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Security interventions and perceived safety and threat following workplace terrorism: a three-wave longitudinal study of ministerial employees in Norway

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ABSTRACT

Spending on counterterrorism interventions has increased markedly in recent decades despite limited evidence supporting their effectiveness. Effectiveness research is mostly based on statistical modelling of risk and risk reduction and tends to ignore the impact interventions have on the subjective consequences of terrorism in a population – e.g. increased fear and anxiety. Feeling fearful and unsafe is common after terrorism and has been shown to mediate negative health outcomes and reduce work functioning in violence-exposed workers. The primary aim of the present study was to explore if visible security measures and escape- and evacuation training are associated with perceived safety and threat in terror-exposed employees. Data from a three-wave longitudinal questionnaire-based observational study of ministerial employees conducted 10, 22 and 34 months after the terrorist attack on the government headquarters in Oslo, Norway in 2011 was combined with retrospective data on installed visible security measures and escape- and evacuation training in ministries for the same period. The main outcomes were employees' perceived safety and threat at work, both scored on a 5-point Likert scale. Results were analyzed with multilevel mixed-effects ordered logistic regression. There was some evidence that more installed visible security measures were associated with higher employee perceived safety at work ($.020 < p$ value $< .061$). The findings on the association between security measures and employee perceived threat were unclear, and there was no evidence that escape- and evacuation training was associated with employee perceived safety or threat. Contrary to what is oftentimes argued in the literature, our study suggests that the installation of visible security measures increases perceived safety in terror-exposed individuals and has no clear effect on perceived threat. Our findings may help close knowledge gaps in counterterrorism effectiveness research and aid decision-makers when discussing post-terrorism strategies and interventions.

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Introduction

The amount of public resources spent on counterterrorism measures has increased substantially in many countries in the last decades (Archick et al. 2006; Hobijn and Sager 2007). Ensuring

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public safety has been the driving argument in justifying the increased spending. Limited research exists, however, on the effectiveness of anti-terror measures at enhancing public safety despite more studies addressing the issue in recent years (Lum, Kennedy, and Sherley 2007; LaFree and Dugan 2009; van Um and Pisoiu 2015). The available evidence mostly relies on statistical modelling of how different measures affect the risk of terrorism, with some studies adding a cost-benefit component to get a monetary estimate of effectiveness. Overall, there is weak or no evidence in favor of most of the counterterrorism measures examined (Lum, Kennedy, and Sherley 2007; Stewart 2008; Stewart and Mueller 2008, 2014; Akhtar, Bjørnskau, and Veisten 2010). A limitation in the above research is the inherent difficulty in doing statistical analysis and modelling of rare, complex and random events like terror attacks. A further weakness of the cost-benefit studies is that counterterrorism measures have many costs and benefits that are hard to account for in direct monetary terms (e.g. Prentice 2008; Akhtar, Bjørnskau, and Veisten 2010; Lieberman 2011).

Another criticism of counterterrorism effectiveness research is that most of the evidence to date ignores the psychological aspects of terrorism (Spencer 2006; Howie 2009; van Um and Pisoiu 2015). That is, effectiveness research relying solely on the analysis and modelling of risk fails to address that one the main aims and consequences of terrorism is the spread *fear* – a subjective feeling that is not necessarily aligned with the objective reality (Silver et al. 2002; Boscarino, Figley, and Adams 2003; Marshall et al. 2007; Rubin et al. 2007). From this perspective, terrorism may be said to have achieved one of its objectives if it leads to a sustained feeling of fear and a reduced feeling of safety in a population, regardless of whether anti-terror measures have virtually eliminated the actual risk of new terror attacks. Evaluating the effectiveness of counterterrorism measures, therefore, should not be limited to investigating the impact various measures have on the risk of further terrorism, and at what cost, but should also consider the effect counterterrorism measures have on subjective feelings of fear and safety in a population.

Theoretically, one might argue that physically visible measures such as roadblocks, police presence, metal detectors and surveillance cameras should decrease fears and increase the feeling of safety by signalling that potential threats are effectively dealt with, and there is some evidence to support this (Taylor and Toohey 2005; Dalgaard-Nielsen, Laisen, and Wandorf 2016). Relatedly, a study on counterterrorism communication found that pre-event communication focusing on providing preparedness information significantly reduced the perceived personal risk of terrorism (Pearce et al. 2019). A more common argument in the scholarly literature, however, is that visible counterterrorism measures have the opposite effect, namely, that their very presence trigger fear and make people feel unsafe by signalling that danger might be lurking (e.g. Coaffee, O'Hare, and Hawkesworth 2009). As pointed out by Dalgaard-Nielsen et al., however, this argument is often assumed rather than empirically tested (Dalgaard-Nielsen, Laisen, and Wandorf 2016), and there is arguably limited empirical evidence to support the claim (Grosskopf 2006). Borrowing from research on security measures in connection to school violence, several studies have found that visible security measures are associated with increased levels of perceived threat and reduced levels of perceived safety among students (Gastic 2011; Zeldin et al. 2011; Theriot and Orme 2016). Also, a study on counterterrorism communication based on expert interviews showed hat counterterrorism efforts may have the unintended negative consequence of increasing public fear of terrorism (Parker et al. 2019). Methodologically, all of the aforementioned studies on the effects of visible security measures on perceived safety and threat rely on cross-sectional self-report data, with the inherent limitations of this type of data (e.g. difficult to investigate causality; potential same-source bias), and the study by Taylor and Toohey used convenience sampling which is generally considered more prone to selection bias than other sampling strategies. Several authors have pointed out that terrorism and counterterrorism research suffer from methodological shortcomings and stressed the need for more methodologically rigorous studies in the field (e.g. Silke 2001; Jackson 2007; Lum, Kennedy, and Sherley 2007).

