless of whether there was a 1% or 99% chance of it occurring, and suggested that for salient negative outcomes, the impact of probability is vastly reduced. Whether this is a manifestation of *probability neglect* or mere *probability weighting* is up for debate, but the general conclusion is that likelihood estimates may carry relatively little weight for highly salient hazards compared to estimates of their consequences. Although this finding seems to contradict the notion of likelihood as the prominent feature of risk judgments, it does align with results from [7] suggesting that consequence estimates should play the most prominent role in risk estimates of high-consequence, disastrous events. Still, it is unclear whether the public perceives soft-target terrorism to be a disastrous, low-likelihood hazard (which would suggest a larger role for consequence judgments), or a relatively low-consequence, high-likelihood hazard (given that soft-target attacks occur far more frequently than more catastrophic or exotic forms of terrorism, such as airplane hijackings or the use of biological weapons).

Even if the ambiguous relation between likelihood and consequence estimates is resolved, it is still unclear how these relatively cognitive assessments of risk interact with more affect-based components of risk perceptions. Perhaps the most comprehensive framework addressing this question is the *risk-as-feelings* model put forth by Loewenstein, Weber, Hsee, and Welch [12]. These authors draw on a wealth of psychological research and argue that some risk-related variables, such as the likelihood of a hazard's occurrence or its estimated consequences, contribute to cognitive judgments of risk. Other variables, such as one's present emotional state, the vividness of the hazard, or affect-laden transformations of probability and likelihood judgments, contribute to affective judgments of risk. Affective and cognitive evaluations of risk are said to interact and ultimately produce behavioral responses. Of course, it is now well-accepted that emotions play a crucial role in decision-making, and that such emotional interference need not be always seen as irrational or suboptimal (an argument that traces back to the Somatic Marker Hypothesis [13,14]).

A stronger assumption of the risk-as-feelings model is that affective and cognitive evaluations of risk can reciprocally influence each other. Individuals can cognitively control their emotional responses to certain stimuli, and emotions can moderate one's evaluation of likelihood and consequence judgments [11,15]. A stronger assumption still is that behaviors can be directly caused by emotional states, but that the impact of cognitive risk evaluations on behaviors is at least partially mediated by affect (see

[13,14] for examples of how a lack of affective responses can sever the link between cognitive knowledge of a situation and appropriate behavioral responses). Still, within domains typically studied by risk perception researchers, the magnitude of these relative effects (the mediational role of affect, the interplay between affective and cognitive risk evaluations) have not been identified. The risk-as-feelings model is often cited as a general testament that emotions play a role in risk judgments, but while the model originally set out to define what psychological risk is composed of, few studies have attempted to validate these claims. This has led to a general understanding that judgments of risk should depend both on cognitive and emotional factors, but quantifiable relations between these subconstructs are hard to come by. Thus, in the domain of soft-target terrorism, it is difficult to know how individual judgments of attack likelihood, judgments of their consequences, and overall affective reactions to the hazard combine to form comprehensive risk appraisals. Lastly, work on risk perception largely assumes that that personal evaluations of risk will drive's one's behavior in relation to the hazard [12,13,16], yet there has been little research on whether perceptions of risk can arise from one's past risk-focused behavior, despite the contention in other domains of psychology that emotions and attitudes can sometimes follow from one's behaviors [17]. Again, this question is of crucial importance when addressing the public response to soft-target terrorism, where individuals can take measures to lower their (perceived) exposure to terror risk, measures that can even have adverse economic consequences on the societal level**.**

1.2. Goals of the Present Study

We argue that a fuller understanding of the public response to soft-target terrorism requires concrete knowledge of how individuals' thoughts, emotions, and behaviors influence each other in the risk perception process. Other studies have examined public responses to the threat of soft-target terrorism [18,19,20], though none have attempted to disambiguate how risk judgments in this domain interact with and form from other component constructs, such as the estimated likelihood of a future attack or judgments of how severe an attack's consequences would be. Past research on risk perception has led to many testable hypotheses regarding such component constructs, whose verification is crucial to a sound understanding of risk perception; the goal of the present study is to test these hypotheses using a six-wave longitudinal panel survey conducted over a six-month period.

