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## **Are the effects of terrorism short-lived?**

Vincenzo Bove,<sup>1</sup> Georgios Efthymoulou,<sup>2</sup> and Harry Pickard<sup>3</sup>

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**Abstract:** Numerous studies demonstrate that terrorism causes strong public reactions immediately after the attack, with important implications for democratic institutions and individual well-being. Yet, are these effects short-lived? We answer this question using a quasi-experimental design and data on three successful and three foiled terrorist attacks in the United Kingdom. We find that heightened risk perceptions and emotional reactions in the wake of successful attacks do not dissipate in the very short run but are sustained over time and up to 130 days after the attacks. We also find that, whereas large-scale attacks cause a long-lasting shift in risk assessments and emotions, the corresponding effect of smaller-scale terrorism incidents appears to subside within one month. Interestingly, foiled attacks can also affect public perceptions, which, however, quickly return to normal levels. We argue that the extent of media coverage is partly responsible for the duration of these effects.

**Key words:** terrorism, risk perceptions, emotions, long-term consequences, quasi-experimental design

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**Note:** Online Appendix available [here](https://www.wider.unu.edu/publication/are-effects-terrorism-short-lived) as supplementary material (<https://www.wider.unu.edu/publication/are-effects-terrorism-short-lived>)

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<sup>1</sup> Department of Politics and International Studies, University of Warwick, Coventry, UK; <sup>2</sup> Department of Economics, University of Sheffield, Sheffield, UK; <sup>3</sup> Newcastle University Business School, Newcastle University, Newcastle upon Tyne, UK; corresponding author: [v.bove@warwick.ac.uk](mailto:v.bove@warwick.ac.uk)

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

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# 1 Introduction

The threat of terrorism features prominently in public and political debates, particularly in the wake of recent emblematic terrorist attacks across Europe. Terrorism has a meaningful connection to the public's psychology and cognition due to the explicitly political nature of terrorist acts, which aim to obtain a 'political or social objective through the intimidation of a large audience beyond that of the immediate victims' (Enders et al. 2011: 321). Terrorism aims at attracting public attention and shaping public opinion, but whether terrorist attacks have an effect largely depends on an audience's reception of them (Nussio et al. 2021). The study of public responses to terrorism has long been a very active area of research in numerous disciplines, and scholars have made a great deal of progress in demonstrating that terrorist violence can have substantial effects on key attitudes such as trust in government, migration preferences, and commitment to civil liberties (see, e.g., Balcells and Torrats-Espinosa 2018; Das et al. 2009; Davis and Silver 2004; Dinesen and Jæger 2013; Echebarria-Echabe and Fernández-Guede 2006; Falcó-Gimeno et al. 2022; Godefroidt 2021; Huddy et al. 2005; Legewie 2013).<sup>1</sup> Terrorist acts also result in a 'complex state of negative emotional arousal' (Godefroidt 2021: 5), making ordinary people feel vulnerable and helpless, and eliciting negative emotions such as anxiety, anger, and sadness, resulting in widespread mental health effects (Hansen et al. 2017, 2016; Sønderskov et al. 2021; Whalley and Brewin 2007). Are these estimated effects long-lasting? In this paper we depart from the magnitude of such effects and focus instead on their duration.

Our paper contributes specifically to recent quasi-experimental studies that have sought to identify the causal effect of terrorism on public sentiments by exploiting the unexpected occurrence of a terrorist attack during the fieldwork of a public opinion survey, where the timing of the event assigns survey respondents into treatment and control groups as good as randomly (for an overview of this approach, see Muñoz et al. 2020). This strategy allows researchers to estimate the causal impact of terrorism by leveraging answers to opinion surveys conducted right before and after attacks. Given the nature of the research question and because of data limitations, these studies usually track public reactions to terrorism only for a few days after the attack. Recent examples include Balcells and Torrats-Espinosa (2018: up to 5 days after the attack), Nussio et al. (2019: up to 3 days), Ferrín et al. (2020: up to 4 days), Van Hauwaert and Huber (2020: up to 18 days), Holman et al. (2022: up to 16 days), Breton and Eady (2022: up to 20 days), and Guo and An (2022: up to 30 days).<sup>2</sup> Overall, the findings suggest that terrorism does shape citizens' attitudes and emotions in important ways. As of yet, however, much less is known about the duration of such effects. Two notable exceptions are Bozzoli and Müller (2011) and Giani et al. (2021). Both use the 2005 London bombings to study the dynamics of public attitudes. Bozzoli and Müller (2011) find that changes in the perceived likelihood of an attack and the willingness to trade off civil liberties for enhanced security remained higher than baseline values throughout the duration of the survey. Giani et al. (2021) compare attitudinal responses to the 2005 London bombings during the 'very short run' of the following week, the 'short run' of the following three weeks, and the 'medium run' of the next three and a half months, and find that support for restrictions on core freedom increases only in the short run, before stabilizing at an increased level in the medium run.<sup>3</sup> That said,

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<sup>1</sup> We refer the reader to Godefroidt (2021) for a comprehensive discussion and meta-analysis of this rich literature.

<sup>2</sup> See also Vasilopoulos (2018) and Larsen et al. (2020), among others.

<sup>3</sup> Some key points distinguish our empirical work from Bozzoli and Müller (2011) and Giani et al. (2021). First, we focus on first-order effects, including the causal impact on emotions, over a longer period of time. Second, we rely on data from the Continuous Monitoring Survey, which offers an uninterrupted series of individual-level observations with a larger  $N$  and allows us to retain the statistical power of our analysis across all time frames. And third, we move beyond the focus on one single major event and instead exploit the timing of large-scale attacks, less salient attacks, and foiled attacks to shed light on the heterogeneity of the incidents' impacts.

there is a noticeable dearth of empirical studies wherein the risk assessments following an attack and the associated emotions are estimated using quasi-experimental methods.<sup>4</sup>

Against this background, this paper investigates the duration of the emotional and cognitive effects of terrorism using a series of natural experiments in the United Kingdom (UK), which exploit the timing of terrorist attacks. We focus in particular on *first-order effects*, the perceptions of terrorism risk, and the emotions that are stimulated by the attack itself. Terrorist acts have tended to inaugurate widespread policy changes such as the US Patriot Act, and thus understanding the psychology of terrorism is crucial to analysing the trajectory of public policy. Empirical studies show that risk assessments and (negative) emotions following terrorist episodes shape cognition and policy preferences (see, e.g., Avdan 2014; Epifanio 2016; Helbling and Meierrieks 2020a,b; Huddy et al. 2005; Lambert et al. 2010; Skitka et al. 2006). There are also wider implications for personal well-being and mental health (Sønderskov et al. 2021). Both direct and indirect exposure to collective traumas like 9/11 affected long-term health outcomes and led to post-traumatic stress symptoms and physician-diagnosed health ailments in a segment of the population (Silver et al. 2013; Whalley and Brewin 2007). Negative emotions are also associated to low life satisfaction, and emotion regulation is an essential feature of mental health (e.g., Gross and Muñoz 1995; Kuppens et al. 2008). We thus consider risk perceptions and the negative emotions stimulated by terrorism as highly consequential variables.