In the occupational setting, research suggests that employee exposure to violence at the workplace negatively impacts somatic-, psychological- and emotional health, impair work functioning, and increase turnover intentions, and that these adverse consequences are mediated by a decreased sense of safety and increased fear of future violence (Rogers and Kelloway 1997; Hogh and Viitasara 2005; Hansen and Elklit 2011; Lanctôt and Guay 2014). Terrorism targeting the workplace might be considered a special and extreme form of workplace violence. Research exploring the effects counterterrorism measures have on employees' perceived threat and safety could therefore be valuable from an occupational health perspective.

The present study is part of a larger longitudinal project exploring the determinants and trajectories of perceived safety and threat in a population of terror-exposed ministerial employees following the 22nd of July terror attack in Norway in 2011 (Nissen et al. 2015; Nissen and Heir 2016; Nissen et al. 2019). On that day, a car-bomb was detonated in the government district in downtown Oslo by a politically motivated Norwegian terrorist. The bomb caused massive damage to government buildings, killed 8 individuals and left more than 200 wounded. The main aims of the present study were to longitudinally examine if the extent of visible security measures installed and the amount of escape- and evacuation training conducted in ministries in the years following the attack were associated with employees' levels of perceived safety and threat at work. Secondarily, we wanted to explore whether employees believed security interventions interfered with their ability to work or affected their well-being at work.

Methods

Design, setting and participants

The study comprised two parts: the first was a questionnaire-based, longitudinal study of governmental employees consisting of three waves of data collection done 10, 22 and 34 months after the terrorist attack in the government district in Oslo, Norway, on 22 July 2011. The second was a retrospective data collection on the extent of security measures implemented and escape- and evacuation training conducted in the ministries for the period between the terrorist attack and the last wave of data collection (spring 2014). This part of the study was done in collaboration with the Norwegian Government Security and Service Organization (GSSO) and the participating ministries themselves from November 2014 to June 2015.

Eligible participants for the study included all employees in the Norwegian ministries at the time of the attack. Eligible participants were excluded if they worked in ministries that did not follow study procedures or lacked data on security measures and evacuation training, or if they left their job in the ministry prior to T1. Employees who left their job at the ministries or changed ministry affiliation during the study were censored – i.e. they contributed data up until the point they left or changed affiliation.

Eligible participants were informed about the study through emails and meetings arranged by the respective ministries during February and March 2012 and given the opportunity to withdraw. Willing participants subsequently received a study invitation letter further explaining study procedures and stressing the voluntary nature of the study. The letter also contained a unique project-ID and a login code that participants used to access the web-based questionnaire. The project-IDs and login codes were generated by an independent data security expert based on participant's social security numbers enabling longitudinal tracking of individuals. The key to match IDs to social security numbers was stored according to regulations by the Norwegian Data Protection Authority and unavailable to the research team. New study invitational letters with login codes were sent out for the second and third round of data collection. The study was approved by the Regional Ethics Committee in Norway.

Measurements

The two main outcome variables were employee perceived safety and employee perceived threat at work. Both were statement-questions scored on a 5-point Likert scale ranging from 1 = disagree to 5 = agree. The statement for perceived safety – 'I feel safe when I am at work' – was taken from the Safety Perception Scale constructed by Grieger et al. when studying employees in the Pentagon after the 9/11 attacks (Grieger, Fullerton, and Ursano 2003). The statement for perceived threat – 'I feel it is only a matter of time before my workplace is subjected to another terrorist attack' – was adapted from Cox and Cheyne's Safety Climate Assessment Toolkit as it showed the highest standardized loading for 'Personal appreciation of risk' (Cox and Cheyne 2000).

Secondary outcome measures included the extent to which employees believed security interventions interfered with their ability to work and whether security interventions affected their well-being at work. These were also statement-questions scored on a Likert scale ranging from 1 = disagree to 5 = agree (the statements were: 'The security measures at work come into conflict with the work I am supposed to do' and 'The security measures at work come at the expense of well-being', respectively). The secondary outcome measures were only inquired about at data collection points T1 and T3.