To study how risk judgments are formed over time, we rely on autoregressive path modeling techniques that can allow for tentative causal inferences by estimating the reciprocal effects between risk-related variables while controlling for their baseline values. Effects from autoregressive models are not technically sufficient to establish causality; however, they eliminate many of the alternative hypotheses that plague causal inference in cross-sectional designs, and therefore are much more likely to uncover true causal effects than other forms of analysis. Given that our longitudinal data collection overlapped with real-world instances of highly publicized terror attacks, we also look for changes in participants' responses in the wake of these terror attacks. This allows us to examine how public perceptions of threat varied with real-world terror events over time, and to identify which components of participants' risk attitudes and reactions were most affected by such occurrences. We thus focus our investigation on how respondents' risk perceptions are impacted by 1) the occurrence of real-world terror events, and 2) other self-reported affective, cognitive, and behavioral variables, with research questions as follows:

1) *How do measures of terrorism-related fear, likelihood estimates, and consequence estimates predict each other over time?* There is evidence that affect (such as fear/anxiety) can impact one's construal of a hazard's likelihood [10,11] and consequences [15], and that cognitive control can impact affective reactions to stimuli [12]. Yet the relative strengths of these predictive relationships in a real-world risk perception context is not known. It is possible that estimates of terror attack likelihood, estimates of consequences, and self-reported fear reciprocally influence each other over time. Yet it is also possible that some of these constructs are more endogenous than others, with asymmetrical effects that could shed light on which exerts the greatest influence on the others.

2) *How do measures of terrorism-related fear, likelihood, estimates, and consequences estimates predict risk perceptions over time?* Many studies elicit respondents' perceptions of risk

without clearly defining what risk entails. We thus seek to identify the degree to which respondents' answers to such risk perception items depend on their own hazard-related fear, estimates of consequences, and estimates of likelihood, to uncover the relative contributions of each variable to the more generic and ambiguous construct of risk. This also allows us to test specific predictions of the probability neglect literature, which suggests that for high-profile hazards such as terrorism, risk estimates should depend more on judgments of consequence than on judgments of likelihood, and contrasting findings from [7], which argues for a more influential role of likelihood judgments.

3) *To what degree are the impacts of likelihood and consequence estimates on risk perceptions and behavior mediated by affect?* One assumption of the risk-as-feelings model is that the role of cognition in determining behavior is at least partly mediated by affect. We thus seek to measure whether self-reported fear of terrorism at least partially mediates the link between cognitive risk variables (likelihood and consequence estimates) and ratings of risk perception.

4) *To what degree do each of the risk-related variables impact future risk-reducing behaviors, and to what degree to such behaviors influence later values of those same variables?* We test the implicit assumption in risk perception research that behaviors depend on evaluations of risk and investigate whether risk attitudes are shaped by past behaviors (which has not previously been studied in regards to terrorism risk perception).

5) *How do each of the aforementioned risk-related variables change in response to highly publicized terror attacks?* Our sample affords us the unique opportunity of examining how risk perceptions depend on real-world terror attacks. There is little research examining which psychological facets of terror risk perception are most sensitive to actual attacks; addressing this research question in conjunction with the reciprocal effects between each of the risk variables can shed light on which cognitive and emotional considerations mediated the relationship between actual terror attacks and corresponding changes in attitudes and behaviors.

2. METHOD

2.1. Participants

Participants were recruited from a continuing panel consisting of 1669 members (age 18 or older, fluent in English) from the United States and Canada originally recruited through various online advertisements (Google Ads, etc.) by Decision Research, Eugene, Oregon. The panel is designed as a quota sample, and while not necessarily statistically representative of the U.S. or Canadian populations, it is diverse with respect to age, ethnicity, and education. Only the 1508 panelists who reside in the United States were contacted about this study, given its overall focus on U.S.-related events, of which 700 agreed to participate. Data collection took place over six waves spaced approximately one month apart, with the number of participants at each wave as follows: n_{wave1}=700, n_{wave2}=664, n_{wave3}=646, n_{wave4}=624, n_{wave5}=606, and n_{wave6}=711. Only those participants who completed the previous survey wave were invited for each subsequent survey wave, with the exception of wave 6, which was open to all 1508 participants originally invited. For purposes of our analysis, we use data from participants with complete responses to all items of interest at all six waves, for a final sample of n=496 (63.9% female). Educational attainment in this sample was as follows: 98.8% graduated high school, 76.6% had some college or vocational training, 48.2% graduated college, and 14.7% had attained post-graduate education. The median age of the sample was 44 (IQR=19).