Beyond the distinct focus on short time periods following attacks, it is notable that extant studies have disproportionately focused on the 9/11 terrorist attacks in New York or other major, emblematic single cases, with much media coverage and many victims. Empirical research into a wider range of terrorist episodes continues to be needed to enhance the generalizability of the findings. To address this issue, we compare three Islamist terrorist attacks: first, the London bombings on 7 July 2005, one of the most important attacks on British soil in recent decades, when four explosive devices were detonated in Central London, killing 52 people and injuring more than 700; second, the Glasgow airport attack on 30 June 2007, when two men drove at the glass doors of the terminal in a car filled with propane canisters, killing one person and injuring five, with the potential to lead to a much larger death toll; and third, the murder of soldier Lee Rigby of the Royal Regiment of Fusiliers on 22 May 2013, stabbed and hacked to death in Southeast London. The three attacks are the same type of terrorist violence—Islamic terrorism—and thus similar in the ideological aim of the perpetrators. At the same time, differences in the lethality of the attacks and the amount of media coverage allow us to investigate how the salience of each attack affects the duration of the estimated effects. Comparing individual responses before and after terrorist attacks enables us to examine the causal effect of terrorism on people’s responses. We benchmark our results against failed terrorist plots—three foiled aeroplane hijackings in 2006, 2009, and 2010—using the same experimental design.

We find that the public’s perceived risk of terrorism increases in the aftermath of the attack, but its effect remains sustained in the short and medium runs. In fact, we detect a level shift upwards that is sustained up to 130 days after the attack. We also show that terrorism results in a state of heightened emotions, and like with risk perceptions, the effect remains statistically significant several weeks after the attack, although its magnitude declines over time. Individuals react in particular with anger and disgust to the threat of terrorism, the former often leading to more support for retaliatory measures such as military action (see, e.g., Fisk et al. 2019).

When we turn to the effect of individual attacks, we find that the salience of the attacks and the ensuing media coverage, by triggering emotional reactions, explain some of the differences across attacks. Given the media cycle and the number of fatalities, it is not surprising that the substantively strongest effects

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<sup>4</sup> Note that numerous studies on psychological reactions to 9/11 have also looked at longer periods, such as Apolone et al. (2002) or Schlenger et al. (2002), up to one and two months following the attack, respectively, yet they use data on psychological symptoms only after the attack, which makes it difficult to establish a causal impact.

are linked to the 2005 London bombings. Interestingly, we show that failed attacks still produce an effect by marginally increasing risk assessments, which, however, quickly return to normal levels, as opposed to successful attacks. In sum, whereas heterogeneity in the attack-induced reactions does exist, the effect of terrorism lasts well beyond the few days after the attack, particularly for successful attacks with a long media cycle.

## 2 The long-run effects of terrorism

### 2.1 Terrorism and risk perceptions

We expect audiences to perceive high risks of future terrorist attacks in the aftermath of an attack.

Risk assessments rarely conform to a calculus of risk as it is normatively understood—as a function of likelihood and severity (Baucum et al. 2021). In this sense, the public usually reacts to attacks by exaggerating assessments of future harm, given that the odds of being harmed by a terrorist act are probabilistically very low (Maguen et al. 2008). This judgement is underwritten by the psychology literature’s view that, in general, statistical probability plays little role in subjective risk assessments (Fischhoff et al. 2005). Among the factors making risk assessments regarding terrorism particularly prone to bias and normative conceptualization of risk is the tendency to pay more attention to low-probability but devastating threats (Gaissmaier and Gigerenzer 2012) and the fact that terrorist attacks—in contrast to natural disasters—are purposeful events, which have the effect of augmenting uncertainty (Viscusi and Zeckhauser 2017).

If terrorism results in heightened risk assessments which tend not to conform to a normative understanding of risk, what explains the temporal dynamics of attention to terrorism? The ‘return to homeostasis’ hypothesis suggests that after an initial dramatic spike following a terrorist attack, risk assessments quickly fall back to a baseline level. Sniderman et al.’s (2019: 245–46) perturbation model, for instance, suggests that ‘the peaks of mass reactions to terrorist attacks are limited in size and duration and their end states marked by a return to baseline values’. This framing suggests that risk assessments are governed by the general psychological tendency of emotional and cognitive perturbation to subside as individuals habituate and return to homeostasis or baseline arousal over time (Maguen et al. 2008). Studies of the psychological effects of war support this ‘return to homeostasis’ picture. Solomon’s (1995) investigation of the Gulf War, for instance, finds that surveyed individuals initially expressed significant fear after SCUD attacks in Israel, but that fear diminished quickly as individuals habituated psychologically. As Giani et al. (2021) argue, the literature generally tends to paint a picture of a ‘panic prone public’ whose immediate but very short-lived reaction to attacks (lasting about a week) is the desire for restrictive anti-terrorism policies, driven by heightened perceptions of terrorist risk.

Yet, contrary to the ‘return to homeostasis’ picture, there are suggestions that risk perceptions following terrorist attacks might have a longer duration. Bux and Coyne (2009) argue that the uniquely unpredictable nature of terrorist attacks has the effect of extending the duration of heightened risk perceptions as compared to other traumatic episodes. A handful of extant studies show some support for the notion that risk perceptions following terrorist attacks have extended durations. Young and Persell (2004) find that 41 per cent of surveyed nursing students nine months after the 9/11 attacks perceived further attacks as ‘somewhat likely’. Bozzoli and Müller (2011) show that both perceived likelihood and perceived threat of terrorism remained significantly above baseline (pre-attack) levels for several weeks after the 2005 London bombings. Using questionnaires distributed among a general community of 338 individuals in northwest England after the event, Bux and Coyne (2009) find that 12 per cent of a sample of residents of England surveyed between five and nine months after the 2005 London attacks continued to feel that another attack could be ‘imminent’.

## 2.2 Terrorism and emotions

We also expect terrorism to heighten emotions of a negative valence. Accordingly, studies conducted subsequent to 9/11 revealed widespread feelings of a negative valence above baseline values throughout the United States (see, e.g., Apolone et al. 2002; Galea et al. 2002; Schuster et al. 2001).