The two main predictors in the study were:

i. The extent of installed visible security measures – e.g. street-level security such as restricted or redirected traffic and roadblocks outside ministry building; security at building entries including professional security staff and high-security doors; ID-card controlled access to various segments within the building; bulletproof glass.
ii. The extent of escape- and evacuation training

The person in charge of security at each ministry was asked by the GSSO to list up the installed visible security measures and the number of escape- and evacuation training sessions in that ministry for each of the following three periods: between the terrorist attack and T1; between T1 and T2; and between T2 and T3. This information was then matched with the GSSO's own records and based on the combined information, the GSSO assigned ministries to one of three categories: those with the highest level of installed security measures or escape- and evacuation training (score = 3); those with the lowest level (score = 1); and those falling in between (score = 2). This was done separately for the two predictors – i.e. ministries were split into the above three categories based on both installed visible security measures and on the extent of escape- and evacuation training. Ministries did not have to be split evenly between categories. Because most visible security measures are permanent installations that employees see every day once they are installed, we decided to use the cumulative score when coding visible security measures. For example, for a ministry scoring 3, 2 and 2 on installed security measures for the three time periods, respectively, the scores used in analysis were 3 (T1), 5 (T2) and 7 (T3). If a ministry did not report back to the GSSO, the assignment to a category was based solely on the GSSO's own records, and if the GSSO did not have sufficient information in their records, the ministry was excluded from the study.

A potential confounding problem was that the ministries which were most severely damaged during the attack and therefore likely had the employees with the lowest levels of perceived safety and highest level of perceive threat, tended to be the ministries implementing the most security measures. Our solution was to create two ministry-level exposure variables to account for this potential confounding effect. The first, *Exposure ministry personnel*, equaled the percentage of employees who reported to be present in the government district at the time of the attack in each ministry. The second, *Damage to ministry offices*, equaled the percentage of offices reportedly damaged during the attack in each ministry.

Table 1. Demographic characteristics of participating ministerial employees across data collection points after the 22 July 2011, terrorist attack in Oslo, Norway.

	T1		T2		T3	
	n	Avg. (*SD*)	*n*	Avg. (*SD*)	*n*	Avg. (*SD*)
Age	1493	46.0 (11.0)	1289	47.3 (10.7)	1009	48.6 (10.4)
	n	%	*n*	%	*n*	%
Sex						
Male	588	39.4	501	38.9	406	40.2
Female	905	60.6	788	61.1	603	59.8
Total	1493	100.0	1289	100.0	1009	100.0
Education						
≤16 years	401	26.9	355	27.6	295	29.2
> 16 years	1091	73.1	933	72.4	714	70.8
Total	1492	100.0	1288	100.0	1008	100.0

Age, sex and education (<13, 13–16 and >16 years) were included as covariates based on findings on their importance for perceived safety and threat in earlier studies by the group (Nissen et al. 2015, 2019; Nissen and Heir 2016).

Statistical analysis

Education was dichotomized into ≤16 years (some years of university study) and >16 years (completed degree at university), because there were relatively few employees in the lower two educational categories in the original dataset (<13 and 13–16 years).

T-test and chi-square test were used to evaluate selection bias in terms of age, sex, the proportion of employees present in the government district when the bomb exploded (used as a proxy measure for likely traumatic exposure) and perceived safety/threat between participants vs. non-participants at each time point, and between employees lost to follow-up vs. those remaining in the study. Unadjusted longitudinal developments in perceived safety and threat at work were examined using linear mixed-effects modelling with time as a categorical predictor. Linear mixed-effects modelling was also used to examine unadjusted developments in the extent to which employees believed security interventions interfered with their ability to work and affected their well-being at work between T1 and T3 (data not collected for T2).

The main aims of the study were investigated through multilevel mixed-effects ordered logistic regression because the outcome variables were all ordered five-category variables and data was clustered within individuals and possibly within ministries. The odds ratios (ORs) presented indicate the change in the odds of being in the highest category of the dependent variable if it is dichotomized (regardless of the chosen cut-off point) per one-unit increase in a given predictor. Proportional odds are an underlying assumption when using this regression model. The regression models were built in a forward, stepwise fashion with the two main predictors added first (both unadjusted and adjusted results were examined) taking account of clustering at the individual level (two-level model). The potential confounders were then added to and kept in the models for a priori reasons, regardless of whether they improved the overall fit or acted as confounders in the present study. Lastly, time was added as a categorical variable as time was hypothesized to be a potential confounder. Likelihood ratio test (LRT) was used to test if adding clustering at the ministry level improved the final models compared to models taking only within-subject clustering into account (i.e. three-level models were compared to two-level models). LRT was further used to test whether adding random slopes to time-changing covariates improved the overall fit of the models. Multinomial logistic regression with clustering at the individual level was used in sensitivity analysis of key findings in the event the proportional odds assumption was violated.