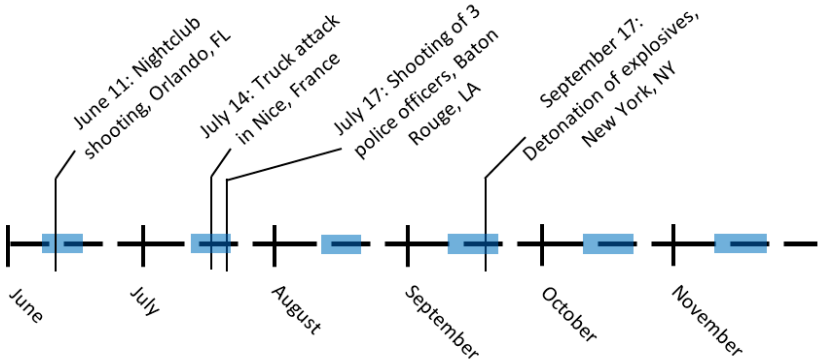
2.2. Procedure

All members of the aforementioned Decision Research Panel who resided in the United States were invited to participate in a six-wave survey regarding the threat of terrorism in the United States. Panel participants who volunteered to participate were administered the survey entirely online, and each wave of the survey was available for completion during the following dates in 2016: June 10-16 (Wave 1), July 11-18 (Wave 2), August 10-17 (Wave 3), September 11-20 (Wave 4), October 11-20

(Wave 5), and November 10-21 (Wave 6). As aforementioned, only participants who had completed the previous survey wave were invited back for the subsequent wave, with the exception of wave 6.

Certain highly-publicized acts of violence occurred during some of the waves of data collection that might have impacted participants' responses regarding the threat of terrorism. While terror attacks are a steady and consistent occurrence across the world, we chose to focus on events that 1) involved the killing or attempted killing of multiple people, 2) were highly publicized in the United States (given our use of a U.S.-based sample), and 3) occurred during one of the waves of data collection. Four events met this criteria: a nightclub shooting in Orlando, FL that killed 49 people (June 11, during wave 1), a truck attack in Nice, France that killed 86 people (July 14, during wave 2), a shooting that killed three police officers in Baton Rouge, LA (July 17, during wave 2), and the detonation of multiple bombs in New York, NY that injured 31 (September 17, during wave 4). The relative timing of these attacks and each data collection wave is summarized in Figure 1. While each of these events is unique and likely conforms to the definition of *terrorism* in varying degrees, each was deemed to potentially impact participants' responses regarding the threat of soft-target terrorism and was thus included for analysis.

Figure 1: Timing of Highly-Publicized Shootings and Terror Attacks During Data Collection



2.3. Materials

Among other items not analyzed here (which we do not report on), the panel survey included 12 items measuring participants' affective, cognitive, and behavioral reactions to the threat of soft-target terrorism in the United States, as follows:

2.3.1. Fear/Anxiety

Participants were asked to rate the degree to which they had felt anxious (item 1), worried (item 2), or frightened (item 3) when thinking about terror attacks from the past six months. Ratings were made on a four-point scale, with response options "never", "not very often", "sometimes", and "very often." We chose to focus specifically on fear, rather than on general negative affect, because distinct negative emotions have been found to differentially correlate with risk perceptions. Fear has been found to positively correlate with risk perceptions, while anger generally correlates negatively with risk perception [8], despite both being considered components of negative affect. Since we are primarily interested in the variables that contribute to perceptions of risk, we limit our emotion-based items to those that focus specifically on fear and anxiety.