The political psychology literature frequently views the emotional reactions engendered by terrorist attacks as transitory, paralleling risk perceptions. Giani et al. (2021) argue that emotional reactions to terrorist incidents fade quickly (within a month), and thus, if emotions drive attitudinal changes, then shifts of attitudes towards restrictive policies should be stronger in the short run and fade quickly in the long run. Brandon and Silke (2007: 176) suggest that emotional responses to terrorism typically ‘reach its peak quickly and then dissipate’.<sup>5</sup> Hence, as in the case of risk perceptions, these emotional reactions are subject to a swift ‘return to homeostasis’, underwritten by the general tendency of perturbation to subside as individuals habituate and return to baseline arousal (Maguen et al. 2008). The extant literature, however, does not specify time frames in which we should expect public emotions to return to the baseline. Thus, for Brandon and Silke (2007), the duration of spikes in emotional reactions depend on the severity of the incident, but what constitutes ‘severity’ and longer and shorter durations of reaction are unspecified.

Empirical studies demonstrate that the serious psychological impacts of terrorist attacks tend to dissipate within a month. Breton and Eady (2022) find that indices of anxiety towards refugees rise sharply, then diminish quickly (within ten days) after a terrorist incident. Knudsen et al. (2005) find, in a study using National Employment Survey data from before and after the 9/11 attacks, that respondents interviewed within the first two weeks following the 9/11 attacks were 55.2 per cent more likely to have experienced depressive episodes than a control group interviewed before the attack. Between two and four weeks after the attack, this figure was 21.2 per cent, but by the period spanning weeks four to six no significant difference was found. Tsai and Venkataramani (2015), using a difference-in-differences approach applied to repeated cross-sectional data from participants in the 2000 and 2001 Behavioral Risk Factor Surveillance System surveys, find that the 9/11 attacks had an adverse, causal effect on a measure of psychological distress, but that these had resolved within four weeks. Schlenger et al. (2002), similarly, find that only two months after the 9/11 terrorist attacks, survey respondents from a representative sample of the US population were found to exhibit levels of ‘clinically significant psychological stress’ within the expected range for a normal community sample after an initial spike. It should be stressed, though, that this collection of studies often set a high bar for what is considered significant emotional effects, by measuring depressive episodes or days of depressive symptoms (e.g., Knudsen et al. 2005; Tsai and Venkataramani 2015) or ‘clinically significant psychological stress’ (e.g., Schlenger et al. 2002). Less severe emotional responses, which may not be of *clinical* significance but might nonetheless shape attitudes and underwrite political views are often overlooked.

Theoretically, the emotional impacts of terrorism could also have a more lasting duration. Pennebaker and Harber (1993) argue that collective experiences of trauma in a community follow a predictable temporal pattern. An initial ‘emergency stage’ of intense emotional reaction and intensive social manifestation lasts for one month. This is followed by a ‘plateau’ period of one month, wherein mental rumination is maintained at high levels, while the social sharing of emotion diminishes progressively. After two months, an ‘adaptation stage’ appears, wherein both mental rumination and outwards expressions of emotion slowly decline.

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<sup>5</sup> Analysis of collective trauma following terrorist attacks is sometimes viewed through the framework of ‘communal bereavement’, the ‘widespread experience of distress among persons who never met the deceased’ (Catalano and Hartig 2001: 333). This is thought to be particularly prevalent when the event in question is taken to indicate the ‘failure of institutions essential to the normal functioning of the community’ (Catalano and Hartig 2001: 334). These effects are considered short-lived, paralleling the quickly diminishing emotional impact of trauma in general (Knudsen et al. 2005).

There is a relative lack of empirical studies which support the notion that emotional reactions to terrorism might be long-lived. This might partly be attributable, however, to the general lack of studies on emotional reactions to terrorism over a long time period (Godefroidt 2021).

Among those studies which capture reactions to terrorism in the long run, Chaiguerova and Soldatova (2013) find evidence of anxiety, aggression, and depression in residents of Besland one year subsequent to a Chechen terrorist attack, although the extent of these emotions depend on the degree of respondents' exposure to the attacks. Whalley and Brewin (2007: 94) find evidence of spikes in emotional reaction that diminish over a course of months, rather than weeks, finding that empirical studies report rates of 'substantial stress' which are 'extremely high in the first few days after the incident but are already in decline in the first 2 weeks and by 6–8 weeks have fallen by two-thirds'.

### 2.3 The role of media coverage

One factor that can explain differences in the temporal dynamics of risk perceptions following terrorist attacks is the media coverage of a risk (Feigenson 2002; Ferwerda et al. 2017). Media attention makes the actions and political agenda of terrorist groups known to a general audience (Schneider et al. 2015). If heavy media coverage of a terrorist attack continues long after the incident, heightened risk perceptions among viewers might be extended, as recollections of the attack remain readily accessible in their memories (Tversky and Kahneman 1973). Another element of the connection between media coverage and the dynamics of risk perceptions is the media's particular framing of events. Framings presenting terrorism as a risk worth avoiding in daily life might enhance the extent and duration of public risk perceptions (Feigenson 2002; Tversky and Kahneman 1973). Giani et al. (2021) provide suggestive evidence that coverage of terrorism in tabloid newspapers in the months following the London bombings tracked attitudinal shifts in support for anti-terrorism measures. The authors theorize that risk perceptions, in this context, acted as an intervening variable between media coverage and policy attitudes.

Similarly, a number of accounts argue that the temporal course of collective emotional reactions, such as risk perceptions, might track messages from the media and government (Maguen et al. 2008: 21). As Lerner et al. (2003) suggest, images of terrorist episodes in media clips may engender strong emotional reactions in the public, which may play a role in sustaining emotional arousal. Ahern et al. (2002) find support for this thesis in survey results which show that watching distressing footage of 9/11 in media clips predicted PTSD symptoms. Silver et al. (2013), using a longitudinal survey of American adults, present evidence that greater media exposure to 9/11 predicted post-traumatic symptoms 1–3 weeks and 2–3 years after the attack.

Cho et al. (2003) find that media coverage which repeatedly presented highly emotional images explains a significant amount of the variance in the negative emotional responses evidenced in survey responses to the 9/11 terrorist attacks. Overall, media coverage is likely to amplify the effect of terrorism as the public is likely to pay attention to the news. But news coverage also serves as a useful proxy for the importance of the attack, given that media are more likely to report lethal attacks or those with salient victims. This issue will be considered in the empirical analysis.<sup>6</sup>

## 3 Data and empirical strategy

We use individual-level data on public opinion and emotions from the Continuous Monitoring Survey (CMS), a set of monthly national internet surveys of the British electorate (with around 1,300 respon-

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<sup>6</sup> In Online Appendix D we provide a theoretical model that can help the interpretation of our findings.

dents participating in each monthly survey) that were conducted as part of the British Election Study over the period 2004–14. The CMS has component questions that are asked every month, and, as such, it offers an uninterrupted series of individual-level observations on specific survey items that can be used to analyse public reactions to terrorism over a (relatively) long period of time.