Table 2. Outcome and predictor distribution across data collection points for participating ministerial employees after the 22 July 2011, terrorist attack in Oslo, Norway.

	T1		T2		T3	
	n	%	*n*	%	*n*	%
Feel safe at work						
1 = disagree	56	3.8	38	2.9	17	1.7
2	104	7.0	80	6.2	38	3.8
3	181	12.1	186	14.4	92	9.1
4	468	31.4	432	33.5	312	31.0
5 = agree	681	45.7	553	42.9	548	54.4
Total	1490	100.0	1289	100.0	1007	100.0
Fear new attack at work						
1 = disagree	831	55.8	577	44.8	492	48.7
2	410	27.5	425	33.0	307	30.4
3	163	10.9	185	14.4	144	14.3
4	62	4.2	76	5.9	48	4.8
5 = agree	24	1.6	24	1.9	18	1.8
Total	1490	100.0	1287	100.0	1009	100.0
Security interventions interfere with work						
1 = disagree	908	61.2			599	59.6
2	351	23.6			246	24.5
3	155	10.4			107	10.7
4	47	3.2			43	4.3
5 = agree	24	1.6			9	0.9
Total	1485	100.0			1004	100.0
Security interventions affect well-being						
1 = disagree	851	57.3			539	53.9
2	324	21.8			241	24.1
3	197	13.3			133	13.3
4	82	5.5			72	7.2
5 = agree	32	2.2			15	1.5
Total	1486	100.0			1000	100.0
Visible security measures						
1 = least	324	21.7	467	36.2	462	45.8
2	872	58.4	424	32.9	424	42.0
3 = most	297	19.9	398	30.9	123	12.2
Total	1493	100.0	1289	100.0	1009	100.0
Escape- and evacuation training						
1 = least	709	62.0	343	35.3	502	54.9
2	137	12.0	411	42.3	413	45.1
3 = most	297	26.0	217	22.3	0	0.0
Total	1143	100.0	971	100.0	915	100.0

The number of employees with missing data on a given variable at a given time-point can be inferred from Tables 1 and 2, and the number contributing data to a given regression model is indicated in Tables 3–5.

Results

Figure 1 summarizes the flow of participants through the study. The participation rates for potential participants were 56.5% at T1 (1493 of 2640); 51.9% at T2 (1289 of 2484); and 49.0% at T3 (1009 of 2059). There was no statistical evidence of a difference in age between participants and non-participants across data collection points, though participants had a higher proportion of women at T1 and T2. Employees lost over the course of the study were younger (44.5 vs. 46.5 years, $p < .001$) and had a higher proportion of males (46.3% vs. 41.3%, $p = .024$) compared to employees remaining in the study (we had demographic data on 676 of the employees lost to follow-up). There was, however, no evidence that the group lost to follow-up differed in terms of the proportion present in the government district when the bomb exploded (data on 493 employees); and limited or no evidence that the group differed in terms of perceived safety or

Table 3. Odds ratios (ORs) with 95% confidence intervals of increasing perceived safety at work, by extent of security measures and escape- and evacuation training in ministerial employees after the 22nd of July terrorist attack in Oslo, Norway in 2011.

	Model 1 Unadjusted ORs (n=see[a])	Model 2 Adjusted ORs ($n = 1588$)	Model 3 Confounder adjusted ORs ($n = 1586$)	Model 4 Full model ORs ($n = 1586$)
Visible security measures	1.15***	1.17***	1.18***	1.12
	[1.10 to 1.21]	[1.11 to 1.24]	[1.12 to 1.25]	[0.99 to 1.27]
Escape- and evacuation training	0.83*	0.83*	0.87	1.04
	[0.71 to 0.97]	[0.71 to 0.97]	[0.71 to 1.07]	[0.84 to 1.30]
Exposure ministry personnel			0.93***	0.93***
			[0.90 to 0.97]	[0.90 to 0.97]
Damage to ministry offices			1.00	1.00
			[1.00 to 1.01]	[0.99 to 1.01]
Age (per one-year increase)			1.01	1.01
			[1.00 to 1.02]	[1.00 to 1.02]
Sex (female compared to males)			0.46***	0.46***
			[0.35 to 0.61]	[0.34 to 0.62]
Education (>16 years compared to <16 years)			1.40*	1.30*
			[1.03 to 1.92]	[1.02 to 1.64]
Time (T1 as baseline)				
T2				0.78
				[0.58 to 1.05]
T3				1.36
				[0.85 to 2.18]

Odds ratios (ORs) indicate the odds of feeling more compared to less safe at work per one-unit increase in a given predictor, regardless of the chosen cut-off point to dichotomize the five-category scale for perceived safety. ORs were estimated through multilevel mixed-effects ordered logistic regression.