2.3.2. Likelihood, Consequence, and Risk Judgments

Participants were presented with the possibility of "an armed attack on civilians" and "a bomb in a public place" and were asked to rate 1) how likely they thought the attack would occur over the next six months, 2) how severe the effects of the attack would be, and 3) the overall level of risk posed by the attack to the United States. Answer choices for each of the three variables of interest (risk, consequences, and likelihood) were as follows:

- Risk (five-point scale): Very low risk, low risk, moderate risk, high risk, very high risk
- Consequences (four-point scale): Not very bad, somewhat bad, pretty bad, very bad

- Likelihood (four-point scale): Not likely, slightly likely, somewhat likely, very likely

These items were meant to serve as measures of the cognitive components of soft-target terror risk perception (likelihood and consequence judgments), and of participants' generic risk attitudes. The definition of risk was intentionally undefined to investigate which variables correlate with respondents' implicit understanding of the term.

2.3.3. Risk-Reducing Behavior.

Participants were asked whether they, over the past six months, had performed any of the following because of their worry about a terror attack: avoided mass gatherings, changed travel plans to avoid certain destinations, or purchased a gun. These items were meant to measure respondents' tendency to take action against the threat of soft-target terrorism, by either taking measures to defend themselves (e.g., purchasing a gun) or avoiding locations with higher perceived risks of attack (avoiding mass gatherings, changing travel plans).

2.4. Analysis

2.4.1. Longitudinal Measurement Invariance

We first sought to ensure that the five groups of items were each measuring a single latent factor (fear/anxiety, likelihood perceptions, consequence perceptions, risk perceptions, and risk-reducing behaviors tendencies). We fit confirmatory factor analysis models to each construct, constraining for strong measurement invariance (equal loadings and item intercepts across all waves), which produced adequate fit for all five constructs (all CFI>0.99, RMSEA<0.05, SRMR<0.04) and loadings >0.75. This justified the treatment of each group of items as reflecting an underlying construct.

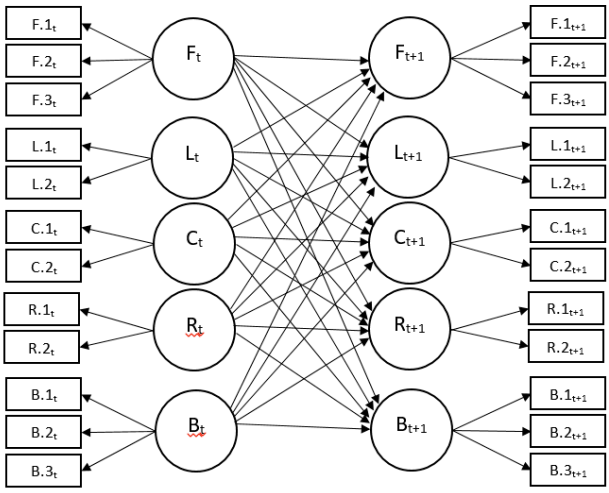
2.4.2. Autoregressive Cross-Lagged Model

After establishing measurement invariance for all constructs, we estimate the relationships among the risk perception variables using a cross-lagged autoregressive model. For two variables of interest *X* and *Y,* a cross-lagged autoregressive model allows for the estimation of *X's* effect on *Y* at a later time point while controlling for baseline values of *Y*. These models can be strongly indicative of causal effects because they can rule out the possibility of *Y* causing *X,* and can at least reduce the estimated effect between *Y* and *X* if they are merely caused by some third variable *Z*. Thus, they provide a stronger test of hypotheses than cross-sectional data alone.

Given the ordinal nature of the items, we fit the autoregressive model using Partial Least Squares (PLS) path modeling. Partial least squares models specify model constructs (e.g., "wave 1 fear") as weighted sums of their indicators and identify the item weights that maximize the covariance between composite constructs. Such models then use a nonparametric bootstrapping procedure for inference on each path coefficient, and thus rely on no distributional assumptions (making them well-suited for datasets with ordinal or binary variables that do not meet typical assumptions of normality, such as the items employed here). Each variable was specified as a potential cause of each of the other variables; thus, each construct for waves 2-6 has five incoming pathways indicating its dependence on 1) its own value at the previous wave, and 2) the value of each of the other four constructs at the previous wave, for a total of 125 path coefficient estimates. Figure 2 shows the path model setup for two subsequent waves (which was extended to all six waves for analysis).