To capture individuals’ perceptions about the risk of terrorism, we explore their answer to the following statement, which is worded in exactly the same way across all monthly surveys: ‘*Do you think the risk of terrorism to British citizens these days is...*’, with possible responses being: a lot better, a little better, the same, a little worse, and a lot worse. To capture emotions, we rely on their answer to the question ‘*Which, if any, of the following words describe your feelings about the risk of terrorism to British citizens (please tick up to four)?*’, with possible responses being: angry, happy, disgusted, hopeful, uneasy, confident, afraid, proud. Among negative feelings, the four stated ones (anger, fear, disgust, and unease) are the most prevalent in the context of terrorism and have been conceptualized as divergent emotional reactions to threat, with important psychological and cognitive consequences (Godefroidt 2021; Huddy et al. 2009).<sup>7</sup>

Using the CMS data, we create the main outcome variables for our regression analysis. We first construct the variable *Risk of terror*, a binary indicator taking value 1 if people report that the risk of terrorism these days is either a little worse or a lot worse (and 0 otherwise). We then construct four binary indicators, *Anger*, *Disgust*, *Unease*, and *Fear*, each taking value 1 if people choose the corresponding word to describe their feelings about the risk of terrorism (and 0 otherwise), as well as a ‘negative emotions index’ using the average value of the four aforementioned variables (see Balcells and Torrats-Espinosa 2018).

Comparing individual responses before and after terrorist attacks enables us to examine the causal effect of terrorism on people’s responses. Our identification strategy relies on the assumption that the timing of attacks is exogenous (unexpected) and largely randomly assigned relative to that of the interviews, and thus individuals interviewed after the attack can be defined as the ‘treatment’ group, whereas those interviewed before the attack can be defined as the ‘control’ group (Balcells and Torrats-Espinosa 2018; Muñoz et al. 2020). We consider three of the four ‘major’ terrorist attacks that occurred between 2004 and 2013: the London bombings (7 July 2005), the Glasgow airport attack (30 June 2007), and the Lee Rigby murder (22 May 2013).<sup>8</sup> The rationale for the choice of these three attacks is twofold. First, they all received widespread media coverage and resulted in deaths, which makes them particularly impactful and relevant. This implies that, regardless of where each attack occurred, individuals from all over the UK were potentially exposed to them. Second, all three attacks were motivated by Islamic extremism, which ensures that the reactions to terrorism are homogeneous with respect to the characteristics of the perpetrators and the driving goals (see Pickard et al. 2022).<sup>9</sup>

Our empirical model specification takes the following form:

$$y_{irw} = \alpha + \beta T_{irw} + \lambda_{rw} + \varepsilon_{irw} \quad (1)$$

where  $y_{irw}$  is one of the outcome variables for individual  $i$ , living in region (government office region)  $r$ ,<sup>10</sup> and interviewed around the time of terrorist attack  $w$ ;  $T_{irw}$  is a binary indicator that takes value 1

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<sup>7</sup> Note that ‘unease’ is meant to capture ‘anxiety’ (<https://www.nhs.uk/mental-health/conditions/generalised-anxiety-disorder/overview>).

<sup>8</sup> Online Appendix A1 offers background material on the three terrorist incidents.

<sup>9</sup> The only other major (deadly) attack that occurred over the period 2004–14 was the murder of Mohammed Saleem (29 April 2013). We do not consider this attack since it was motivated by right-wing extremism and it took place 23 days before the murder of Lee Rigby, and thus the individuals interviewed between the two attacks are already defined as ‘control’.

<sup>10</sup> England, Scotland, and Wales are divided into 11 regions.



if the individual was interviewed after the day of the attack, and 0 before the day of the attack;<sup>11</sup>  $\lambda_{rw}$  represents attack-by-region fixed effects;<sup>12</sup> and  $\varepsilon_{irw}$  is an error term, clustered at the attack-by-region level. We compare answers between the control group, interviewed 30 days before the attack, and three different treated groups, interviewed at three distinct time intervals or ‘frames’. Specifically, following Giani et al. (2021), we first compute the treatment effect among respondents interviewed within one week after the attack, the *very short run*, when the threat is the most salient and emotions are potentially very high; we then focus on respondents interviewed in the first month (minus the first week) of the attacks, the *short run*, which represents the short period following the initial emotional reaction; and finally, we look at the responses of individuals interviewed in the next 100 days (the first 130 days after the attacks minus the first month), the *medium run*. The latter allows us to understand whether any reaction is short-lived or yields a more permanent shift in attitudes or emotions.

A concern that may arise when one considers outcomes that are measured a long time after the treatment (event) occurred is that this might lead to an underestimation of the effects and a greater potential for bias due to the occurrence of other unrelated events (Muñoz et al. 2020). As such, many researchers choose to rely on narrow bandwidths (short time intervals) around the event date as a way to reduce the probability that other events or factors drive the estimated effects. An important reason why this concern is much less acute in our context is that we focus on the first-order effects of terrorism and exploit information from survey items that are designed to capture *attitudes and feelings elicited by terrorism*—as opposed to general attitudes or the emotional state, which may depend on a wide range of factors and can be influenced by multiple events. This, together with the fact that no other major terrorist incidents occurred within 130 days after the sampled attacks, maximizes the probability that the pre-/post-attack changes in our outcomes are caused by these attacks, and allows us to credibly estimate the duration of the resulting effects.

Another possible threat to our identification strategy is that individuals with specific characteristics may respond to the survey at different points in time, and these characteristics may be predictive of the outcome. In Online Appendix B1 we show that there is a strong balance in observed characteristics across treatment and control units, and that the reported estimates do not change when we augment Equation (1) with a wide set of individual-level controls, including gender, age, education, income, and ethnicity. In addition, we use entropy weighting (Hainmueller 2012) to weight the control group in a way such that the moment conditions of each covariate match the one of the treatment group, and employ coarsened exact matching (Blackwell et al. 2009) as an alternative approach to produce a covariate balance between the treatment and control units. To lend further credibility to the causal estimates, we also conduct a number of robustness checks, such as testing for pre-existing trends and estimating the treatment effect on outcomes that should not be affected by terrorist attacks.