95% confidence intervals in brackets.

*$p < .05$, ** $p < .01$, *** $p < .001$.

[a]There were 1845 employees with data on security measures and 1588 with data on escape- and evacuation training

perceived threat at work. If anything, employees lost to follow-up tended to feel more safe and less threatened at work. The employees excluded prior to T1 ($n = 1988$) were, as a group, less exposed than the employees included in the study as most employees worked in ministries located several hundred meters away from the government district where the bomb was detonated.

Demographic characteristics of participants are summarized in Table 1, and Table 2 shows the distribution of outcomes and primary predictors across data collection points. The variable *Exposure ministry personnel* (the percent of employees present in the government district during the attack for a given ministry) ranged from 0% to 18.6%, and the variable *Damage to ministry offices* (the percent of offices damaged during the attack for a given ministry) ranged from 0% to 97.3%.

There was no change in the unadjusted mean level of perceived safety between T1 and T2, though an increase from T1 to T3 (mean perceived safety scores: 4.08 and 4.33 at T1 and T3, respectively; $p < .001$). The associations of visible security measures and escape- and evacuation training with perceived safety at work are summarized in Table 3. Prior to adjusting for time, there was very strong evidence ($p < .001$) in all models that higher levels of visible security measures were associated with increased perceived safety at work. Time positively confound this association, and in the final model (model 4) there was weak to no evidence for an association ($p = .061$). However, if the final model was rerun with escape- and evacuation training excluded

Table 4. Odds ratios (ORs) with 95% confidence intervals of increasing perceived threat at work by extent of security measures and escape- and evacuation training in ministerial employees after the 22nd of July terrorist attack in Oslo, Norway in 2011.

	Model 1 Unadjusted ORs (n = see[a])	Model 2 Adjusted ORs ($n = 1588$)	Model 3 Confounder adjusted ORs ($n = 1586$)	Model 4[b] Full model ORs ($n = 1586$)
Visible security measures	1.11***	1.06*	1.12***	0.94
	[1.05 to 1.16]	[1.00 to 1.13]	[1.05 to 1.19]	[0.82 to 1.08]
Escape- and evacuation training	0.94	0.95	1.25	0.90
	[0.78 to 1.13]	[0.79 to 1.15]	[0.99 to 1.57]	[0.68 to 1.19]
Exposure ministry personnel			1.05*	1.06**
			[1.01 to 1.10]	[1.02 to 1.11]
Damage to ministry offices			0.98***	0.99*
			[0.98 to 0.99]	[0.98 to 1.00]
Age (per one-year increase)			0.98	0.98
			[0.97 to 1.00]	[0.97 to 1.00]
Sex (female compared to males)			1.02	1.03
			[0.72 to 1.45]	[0.72 to 1.49]
Education (>16 years compared to <16 years)			0.58**	0.71*
			[0.39 to 0.86]	[0.52 to 0.95]
Time (T1 as baseline)				
T2				2.54***
				[1.82 to 3.55]
T3				1.85*
				[1.10 to 3.09]

Odds ratios (ORs) indicate the odds of feeling more compared to less threaten at work per one-unit increase in a given predictor, regardless of the chosen cut-off point to dichotomize the five-category scale for perceived threat. ORs were estimated through multilevel mixed-effects ordered logistic regression.
95% confidence intervals in brackets.
* $p < .05$, ** $p < .01$, *** $p < .001$.
[a]There were 1844 employees with data on security measures and 1588 with data on escape- and evacuation training.
[b]Random slope was added for escape- and evacuation training.

as a covariate, the evidence of an association between security measures and perceived safety strengthened (OR = 1.14; $p = .020$). This was not primarily due to confounding by escape- and evacuation training, but because the number of employees contributing data to the final model increased if escape- and evacuation training was dropped as some ministries lacked data on escape- and evacuation training. With more individuals contributing data to the final model, the power of the model to detect a true association increased. Sensitivity analysis with multinomial logistic regression and safe = 1 as the baseline category and without adjustments for time showed a stepwise increase in the odds ratio (OR) per one-unit increase in visible security measure for successive categories of safe (i.e. safe scores of 2–5). The pattern of stepwise increase in the ORs disappeared, however, when time was added as a confounder.

There was no evidence in the full models (models 3 and 4) that the extent of escape- and evacuation training was associated with perceive safety at work. LRT did not indicate that adding clustering at the ministry level or random slopes to time-changing confounders improved the models.

Unadjusted analysis showed that employees' mean level of perceived threat at work was higher at T2 (1.87) and T3 (1.80) compared to T1 (1.68; $p < .001$). Table 4 shows the associations of visible security measures and escape- and evacuation training with employees' perceived threat at work. Prior to adjusting for time, there was moderate to strong evidence that higher

Table 5. Association (odds ratios, OR, with 95% confidence intervals) between extent of security interventions and ministerial employees' perceptions of how much interventions interfere with work and affect well-being after the 22nd of July terrorist attack in Oslo, Norway in 2011.