To test for the effects of the four events of interest (Orlando shooting, Nice truck attack, Baton Rouge officer killings, and New York City detonations), we created dichotomous contrasts for each attack indicating whether participants completed the survey before (-1) or after (1) the event's occurrence and included these contrasts in the path model. Each event contrast was specified as a potential cause of each of the variables in the wave during which the event occurred (Orlando=wave 1, Nice=wave 2, Baton Rouge=wave 2, New York=wave 4), to test whether responses in that wave were generally higher (or lower) after the event.

Figure 2: PLS model setup for adjacent waves *t* and *t+1* (Note: L=Likelihood estimates. C=Consequence estimates. R=Risk estimates. F=Fear/anxiety ratings. B=Risk-reducing behavior ratings)



3. RESULTS

3.1. Descriptive Statistics

Although our main analysis relies on the estimation of constructs underlying responses to the ordinal items, we present descriptive statistics for each scale's simple sum score in Table 1. Internal consistency was satisfactory, with Cronbach's alpha at both waves exceeding .70 for most scales. Relative to the ranges of each scale, risk-reducing behavior scores were generally low, fear/anxiety and likelihood estimates were generally moderate, and consequence and risk estimates were relatively high.

Table 1: Descriptive Statistics for Raw Scale Scores Across All Waves

Construct (Range)	Value	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Fear (3-12)	Mean	7.56	7.76	7.64	7.44	7.45	7.45
	SD	2.57	2.59	2.54	2.61	2.58	2.60
	α	0.92	0.92	0.88	0.90	0.90	0.90
Likelihood (2-8)	Mean	5.31	5.69	5.30	5.25	5.40	5.26
	SD	1.59	1.51	1.59	1.59	1.53	1.60
	α	0.76	0.71	0.74	0.78	0.80	0.83
Consequence (2-8)	Mean	6.46	6.56	6.34	6.21	6.08	5.96
	SD	1.44	1.41	1.45	1.49	1.46	1.49
	α	0.83	0.82	0.81	0.83	0.79	0.82
Risk (2-8)	Mean	6.59	6.90	6.63	6.43	6.58	6.42
	SD	1.96	1.95	1.88	1.89	1.85	1.92
	α	0.83	0.86	0.84	0.84	0.82	0.85
Behaviors (0-3)	Mean	0.49	0.52	0.53	0.49	0.49	0.45
	SD	0.88	0.91	0.92	0.87	0.90	0.88
	α	0.70	0.68	0.69	0.68	0.70	0.77

3.2. Effects of Terror Attacks

According to the PLS model, those who completed the wave after the Orlando shooting gave significantly higher consequence (β=0.10; d=0.21), likelihood (β=0.21; d=0.44), and risk estimates (β=0.18; d=0.39) than those who completed it before the attack. At wave 4, participants who completed the survey after the detonation of an explosive device in New York City reported slightly higher levels of fear (d=0.14). There were no significant changes in respondents' affect, behavior, or

risk perceptions in response to the Baton Rouge police shooting or the Nice truck attack. Thus, the impact of these attacks on respondents' risk-related variables were largely confined to the Orlando shooting (with only a small effect of the New York City bombings), with its effects largely cognitive (rather than affective or behavioral) in nature.

3.3. Autoregressive Path Model

In addition to estimating the impacts of each soft target terror attack, the model also estimates how each risk-related variable depends on each of the other variables at the previous time points. We briefly summarize the model's implications for each research question as follows:

3.3.1. Fear, Consequences, and Likelihood Over Time

Table 2 presents the reciprocal effects of fear, likelihood, and consequence estimates at each wave. Parameters suggest that fear was generally more temporally stable (average β=0.669) than either likelihood estimates (average β=0.412) or consequence estimates (average β=0.487). Consequence and likelihood estimates seemed to develop relatively independently of one another, as none of their reciprocal cross-lagged effects were significantly nonzero. Fear had small but significant impacts on later likelihood and consequence estimates, which were largest for waves 4, 5, and 6 (average effect on likelihood=0.101; average effect on consequences=0.095). Fear was generally not significantly impacted by prior consequence estimates (average β=0.055) or likelihood estimates (average β=0.053). Thus, consequence and likelihood estimates were relatively independent of one another, had only negligible effects on fear, and were themselves somewhat dependent on prior ratings of fear/anxiety (though only to a small degree).