## 4 Results

### 4.1 Dynamics of risk perceptions and negative feelings

We start by providing a graphical representation of the conditional relationship between the treatment indicator (in bins) and the mean of the variable *Risk of terror*, using a ‘binned scatterplot’. Relative to the standard approach of reporting results (i.e. plots of fitted values) the binned scatterplot depicts the non-parametric relationship of interest and allows the quick detection of non-linearities, outliers, and

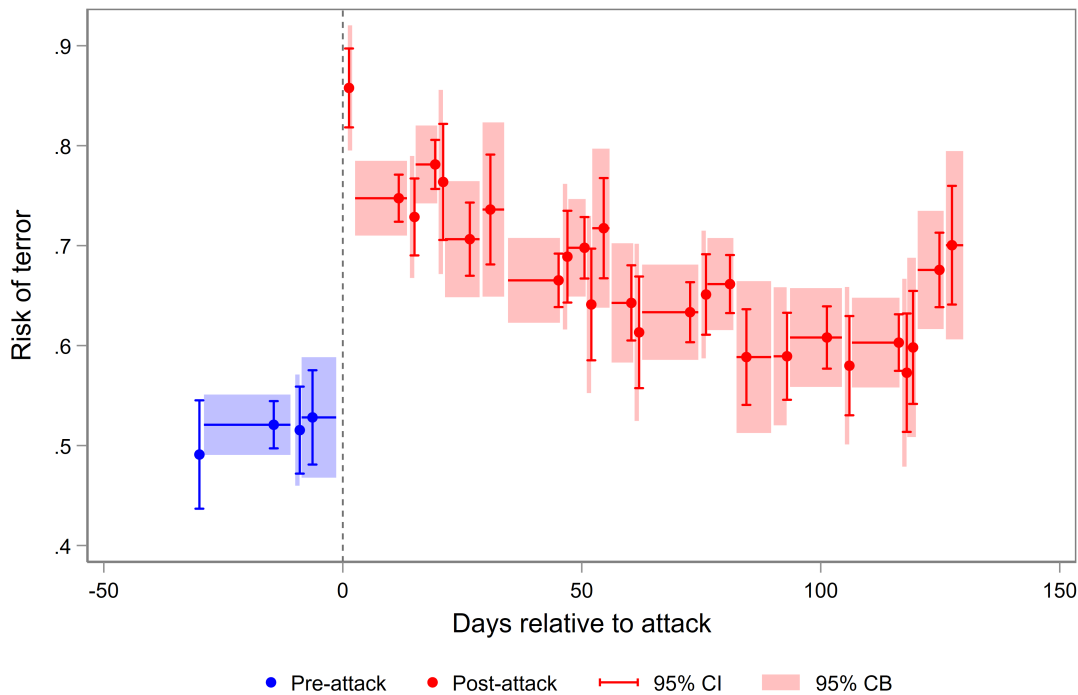
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<sup>11</sup> To avoid measurement errors, we drop individuals who were interviewed on the day of the attack.

<sup>12</sup> The inclusion of attack-by-region fixed effects restricts the pre- and post-attack comparisons to individuals interviewed around the same attack and living in the same region, which can also remove any biases arising from systematic differences in how the monthly surveys were conducted (Balcells and Torrats-Espinosa 2018).

distributional differences (Hainmueller et al. 2019; Starr and Goldfarb 2020).<sup>13</sup> As shown in Figure 1, exposure to new terrorist attacks leads to strong post-attack reactions: the public’s perceived risk of terrorism increases from around 0.52 (on a 0–1 scale) to more than 0.75 in the first few days following the attacks. We can also see that the mean estimate of *Risk of terror* declines in the medium run but remains significantly higher than that of the control group. In fact, the temporal dynamics reveal a level shift upwards that is sustained over time and up to 130 days after the attacks. This finding runs counter to the ‘return to homeostasis’ hypothesis about risk perceptions, which predicts a return to baseline levels of perturbation after a short-lived and dramatic spike. Although the extant literature is not clear about the precise time frame in which we would expect a spike to diminish, the finding that terrorism risk perceptions are consistently higher after the attacks than before the attacks provides strong evidence that this type of response follows a different and extended trajectory.<sup>14</sup>

Figure 1: Risk of terror: non-parametric estimates



Note: this figure displays a binned scatterplot and the corresponding confidence intervals and confidence bands, as described in Cattaneo et al. (2019b) and implemented using the `binsreg` package. We choose the number of bins by minimizing the integrated mean squared error of the binned scatterplot in the pre- and post-attack periods, as in Cattaneo et al. (2019a). The estimation includes attack-by-region fixed effects.

Source: authors’ calculations based on CMS data.

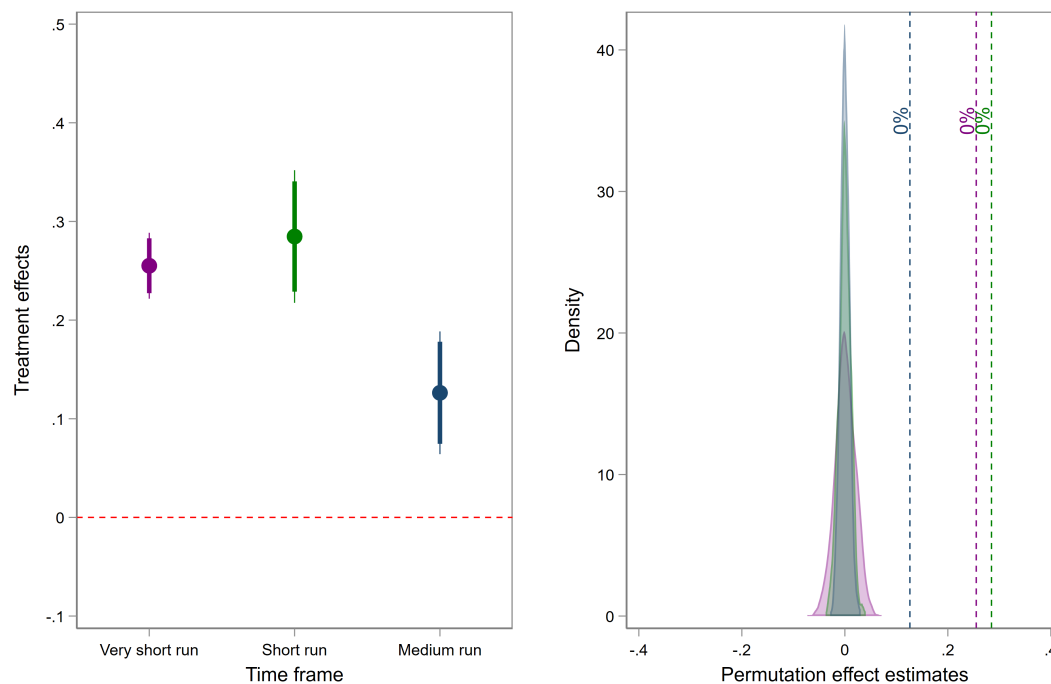
We continue by estimating Equation (1) across the three predetermined time frames (as discussed in the previous section) using a linear probability model. The results are displayed in the left panel of Figure 2. In line with the patterns of Figure 1, we can observe a large and highly statistically significant change

<sup>13</sup> One of the most important choices in constructing a binned scatterplot is the number of bins. As noted by Starr and Goldfarb (2020), more bins allow the researcher to identify more curvilinear patterns, but because each bin has fewer data points there will be more idiosyncratic variance; in contrast, fewer bins include more data points, leading to more precision, but may be less effective in identifying non-linearities. To trade off the bias and variance in an objective way, we choose the number of bins by minimizing the integrated mean squared error of the binned scatterplot, as in Cattaneo et al. (2019a). Confidence intervals around a single point may be somewhat misleading since each point in a binned scatterplot represents the data from an entire interval of data (Starr and Goldfarb 2020). As such, we report both confidence intervals (at a single point, the mean within the bin) and confidence bands (across the whole bin).