	Interfere with work		Affect well-being at work	
	Model 1 Adjusted ORs ($n = 1464$)	Model 2 Full model ORs ($n = 1463$)	Model 3 Adjusted ORs ($n = 1465$)	Model 4 Full model ORs ($n = 1464$)
Visible security measures	1.03	1.03	1.05	1.17*
	[0.98 to 1.09]	[0.91 to 1.17]	[0.99 to 1.11]	[1.03 to 1.33]
Escape- and evacuation training	1.23*	0.94	1.30**	0.99
	[1.04 to 1.45]	[0.76 to 1.16]	[1.09 to 1.55]	[0.79 to 1.24]
Exposure ministry personnel		1.03		1.00
		[0.99 to 1.06]		[0.97 to 1.04]
Damage to ministry offices		1.01**		1.01**
		[1.00 to 1.01]		[1.00 to 1.01]
Age (per one-year increase)		1.00 [0.98 to 1.01]		1.00 [0.99 to 1.01]
Sex (female compared to males)		0.56*** [0.43 to 0.73]		0.45*** [0.34 to 0.60]
Education (>16 years compared to <16 years)		0.98 [0.72 to 1.32]		1.34 [0.98 to 1.84]
Time (T3 compared to T1)		0.81 [0.50 to 1.32]		0.53** [0.33 to 0.86]

Odds ratios (ORs) indicate the odds of a one-category increase in the dependent variables per one-unit increase in a given predictor, regardless of the chosen cut-off point to dichotomize the five-category dependent variables (both scored on a 5-point Likert scale ranging from 1 = disagree to 5 = agree). ORs were estimated through multilevel mixed-effects ordered logistic regression.

95% confidence intervals in brackets.

*$p < .05$, **$p < .01$, ***$p < .001$.

levels of visible security measures were associated with increased perceived threat at work (models 1–3). However, there was no evidence that security measures were associated with employee's perceived threat after controlling for time (model 4). There was no evidence in any of models that the extent of escape- and evacuation training was associated with perceived threat at work. LRT did not indicate that adding clustering at the ministry level improved the model, though LRT indicated random slope should be added for escape- and evacuation training.

Most employees disagreed that security interventions interfered with work or affected well-being (Table 2), and there was no evidence of a change in employees' views on this between T1 and T3 (unadjusted analysis). Before controlling for confounders and time, there was moderate evidence that higher levels of escape- and evacuation training were associated with increased odds that employees believed security interventions interfered with work and affected well-being (models 1 and 3, Table 5). These associations, however, appeared to be due to the positive confounding effects of time and damage to ministry offices – i.e. there were no associations in the full models (model 2 and 4). The extent of installed security measures was not associated with whether employees believed security interventions interfered with their ability to work, though there was some evidence in the full model that higher levels of security measures were associated with increased odds that employees believed security interventions affected well-being (model 4, Table 5). There was very strong evidence ($p < .001$) that women believed security interventions interfered with work and affected well-being at work to a lesser extent than men.