Table 2: Model Coefficients For Fear, Consequence, and Likelihood Across All Waves (Note: *p<0.05)

Previous Wave	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Fear					
Fear	0.640*	0.684*	0.644*	0.679*	0.694*
Likelihood	0.062	0.050	0.085	-0.016	0.086*
Consequences	0.043	0.032	0.053	0.096*	0.052
Likelihood					
Fear	0.034	0.110	0.105*	0.105*	0.152*
Likelihood	0.426*	0.326*	0.396*	0.514*	0.426*
Consequences	0.022	0.00	0.056	0.000	0.026
Consequences					
Fear	0.070	0.075	0.140*	0.064	0.125*
Likelihood	-0.004	0.056	0.053	-0.074	0.012
Consequences	0.440	0.390	0.489	0.556	0.558

3.3.2. Components of Risk Perception.

Table 3 presents the effects of fear, likelihood, and consequence estimates on risk perceptions across all six waves. Risk perceptions generally depended on all three of these variables, with likelihood estimates having a larger average effect (average β=0.215) than consequence estimates (average β=0.131) or fear/anxiety (average β=0.131). It is notable that the average effect of likelihood on risk perception was only 36% smaller than risk perception's average stability coefficient (average β=0.334), suggesting that a substantial portion of the variance in risk perception over time was attributable to likelihood estimates. Indeed, the average semipartial correlation between likelihood estimates and later risk perception estimates was 0.156, compared to an average semipartial correlation of 0.201 between risk perceptions at adjacent waves. Likelihood estimates and consequence estimates were generally dependent on past risk perceptions, though the same was not true of fear/anxiety (which did not significantly depend on risk perception in any of the waves). Thus, it seems that fear exerted a one-way influence on future risk judgments, but that risk judgments exhibited reciprocal effects with likelihood and consequence estimates.

It is worth noting that the effect of wave 1 fear on wave 2 risk perceptions was substantially smaller than this same cross-lagged effect at all other waves. This attenuated effect might reflect the impact of the Orlando attack, which seemed to increase respondents' consequence and likelihood estimates but not their self-reported fear, and thus may have attenuated the correlation between fear at wave 1 and risk perceptions at wave 2.

Table 3: Effects Between Risk Perceptions and Risk-Related Variables Across All Waves (Note: *p<0.05)

Previous Wave	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Risk Perceptions					
Fear	0.042	0.224*	0.137*	0.085*	0.169*
Likelihood	0.271*	0.243*	0.136*	0.234*	0.192*
Consequences	0.097*	0.138*	0.209*	0.116*	0.094*
Fear					
Risk	0.022	0.059	0.012	0.072	0.010
Likelihood					
Risk	0.165*	0.234*	0.151*	0.161*	0.230*
Consequences					
Risk	0.131	0.173*	0.075	0.131*	0.083