<sup>14</sup> These findings are also in line with Bux and Coyne (2009), who suggest that a swift return to baseline perturbation is not to be expected after a terrorist episode, given the dramatic way in which it forces the public to revise its beliefs about risk.

of perceptions in the very short run, which persists in the short run. Substantively, the point estimates imply that the perceived risk of terrorism increases by about 50 per cent in the very short run, and by about 56 per cent in the short run, relative to the pre-treatment mean. In the medium run, we can observe a decline in risk assessments compared to the short run; yet, the treatment effect retains its statistical significance and is far above the pre-treatment levels, suggesting that people continue to feel that another attack is possible for quite a long time after the attack. To ensure that the reported estimates are unlikely to be observed by chance, we perform permutation tests that randomly shuffle the data 1,000 times and estimate a treatment effect for each random draw and each time frame. The resulting distributions are displayed in the right panel of Figure 2. As can be seen, there is 0 per cent probability that the observed treatment effects are observed by chance, providing further credibility to our causal claims.

Figure 2: Risk of terror: main results



Note: the left panel displays the treatment effect on public perceptions about the risk of terrorism across the three time frames (very short run, short run, and medium run). The treatment effects are estimated using a linear probability model, controlling for attack-by-region fixed effects. Standard errors are clustered at the attack-by-region level. Fat (thin) lines signify the 90 per cent (95 per cent) confidence interval. The sample sizes are:  $N$  (very short run) = 4,186;  $N$  (short run) = 5,886; and  $N$  (medium run) = 14,957. The right panel shows the results from permutation tests that randomly shuffle the data 1,000 times, strataed by attack-by-region, and estimate a treatment effect for each random draw and each time frame. The reference lines show the observed effects, with labels reporting the proportion of times that the treatment effects under the permuted data are at least as extreme as under the observed data.

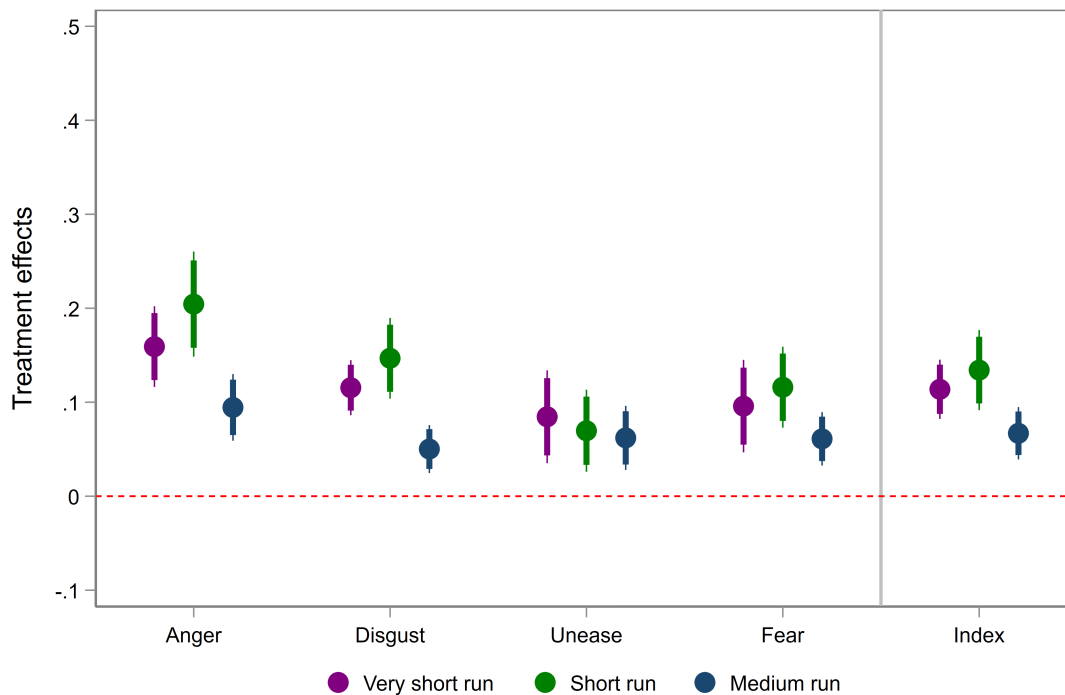
Source: authors' calculations based on CMS data.

Figure 3 shows the results for emotions of negative valence, based on the same regression set-up as in Figure 2.<sup>15</sup> The evolution of negative feelings, as captured by the overall index, is consistent with the dynamics of risk assessments: there is a sharp increase in the first week after the attacks, a further (mild) increase in the next three weeks, followed by a noticeable decline afterwards (the next 100 days). Still, even in the medium run, the treatment effect remains substantively and statistically significant, suggesting, once again, that the 'return to homeostasis' view might be misguided. Turning now to the four components, we can see that anger, and to some extent disgust, prevail over the other negative

<sup>15</sup> The binned scatterplot for the negative emotions index, as well as the full regression results for risk perceptions and the negative emotions index across the three time frames, are available in Online Appendix C.

feelings in the very short run and short run, and can largely explain the more intense emotional reaction to terrorism in the immediate aftermath of terrorist attacks.<sup>16</sup>

Figure 3: Negative emotions: main results



Note: the figure displays the treatment effect on the outcome listed on the horizontal axis across the three time frames (very short run, short run, and medium run). The treatment effects are estimated using a linear probability model, controlling for attack-by-region fixed effects. Standard errors are clustered at the attack-by-region level. Fat (thin) lines signify the 90 per cent (95 per cent) confidence interval. The sample sizes are:  $N$  (very short run) = 4,350;  $N$  (short run) = 6,089; and  $N$  (medium run) = 15,432.

Source: authors' calculations based on CMS data.