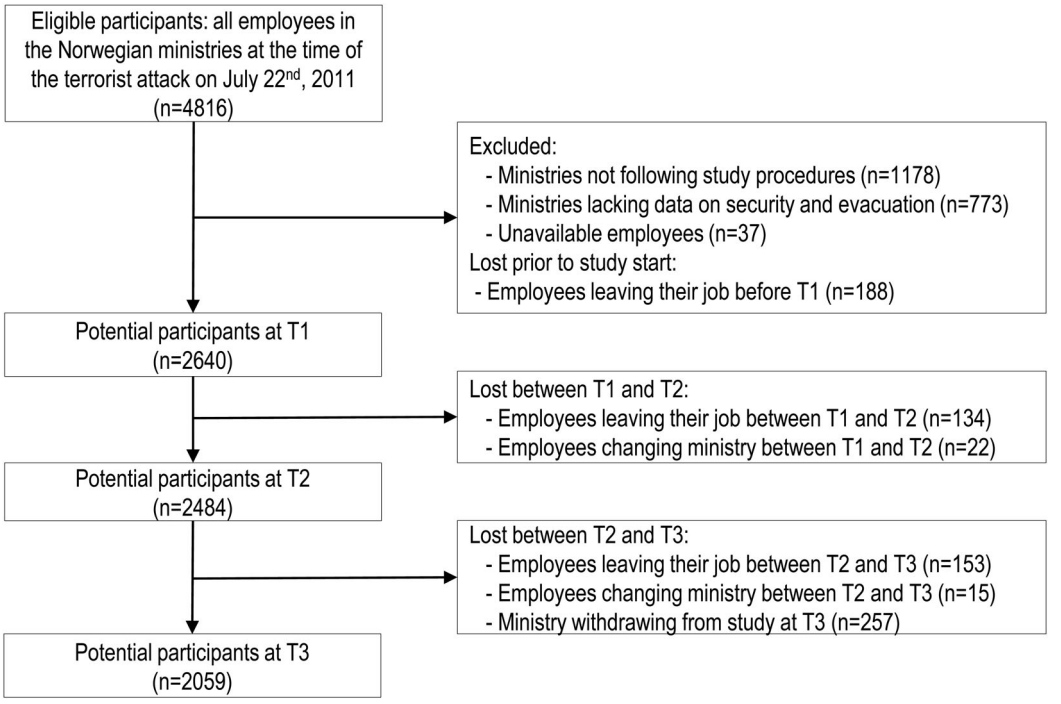

Figure 1. Flowchart of participating ministerial employees through the study after the 22 July 2011, terrorist attack in Oslo Norway.

Discussion

Summary of main findings

The present longitudinal study on employees in the Norwegian ministries exposed to a workplace terrorist attack explored whether employees' level of perceived safety and threat at work were associated with the extent of installed visible security measures and escape- and evacuation training in the three years following the attack. There was some evidence that more installed visible security measures were associated with increased perceived safety at work. The evidence on the association between visible security measures and perceived threat was not clear. There was no evidence that the extent of escape- and evacuation training was associated with either employees' perceived safety or perceived threat at work. Secondarily, there was some evidence that the extent of installed visible security measures was positively associated with employees' perception that security interventions affected well-being at work. An interesting *post hoc* finding was that women had about half the odds of believing security interventions interfered with work and affected well-being at work compared to men.

Interpretation of main findings

Our finding that perceived safety at work was positively associated with the extent of installed visible security measures is in line with results from a prior study in Denmark investigating the effects of visible security measures in public spaces on feelings of safety and security among Danish citizens (Dalgaard-Nielsen, Laisen, and Wandorf 2016). However, the finding is contrary to much of the scholarly literature which tend to argue that visible security measures will lead to a reduced feeling of safety by triggering anxiety and fear (Grosskopf 2006; Coaffee, O'Hare, and Hawkesworth 2009). As has been noted by other researchers, however, this perspective is

frequently assumed rather than based on strong empirical evidence (Dalgaard-Nielsen, Laisen, and Wandorf 2016). The limited evidence that exists comes from a pilot study in Florida where viewing pictures of various visible security measures given a context of terrorism triggered feelings of arousal, suspicion and fear in a group of students. Also, though not directly related to terrorism, research on the effects of security measures in schools has shown that visible security measures reduce students' level of perceived safety at school (Gastic 2011; Perumean-Chaney and Sutton 2013). The contrasting findings in these studies and ours might partly be explained by population, setting and design differences: the present study used a three-wave longitudinal design where participants were adults and arguably all victims of terrorism, either directly by being in the government district when the bomb was detonated, or indirectly as targets of a politically motivated terrorist attack. In the contrasting above-mentioned studies, the sample comprised students at university or pre-university levels and participants had no history of exposure to terrorism, and only the Perumean study used a longitudinal design.

Factors that could suggest a causal link between security measures and perceived safety include that data on security measures spanned the one-year time-periods preceding data collection on perceived safety and the longitudinal design of the study. It is also plausible that visible security measures might influence perceived safety. Nonetheless, our design does not allow for firm causality conclusions.

The findings on how visible security measures were associated with perceived threat at work is harder to conclude from. Even though there was quite strong evidence that more visible security measures were associated with higher perceived threat prior to adjusting for time, there was no evidence after controlling for time – i.e. the association appeared to be due to the confounding effects of time. Given that a sum-score was used for the variable security measures in analysis, it appears necessary to consider, and control for, time as a confounder. A positive association between visible security measures and feelings of fear/fearfulness has been described in a few other studies, one relating to terrorism (Grosskopf 2006) and one exploring the effects of security measures at schools (Zeldin et al. 2011). Again, however, there are many important differences in study design, population and setting that make comparison difficult. In summary, our study gives little support to the argument that visible security measures increase the feeling of threat and heighten fears.

Our results gave no evidence to suggest that the extent of escape- and evacuation training was associated with employees' level of perceived safety or threat at work. The results are broadly in line with an earlier study from our group which found no association between employees' perceived safety and their views on whether there had been sufficient escape- and evacuation training at work (Nissen and Heir 2016).