3.3.3. Mediating Role of Fear

To examine the role of fear/anxiety in mediating the impact of cognitive variables (likelihood and consequence) on risk perceptions, we calculate the total effects of likelihood and consequence estimate on risk perceptions two waves later by summing over their indirect paths through constructs at the intermediate wave. We then calculate the proportion of these total effects that are accounted for by fear/anxiety at the intermediate wave. As an example, the total effect of wave 1 likelihood estimates on wave 3 risk perceptions is 0.217, whereas the indirect effect through wave 2 fear/anxiety is 0.026, suggesting that 11.8% of the total effect is accounted for by fear. Applying this method for waves 1 & 3, 2 & 4, 3 & 5, and 4 & 6 suggests that fear accounted for 7.5%, 5.0%, 4.6%, and 0.0% of likelihood's total effect on risk perceptions, and 10.3%, 3.6%, 2.9%, and 13.7% of consequence's total effect on risk perceptions. Thus, the effects of cognitive risk estimates on overall risk perceptions were only slightly mediated by self-report ratings of fear. Fear did seem to mediate a non-negligible portion of the effects of consequence on risk perceptions at waves 2 and 5, though fear's role in the consequence-risk relationship was somewhat unstable (varying between 2.9% and 13.7%), and its largest effects at waves 2 (10.3%) and 5 (13.7%) have different explanations: the relatively large effect of wave 2 fear on wave 3 risk perceptions, and the relatively large effect of wave 4 consequence estimates on wave 5 fear. Thus, fear does not seem to play a consistent, non-negligible mediation role in the relationship between cognitive risk variables and overall risk perceptions.

3.3.4. Role of Behavior

Table 4 presents the reciprocal effects between each construct and risk-reducing behaviors. Fear/anxiety was arguably the only construct with a consistent, non-negligible effect on future behavior (average β=0.133), and risk-reducing behaviors significantly predicted future ratings of fear in all but one wave (average β=0.096). The average effects of behavior on other risk-related variables (0.031 for likelihood, -0.043 for consequences, -0.043 for risk perceptions) were substantially smaller than for fear/anxiety. Thus, self-reported fear surrounding soft-target terrorism and concrete behaviors seemed to exhibit a reciprocal relationship that was not shared by cognitive risk constructs.

Table 4: Effects Between Behavior and Other Constructs Across All Waves (Note: *p<0.05)

Previous Wave	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Behavior					
Fear	0.166*	0.117*	0.154*	0.059	0.168*
Likelihood	0.074	0.003	0.079	0.043	0.000
Consequences	-0.092*	-0.026	-0.009	-0.008	-0.039
Risk Perceptions	0.022	0.065	-0.043	0.002	0.040
Fear					
Behavior	0.093*	0.057	0.117*	0.103*	0.088*
Likelihood					
Behavior	0.015	0.110*	0.082	-0.054	0.000
Consequences					
Behavior	-0.011	-0.059	-0.030	-0.021	-0.094*
Risk Perceptions					
Behavior	0.070	0.068*	0.104*	0.005	-0.033

4. DISCUSSION

The purpose of this investigation was to examine how individuals' risk perceptions regarding soft-target terrorism formed over time, as a function of 1) highly publicized terror attacks, and 2) cognitive, affective, and behavior facets of risk perception. Regarding the real-world shootings and terror attacks that occurred during our sample, the largest observed effects occurred in the wake of the 2016 Orlando nightclub shooting. This result is relatively unsurprising, as the other attacks studied were either international rather than domestic (the Nice truck attack) or involved a far lesser death toll (the Baton Rouge officer shooting, explosives in New York City) than the Orlando shooting. Still, the impact of the Orlando shooting on participants' responses was confined to estimates of likelihood, consequences, and overall risk, as levels of fear and risk-reducing behaviors remained unaffected.

Interestingly, this distinction among the measured variables—risk perceptions, likelihood estimates, and consequence estimates versus fear and behavior—seemed to emerge when studying their reciprocal effects over time. Risk perceptions, though dependent on fear, consequence estimates, and likelihood estimates, only prospectively influenced consequence and likelihood estimates (but not self-reported fear). Fear, in turn, demonstrated stronger reciprocal effects with risk-reducing behaviors. Put simply, the variables seemed to generally operate in two "loops": estimates of consequence and likelihood formed risk judgments, which in turn shaped later consequence and likelihood estimates, while fear and behavior shaped each other over time. The Orlando attack largely impacted the first cluster of variables, while leaving the other relatively unchanged. Of course, this is somewhat of an oversimplification—fear exerted small but significant one-way effects on risk judgments, consequence estimates, and likelihood estimates, and there was almost no reciprocal effect between consequence and likelihood estimates (despite both of their dependence on risk judgments).