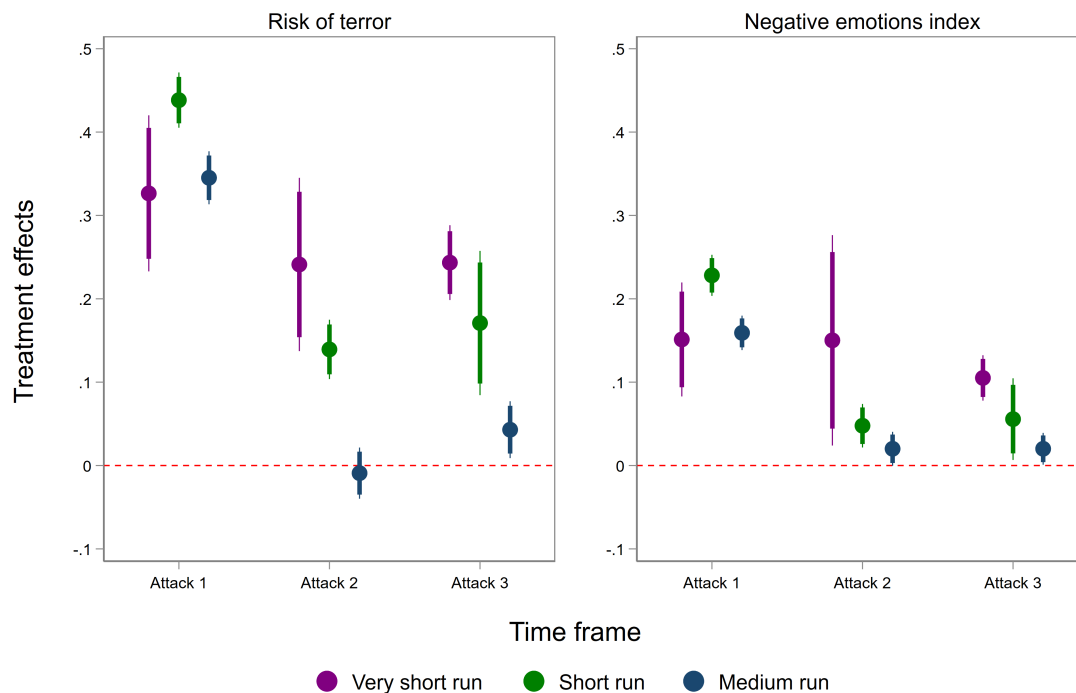
## 4.2 Results for individual attacks

As discussed in Section 2.3, media coverage can play an important role in determining the extent and duration of public risk perceptions and emotional reactions. As such, one would expect the results to be stronger and longer-lasting for attacks that received prominent and prolonged attention in the national media. To test for this, we run the same analysis as in Figures 2 and 3 for each sampled attack separately. The corresponding results, reported in Figure 4, verify the moderating role of media coverage in how individuals respond to terrorism. For the 2005 London bombings (attack 1)—a highly shocking and sensational event with a large number of victims and a quite long media cycle—the effects seem to persist over a long period of time: both risk perceptions and negative feelings increase in the very short run, become more pronounced in the short run, and stabilize (at the initial post-attack levels) in the medium run. On the other hand, for the 2007 Glasgow airport attack and the 2013 Lee Rigby murder (attacks 2 and 3, respectively)—two less severe terrorist incidents with a small number of victims and a short media cycle—the effects appear to be transitory: while there is a large increase in risk assessments and negative emotions in the very short run (similar to that of the 2005 London bombings), both reactions become weaker in the short run and return to baseline levels (or remain marginally above them) in the medium run. Overall, two conclusions emerge from this analysis. First, large-scale attacks can cause a large and long-lasting shift in public reactions; and second, smaller-scale attacks can still trigger sizable

<sup>16</sup>Evidence of increased negative feelings in the wake of terrorist attacks is also provided in Online Appendix A2, based on a sentiment analysis of Twitter data.

changes in attitudes and emotions, which, however, tend to dissipate within one month—in line with the short media cycle of these events.<sup>17</sup>

Figure 4: Risk of terror and negative emotions: results for each attack



Note: see the notes of Figures 2 and 3. Attack 1 = 2005 London bombings; attack 2 = 2007 Glasgow airport attack; attack 3 = 2013 Lee Rigby murder. The sample sizes for the left panel are:  $N_1$  (very short run) = 1,211;  $N_1$  (short run) = 2,511;  $N_1$  (medium run) = 4,693;  $N_2$  (very short run) = 1,156;  $N_2$  (short run) = 2,230;  $N_2$  (medium run) = 5,473;  $N_3$  (very short run) = 1,819;  $N_3$  (short run) = 1,145;  $N_3$  (medium run) = 4,791. Similar sample sizes are used in the right panel.

Source: authors' calculations based on CMS data.

### 4.3 Comparison with failed attacks

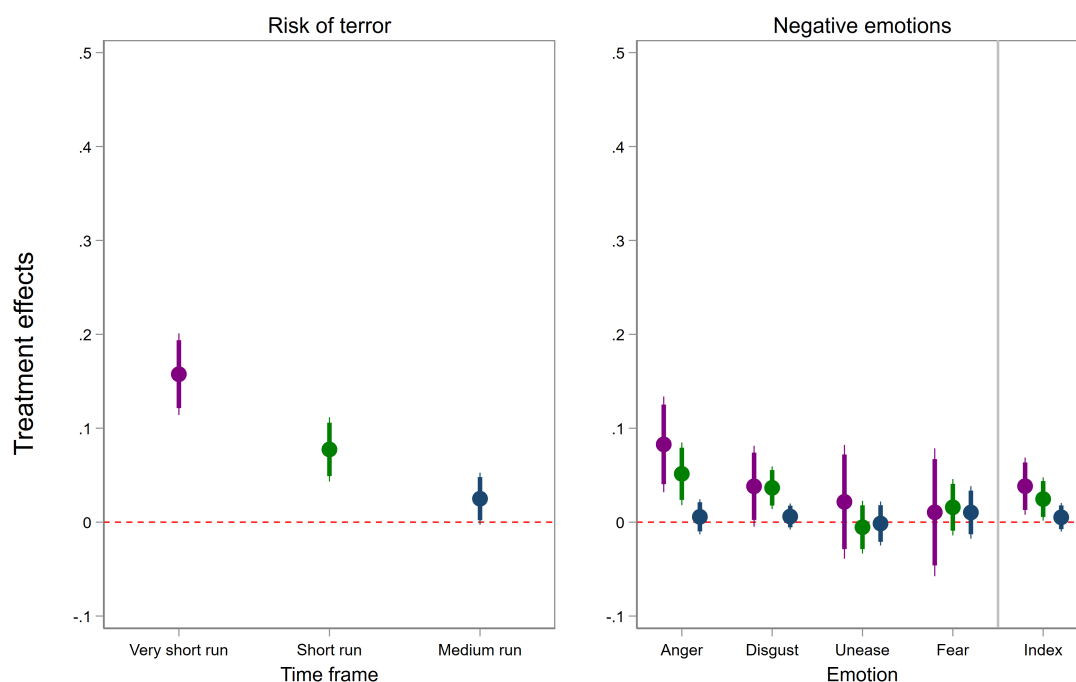
To better understand how large and persistent the reported effects are, we perform a benchmarking exercise where we compare our results with those for failed attacks. More precisely, we run the same regression set-up as before but we now exploit information from three foiled aeroplane hijackings whose timing coincides with the CMS data-collection period.<sup>18</sup> Since these attacks were interrupted by the security services, the content of media reporting was mostly informed by government announcements. Nevertheless, each event was covered extensively on national media.<sup>19</sup> The left panel of Figure 5 presents the treatment effect of these failed attacks on *Risk of terror* across the three time frames. Overall, we can observe an increase in risk assessments, which quickly decays back to baseline levels. Substantively, the effect is about 40 per cent smaller in the very short run, and about four times as small in the short run, compared to the successful attacks. Turning now to the evolution of negative feelings after these failed attacks (right panel of Figure 5), we can detect a very small increase in *Anger* and *Disgust* in the very short run and short run—which is 50–75 per cent smaller than for successful attacks—but no effects in the medium run (and no effects at all for the other two feelings).