Our secondary finding, that the extent of installed visible security measures was positively associated with employees' perception that security interventions affected well-being at work, is in line with prior expectations. The evidence was not strong however, which may partly be because analyses were based on only two waves of data collection (T1 and T3). In contrast to expectations, there was no evidence of an association between the extent of installed security measures and employees' perception that security interventions interfered with work. The strong post-hoc finding that men had about twice the odds of women of believing security interventions interfered with work and affected well-being at work was a bit surprising. In fact, after controlling for possible confounding effects of post-traumatic stress reactions (measured with the PTSD Checklist, PCL) and symptoms of anxiety (measured with the Hopkins Symptom Checklist, HSCL), the difference in odds were even greater. Our results are broadly in agreement with prior research on hotel guests' views on security which has found that women tend to be more supportive of and willing to pay for strong security measures (Feickert et al. 2006). Our study, therefore, adds evidence to support the idea of sex differences in terms of how security measures are perceived.

Limitations and strength

The study has some important limitations. One limitation concerns how data was collected and scored for the two main predictors: extent of installed visible security measures and escape- and evacuation training. About half of the participating ministries did not report back to the GSSO during data collection, meaning these ministries were assigned a score based on the records available at the GSSO. However, because five of these ministries were located in the same building as a ministry that did report back, and since most security measures and escape- and evacuation training sessions were implemented at building-level, indirect information was obtained for all ministries in the building. Furthermore, ministries reported the requested information with varying levels of detail, making comparison of ministries difficult and introducing a notable level of subjectivity to the final scoring of ministries by the GSSO. This would likely lead to nondifferential misclassification with a consequential bias towards unity (ORs = 1.00).

As pointed out in our prior articles, a further weakness of the study is that many of the key variables are based on single-item questions or Likert statements with limited psychometric data available (Nissen et al. 2015; Nissen and Heir 2016). There is, however, a fair amount of evidence on the use of single-item questions in research suggesting that the loss in validity and reliability is limited, and that single-item questions therefore might be acceptable in some settings (Elo, Leppänen, and Jahkola 2003; Boer et al. 2004; Zimmerman et al. 2006; Bergkvist and Rossiter 2007). Nevertheless, future studies might benefit from moving away from single item measures and instead use pre-tested and validated scales.

The decision to use a cumulative sum-score for visible security measures and the subsequent potential problem with confounding by time constitute a potential limitation of the study, and should be considered when interpreting findings. In principle, adding time as a covariate in the final model should eliminate or at least reduce the confounding effects of time. Given that regression estimates changed notably upon adding time to the different models, it is clear that the modelling of time played a key role in the analytic process. We opted for transparency and report results both before and after time adjustments (Twisk 2013). It is also hard to exclude confounding by other variables not included in the models. For example, it is possible that ministries with a strong focus on safety and security in the post-attack period, not only installed many visible security measures as part of their response, but also implemented other security strategies (e.g. distributed educational information, arranged meeting where security and safety issues were discussed with employees). If these strategies enhanced employees' perceived safety at work, they would confound our results.

In terms of selection bias, sex differences in participation rates and loss to follow-up likely had a minimal effect on the main conclusions of the study as results were similar with data split on sex. However, the size and strength of the secondary finding – that installed security measures were positively associated with the belief that security interventions interfered with well-being at work – was probably underestimated because proportionally more women contributed data. Importantly, there was no statistical difference between participants and nonparticipants in the proportion of employees present in the government district at the time of the attack (Hansen, Nissen, and Heir 2013), and loss to follow-up was also unrelated to being present. Furthermore, employee's lost-to follow up had similar levels of perceived safety and threat at work as employees remaining in the study (based on data from about half of lost employees), making it less likely that loss to follow-up greatly impacted the main findings.

Lastly, no prospectively written document with detailed hypotheses and plans for analyses on the present study exists. We conceptually developed the main study aims prior to starting the data collection with the GSSO, though not at a level where detailed analyses plans were made. Therefore, we cannot rule out bias in how we handled data and decided on statistical models, though we have tried to report all aspects of this as transparently as possible.

The study has some important strength including a longitudinal design with three waves of data collection spanning three years, and a large sample size with a quite high response rate. Furthermore, by combining subjective, self-report data on perceived safety and threat with more objective data on security measures, the study may partly circumvent some of the problems that may arise from relying solely on self-report data (e.g. same-source bias). As highlighted in several articles in recent years, terrorism and counterterrorism research face several methodological challenges (Silke 2001; Spencer 2006; Jackson 2007; Lum, Kennedy, and Sherley 2007; van Um and Pisoiu 2015). The present study should thereofre help remedy some of the highlighted methodological shortcomings and provide empirical evidence that might aid decision-makers opt for sound and effective strategies following terrorism.

Conclusions

Contrary to what is commonly argued in the scholarly literature, our results seem to suggest that the installation of security measures after terrorism increases perceived safety and has no clear effect on perceived threat. Our study could impact discussions on the choice of counterterrorism strategies by highlighting the likely consequences security measures have on people's subjective feelings of safety and threat in the aftermath of terror. However, more studies of strong methodology are needed to corroborate our results and explore if the findings apply outside the setting of workplace terrorism.

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No potential conflict of interest was reported by the authors.

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