This pattern of findings sheds light on some of the outstanding questions surrounding the psychological nature of risk perception. Regarding the role of affect, it was clear that judgments of risk for soft-target terrorism depended on prior levels of fear, yet the role the cognitive risk considerations (likelihood and consequence estimates) in forming risk judgments was not mediated by fear—rather, it seems that fear, judgments of terror attack likelihood, and judgments of a terror attack's expected consequences each predicted unique variance in risk perceptions. However, respondents' risk-reducing behaviors were much more dependent on affective considerations than cognitive considerations, and interestingly even shaped future reports of terrorism-related fear. Thus, in line with the risk-as-feelings model, there did seem to be a direct relationship between behavior and fear that was not mediated by cognitive evaluations of the hazard. The finding that future estimates of fear can depend on past risk-reducing behaviors is a novel result that warrants further investigation.

Our results also help clarify the psychological nature of risk perception, an oft-referenced construct that has often gone without a clear psychological definition. Ratings of risk perception were strongly

related to estimates of terror attack likelihood, which mirrors findings from [7] suggesting a primary role for likelihood estimates when forming risk judgments. Findings from the literature on probability neglect [10] suggest that judgments of consequence should dominate when evaluating affectively-rich hazards, in which terrorism would likely be classified; yet it may be that soft-target terrorism, due to its relatively low consequences and frequent occurrence (compared to other forms of terrorism), is treated differently than more extreme forms of terrorism. Repeated media exposure to these kinds of incidents may make the consequences of these attacks less affectively salient and may shift individuals' attention to when the next attack will occur rather than on its actual outcome. Of course, our findings do not necessarily contradict past work on probability weighting or probability neglect, as our focus was on subjective perceptions of likelihood rather than the evaluation of probabilities. If anything, our results (along with those from [7]) simply suggest that, despite individuals' well-documented insensitivity to probabilities for high-consequence risks, the same should not necessarily be said of subjective perceptions of likelihood.

Still, while respondents' risk judgments were highly influenced by their estimates of terror attack likelihood, they were not synonymous with these estimates. If anything, our results point to a need for further clarification of the construct of risk on a psychological level. It seems that risk, as it was interpreted by participants, served as a sort of affect-weighted expected value, a quantity dependent on both consequence and likelihood information, but nevertheless shaped by one's own experience of fear in relation to the hazard. Yet it served as more than a mere composite of other component constructs, as it predicted unique variance in later likelihood and consequence estimates that could not be explained by other variables. Thus, it seems that the concept of risk does have meaning independent of its most proximal component constructs, meaning that may have more to do with respondents' cognitive evaluations of a hazard than their affective reactive to it.

Of course, our study was limited in its reliance on a panel sample, rather than one that is representative of the United States population. Thus, care should be taken in over-generalizing the results presented here. As aforementioned, there may be variables highly relevant to terrorism risk perceptions that were not studied here, which would also impact the generalizability of our model. For instance, the role of affect in the risk perception process is not likely confined to items focusing on self-reported fear; other emotions (anger, sadness, etc.) likely play important roles, and might moderate responses to other variables (as proposed by the risk-as-feelings hypothesis [12]). Still, we argue that the data presented here might allow future researchers to better understand risk perception in the context of soft-target terrorism. Our results suggest that public risk evaluations of soft-target terror are highly dependent on perceptions of likelihood, and that, while highly publicized terror attacks might shape individuals' cognitive evaluations of risk, they may not change their underlying affective or behavioral reactions to the threat. Our findings also suggest that risk perception carries unique predictive value beyond its most obvious components (fear, likelihood, and consequence judgments) and highlight the need to better understand its psychological substrates. Future studies should attempt to replicate and build off these findings, in hopes of developing a sounder understanding of how the mind integrates cognitive and affective information when confronted with the modern threat of terror.

4. CONCLUSION

Our findings suggest that likelihood estimates played a large role in the development of soft-target terror risk perceptions, and that risk perceptions carried unique predictive variance that impacted later estimates of likelihood and consequences. Thus, while the exact psychological nature of "risk" remains somewhat unclear, these results can inform future work that aims to use risk perception as a meaningful self-report construct in the study of public terrorism response.

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