<sup>17</sup> See Online Appendix A3 for a more detailed discussion about the extent and duration of media coverage for each of the three attacks.

<sup>18</sup> The foiled aeroplane hijackings took place on 9 August 2006, 25 December 2009, and 9 October 2010.

<sup>19</sup> See, for example, <https://tinyurl.com/38tcbps>, <https://tinyurl.com/ydvfmfpy>, and <https://tinyurl.com/24ktknrx>, for each attack, respectively.

Figure 5: Risk of terror and negative emotions: failed attacks



Note: see the notes of Figures 2 and 3. The sample sizes for the left panel are:  $N$  (very short run) = 3,001;  $N$  (short run) = 5,480; and  $N$  (medium run) = 12,010. Similar sample sizes are used in the right panel.

Source: authors' calculations based on CMS data.

Overall, our results support the argument that failed or foiled terrorist attempts, when they are largely reported in the media, can produce a ‘strong alarming effect on a wide audience’ (Shoshani and Slone 2008: 637), which can lead to increased threat perceptions and anger in the first few weeks after the attacks. However, as memories of such ‘near-miss’ terrorist incidents fade and evaluations of how close the events came to being successful attacks diminish (Dillon et al. 2014), the resulting effects quickly return to normal levels.<sup>20</sup>

#### 4.4 Further analyses and robustness tests

In Online Appendices B2–B8 we carry out additional analyses and robustness checks. Specifically, we perform validity tests to strengthen our identification assumptions, including testing for pre-existing trends (Section B.2); conduct placebo tests on alternative outcomes to rule out the possibility of spurious relationships (Section B.3); examine the treatment effect on positive emotions about the risk of terrorism (Section B.4); test for heterogeneity in the direction (and duration) of the terrorism effects across individuals (Section B.5); explore the conditionality of the effects upon geographic distance by comparing the results for attacked and non-attacked regions (Section B.6); and check robustness to using a probit model rather than a linear probability model (Section B.7). Taken together, the results lend credibility to our causal claims and provide strong support to our key findings. Finally, in Section B.8, we test for a ‘second-order echo effect’ of terrorism: its influence on migration attitudes. We find that terrorism can

<sup>20</sup> This is also in line with the study of Brodeur (2018) on terrorism, public uncertainty, and employment. The author finds that successful attacks reduce the number of jobs and total earnings in the years following the attack by 2 per cent, whereas failed attacks have no statistically significant impact. He argues that the intervening variable of heightened media coverage of successful attacks—in comparison with unsuccessful ones—explains this discrepancy. Given the presence of media coverage in our context, an equally plausible explanation is that the heightened emotional reactions to the human costs associated with successful terrorist attacks—which is not present in cases of failed attacks—can cause larger and longer-lived effects.

also lead to a long-lasting shift in such attitudes, with people perceiving the number of asylum-seekers as a more important problem after the attacks compared to before the attacks.<sup>21</sup>

## 5 Conclusions

We study the long-term effect of terrorist attacks on risk perceptions and negative emotions using a quasi-experimental design and six terrorist attacks in the UK. Our results suggest that both heightened emotional reactions and risk perceptions that result from terrorist attacks tend not to dissipate in the short run. For society, the magnitude of the estimated effects are grave. Using 2021 population figures, back-of-the-envelope calculations indicate that approximately 17–19 million more people have heightened risk perceptions in the first 7 days (very short run) and the proceeding 3 weeks (short run) after the attacks, compared to 30 days before the attacks. For around 8.4 million more people, the effects persist into the medium run (the next 100 days). Looking at the effects for individual attacks, our results suggest that large-scale attacks cause a long-lasting shift in public perceptions and emotions, whereas smaller-scale attacks trigger significant changes in attitudes and emotions, which, however, subside within one month. Finally, performing a comparison with failed attacks, we find that this type of attack produces some small effects on risk perceptions, which, unlike successful attacks, quickly return to normal levels.

The deleterious consequences attached to these heightened reactions are likely to confront policymakers long after attacks occur. For one, intense emotional responses to terrorism have been linked with shifts in attitudes towards public policy. For example, high levels of anger in a population may lead to policy preferences for aggressive military action which seek to retaliate against an identifiable target. Similarly, the terror management theory suggests that ‘mortality salience’, or the continuing cognition of the inevitability of death, primed by traumatic events such as terrorist attacks, can lead to ‘ideological intensification’ wherein audiences entrench their commitment to pre-existing cultural worldviews. As such, exposing subjects to news about terrorist incidents confronts them with thoughts about death, which in turn cause an increased prevalence of prejudiced attitudes towards out-groups.

The possibility that media reports may be partly responsible for continued, heightened emotional responses and risk perceptions after terrorist attacks suggests that these unintended effects should be considered in shaping media reporting. In particular, repeatedly or disproportionately broadcasting violent images may have the effect of extending the duration of heightened risk perceptions, and potentially result in long-term clinically significant psychological conditions. Taken together, our findings highlight the gains in disentangling the quantitative effects of terrorism over the short and long run, and point to the need to identify remedial measures to counteract negative spillovers, such as deteriorating levels of mental health.

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<sup>21</sup> We report the full regression results in Online Appendix C.

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